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**The development of a physiotherapy intervention program  
for closed or open reduction and / or internal fixation of  
mandibular condyle fractures**

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A research report submitted in fulfillment of the requirements of the M.Sc. Physiotherapy degree in the Faculty Health Sciences, at the University of the Free State.

**Declaration**

I, A. van der Merwe, certify that the script hereby submitted by me for the M.Sc. Physiotherapy degree at the University of the Free State is my independent effort and had not previously been submitted for a degree at another university / faculty. I furthermore waive copyright of the script in favour of the University of the Free State.

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A. van der Merwe

22<sup>nd</sup> day of January 2013

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## **Abstract**

*Introduction:* The need for physiotherapy intervention in the treatment of mandibular condyle fractures has been highlighted. No unifying criteria are currently available regarding a post-surgical functional exercise program for patients who sustained mandibular condyle fractures.

*Aim:* The research study conducted aimed to perform a needs analysis amongst maxillo-facial surgeons and physiotherapists in South Africa, regarding the perceived need for a post-operative physiotherapy intervention program for patients who sustained mandibular condyle fractures. The study also aimed to develop a post-operative functional exercise program for patients who sustained mandibular condyle fractures.

*Methodology:* The first part of the research comprised of a needs analysis questionnaire, sent out to qualified experts: one physiotherapist and one maxillo-facial surgeon from each of the training institutions in South Africa. The data obtained from the needs analysis questionnaire was used to compile an online questionnaire with statements regarding the type and dosage of a suitable physiotherapeutic treatment protocol. The Delphi method was used, and this questionnaire was sent out to a further 20 experts (national and international) in the fields of physiotherapy, maxillo-facial surgery and dental surgery. A convenience sampling method was used to select appropriately trained participants for the needs analysis and Delphi questionnaire.

*Results:* A definite need for physiotherapy intervention for mandibular condyle fracture patients was proposed by the needs analysis participants (100%). A total of 85.7 % (needs analysis) and 100 % (Delphi questionnaire) of respondents indicated that all mandibular condyle fracture patients should receive in-hospital physiotherapy intervention. By utilising the Delphi method, a suitable physiotherapy intervention program for mandibular condyle fracture patients was developed. Inter-reviewer consensus was reached regarding what each exercise entails, as well as what in-hospital physiotherapy visits should be comprised of. Stability was reached regarding the commencement and dosage of the various jaw exercises.

*Conclusion:* Experts in the field proposed that physiotherapists should provide post-operative rehabilitative therapy to patients who have sustained mandibular condyle fractures. The proposed post-surgical intervention program provided in this study can serve as a baseline for implementation in further research studies. The advantages of referring mandibular condyle fracture patients to physiotherapy were also presented.

## **Nomenclature**

**Mastication:** The act of chewing, tearing, or grinding food with the teeth while it becomes mixed with saliva (Standing, Borely, Collins, Crossman, Gatzoulis, Healy, Johnson, Mahadevan, Newell and Wigly 2008:536).

**Masticatory muscles:** The four principal muscles of mastication are: mm. masseter, temporalis, the medial pterygoid and the lateral pterygoid. These muscles are responsible for producing mandibular movement (protrusion, retrusion, elevation, depression, lateral deviation) as well as temporomandibular joint movement (Standing *et al.*, 2008:536).

**Trismus:** A complication arising from traumatic and post-operative conditions involving the muscles of mastication and their attachments, resulting in an inability to open the mouth adequately (Gonzalez, Sakamaki, Hatori, Nagumo 1992:227).

**Temporomandibular joint dysfunction:** Characterized by pain in the peri-auricular region, the temporomandibular joint itself or in the masticatory muscles. It may present with limitations or deviations in mandibular range of motion and grinding or clicking noises during mandibular function. Other common complaints are headaches, facial pain, neck ache, ear ache, tinnitus or perceived hearing loss (Mobilio and Catapano 2010:1).

**Passive movement:** Any movement of a mobile segment which is produced by any means other than the particular muscles relating to that segment's movement. It includes mobilisation and manipulation (Maitland, Hengeveld, Banks and English 2005:1).

**Mobilisation:** The mandibular condyle is moved in relation to a portion of the temporal bone (Standing *et al.*, 2008:530).

**Joint distraction:** The separation of joint surfaces without rupture of their binding ligaments and without displacement (Dorland's Medical Dictionary for Health Consumers 2007).

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# CHAPTER 1

## Introduction

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Maxillofacial trauma represents a costly socio-medical problem, as it affects a considerable amount of trauma patients and because traumatic injury has been identified as the leading cause of decreased productivity (Sawazaki, Lima, Asprino, Moreira and de Moraes 2010:1252).

The mandible is the most affected by trauma to the facial area, in approximately 80 % to 81.3 % of cases (DeFabianis 2002:268; Singh 2009:18), and has a potentially serious impact on mouth function and facial features (Feng, Chen, Zhang, Yang, Lin, Tian and Liu 2009: 46). Previous South African studies conducted by maxillo-facial surgeons, recorded a significant number of fractures to the facial area (Desai 2006:16; Rikhotso and Ferretti 2008:222; Singh 2009:15,18). Rikhotso and Ferretti (2008:222) stated that condyle fractures accounted for up to 57 % of all mandibular fractures, with condyle fractures being the most controversial fracture type when diagnosing or treating the facial area (Zachariades, Mezitis, Mourouzis, Papadakis and Spanou 2006:421).

Trauma is regarded as a major factor leading to temporomandibular joint (TMJ) dysfunction (Görgü, Deren, Sakman, Ciliz and Erdoğan 2002:356) and the complications caused to the TMJ are far reaching in their effects and not always immediately apparent after trauma or surgery (Zachariadis *et al.*, 2006:429). According to South African and American research, prolonged intermaxillary fixation, the absence of active physiotherapy, and poor patient compliance results in an increased risk for mandible hypomobility as well as a high risk of developing periodontal problems regarding mouth function (Thiele and Marcoot 1985:226; Rikhotso and Ferretti 2008:225).

Working closely with dentists as well as maxillofacial surgeons, the researcher has seen many mandibular condyle fracture patients who were struggling to regain mandibular function, and were struggling with persistent trismus, after the removal of intermaxillary fixation. Only after the six week follow-up visit with the surgeon the patients are referred for physiotherapy, and only if they were clear and adamant about their functional limitations.

## Chapter 1: Introduction

No standardised criteria or post-operative rehabilitation programs for patients who have sustained mandibular fractures, could be found in the literature (Bevilaqua-Grosso, Monteiro-Pedro, De Jesus Guirro and Bérzin 2002:271; Yun and Kim 2005:1576; Feng *et al.*, 2009:46). Previous research studies investigating the effects of post-mandibular condyle fracture exercise regimes varied in dosage and exercise types, and were all provided by the surgeons themselves with no physiotherapy demonstrations or interventions (Hwang, Han, Kil and Lee 2002:709; Rikhotso and Ferretti 2008:223; Feng *et al.*, 2009:48). Contrary to these, a South African research study specifically highlighted the need for physiotherapy intervention in the treatment of mandibular condyle fractures (Rikhotso and Ferretti 2008:226).

Physiotherapists are practitioners who assess, treat and manage a variety of injuries, by being competent in the areas of pain relief, joint mobilisation, exercise therapy and correcting faulty movement patterns (<http://www.hpcs.co.za>; <http://www.physiosa.org.za>). Therefore physiotherapists should be able to provide a rehabilitative service to patients who sustained mandibular condyle fractures, aiding in quicker recovery. Further advantages for physiotherapy intervention would include decreasing joint dysfunction after trauma, preventing and treating TMJ dysfunctions and pain, reducing in-hospital stay and reducing time demands on the surgeon regarding home advice and exercise prescription (Langendoen, Müller and Jull 1997:196; Feng *et al.*, 2009:46; Trott 2011:5).

The aim of the study was to determine the perceived need for a post-operative intervention program for patients who sustained mandibular condyle fractures, and to compile a proposed physiotherapeutic intervention program for the post-operative rehabilitation of patients after mandibular condyle fractures.

*Study overview:* The study consisted of two sets of internet questionnaires, sent out to experts in the fields of physiotherapy, maxillo-facial surgery and dental surgeons. The first part of the research comprised of a needs analysis questionnaire, aimed to determine the proposed need for physiotherapy intervention for patients who sustained mandibular condyle fractures.

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The returned results identified a definite need for physiotherapy intervention for mandibular condyle fracture patients. From the needs analysis questionnaire, an online questionnaire with statements regarding the type and dosage of a suitable physiotherapeutic treatment protocol was formulated. The Delphi method was used, and the Delphi questionnaire was sent out to a further 20 experts in the fields of physiotherapy, maxillo-facial surgery and dental surgery. Experts for the Delphi questionnaire included national and international physiotherapists, maxillo-facial surgeons and dental surgeons. The Delphi questionnaire was adjusted after each round according to reviewer comments, with the aim of achieving consensus on all questions / statements posed to reviewers. Questions not achieving consensus between reviewers and any new statements made by the reviewers were formulated into the second and third rounds of this questionnaire.

A definite need for physiotherapy intervention for mandibular condyle fracture patients was identified by needs analysis participants. A suitable physiotherapy intervention program for mandibular condyle fracture patients was also developed, utilising the Delphi method.

The script starts with a discussion of the current literature regarding mandibular anatomy, the treatment of mandibular condyle fractures, and the complications and treatment thereof, following mandibular condyle fractures. This discussion is followed by an in-depth discussion of the methodology and results of the needs analysis, and the methodology and results of the Delphi questionnaire. The script is concluded with a short discussion chapter where the information obtained from the needs analysis and Delphi questionnaire are critically discussed and concluded.

# CHAPTER 2

## Literature study

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In this chapter a summary of the most relevant literature regarding post-operative / -reduction exercise protocols, the prevalence and the impact of mandibular condyle fractures on mouth function will be discussed for patients who suffered mandibular condyle fractures. The literature study will include the prevalence and impact of mandibular condyle fractures on mouth function.

### **2.1. Search strategy**

An extensive literature search was conducted using the following search engines, between April 2010 and November 2011:

- PubMed,
- Cochrane Library,
- MEDLINE,
- Medical Matrix,
- PEDro, and
- Science Direct.

Key words used during the conduction of the literature search were “mandibular condyle fractures”, “physiotherapy for mandibular condyle fractures”, “temporomandibular joint”, “temporomandibular joint dysfunction”, “physiotherapy”, “exercise”, “rehabilitation”, “trismus treatment” and “mandibular anatomy”.

The literature search was limited to English publications. References cited in the identified articles were also searched for further possible inclusion into the literature review.

### **2.2. Prevalence and impact of mandibular condyle fractures**

*“Maxillofacial trauma has been investigated worldwide because it affects a significant percentage of trauma patients and traumatic injury has been identified as the leading cause of reduced productivity, accounting for the loss of more working years than heart disease and cancer combined”* (Sawazaki *et al.*, 2010:1252). The mandible is mostly affected by facial

## Chapter 2: Literature study

trauma resulting from high-velocity impact, such as interpersonal assaults (86.5 %), or a road traffic accident (13.5 %), causing the mandible to fracture (Yun and Kim 2005:1576; Desai 2006:16, Feng *et al.*, 2009:46).

It was found that over a three year period (years 2002 - 2005) a total of 43.8 % of all fractures recorded in a hospital in Limpopo, South Africa, were fractures of the facial area, 81.3 % being that of the mandible (Singh 2009:15,18). Two studies conducted in a hospital in Johannesburg, South Africa, both over a six month period, found that 84 (Rikhotso and Ferretti 2008:222) and 133 (Desai 2006:16) patients presented with mandibular fractures. Studies conducted by Desai (2006:16), Rikhotso and Ferretti (2008:225) and Singh (2009:21), indicated that 73.8 %, 86.5 % and 77.3 % of mandibular fractures, respectively, were caused by interpersonal violence due to direct force to the mandible.

A South African study conducted by Rikhotso and Ferretti (2008:222) found that condyle fractures accounted for 27 % to 57 % of all mandibular fractures. Condylar fractures usually results from an indirect force applied to the mandible, and are usually associated with at least one other mandibular fracture (Zachariadis *et al.*, 2006:421).

According to Zachariadis *et al.* (2006), fractures of the condyle are the most controversial type of fracture when diagnosing or treating the jaw area (Zachariadis *et al.*, 2006:421). Condylar fractures can be of extracapsular (condylar neck or subcondylar area) or intracapsular nature, and can also be undisplaced, displaced, deviated or dislocated (Zachariades *et al.*, 2006:421). Treatment depends on various factors ranging from patient age, fracture level and fracture displacement (Zachariades *et al.*, 2006:421). Thiele and Marcoot (1985:226) described three different approaches to the treatment of condyle fractures: open reduction and internal fixation, closed reduction and intermaxillary fixation (IMF), and functional therapy. Most condyle fractures can be successfully treated by closed reduction and intermaxillary fixation, but severely dislocated fractures with gross malalignment, severe pain or decreased function require surgical treatment (Thiele and Marcoot 1985:226; Hwang, Park and Lee 2005:113).

### **2.3 Mandibular anatomy and temporomandibular joint arthrokinematics**

A thorough comprehension of mandibular anatomy and temporomandibular joint (TMJ) arthrokinematics are of the utmost importance when assessing the various treatment protocols for mandibular condyle fractures, as well as to understand the reasons for the occurrence of complications.

Mandibular fractures can anatomically occur in the symphysis (anterior, where the two halves of the mandible meet to form the mental protuberance), body, angle, ramus, condyle or coronoid process of the jaw (Figure 1).

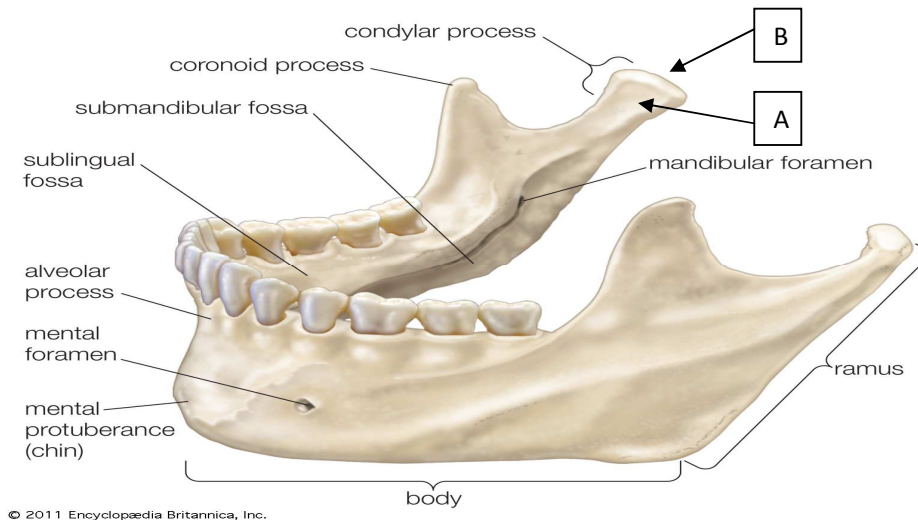


Figure 1. Mandible anatomy (Encyclopædia Britannica Online. *Encyclopedia Britannica Inc.* 2011).

The function of the mandible is to exert the force necessary to chew food (Standing *et al.*, 2008:536). A purely vertical force is ineffective in breaking up food, thus a lateral movement of the mandible is used to create a shear component, which enhances the effectiveness of mastication (Standing *et al.*, 2008:536). The four principal muscles of mastication are the mm. masseter, temporalis, medial pterygoid, and the lateral pterygoid (Standing *et al.*, 2008:536). These four muscles are responsible for producing mandibular movement (protrusion, retrusion, elevation, depression, lateral deviation) as well as temporomandibular joint movement (Standing *et al.*, 2008:536).

Each TMJ has a biconcave articular disc, composed of fibrocartilagenous tissue, positioned between the mandibular condyle (indicated “A” on figure 1) and the articular eminence (indicated “B” on figure 1) of the temporal bone (Figure 2) (Levangie and Norkin 2001:186-187). The disc divides each joint into two and is responsible for maintaining the congruency of the joint movement between the convex surfaces of the condyle and the articular eminence (Levangie and Norkin 2001:187). The lower joint compartment, formed by the anterior surface of the mandibular condyle and the articular disc, is a hinge joint and is responsible for rotational movement (Levangie and Norkin 2001:189; Standing *et al.*, 2008:534). The upper joint compartment formed by the articular disc and the articular eminence of the temporal bone is a gliding joint responsible for translational movement (Levangie and Norkin 2001:189; Standing *et al.*, 2008:534). The inferior compartment allows for rotation of the condylar head around an instantaneous axis of rotation, for the first 20 mm of mouth opening. After that the mouth can no longer open without the superior compartment of the TMJ becoming active (Standing *et al.*, 2008:536).

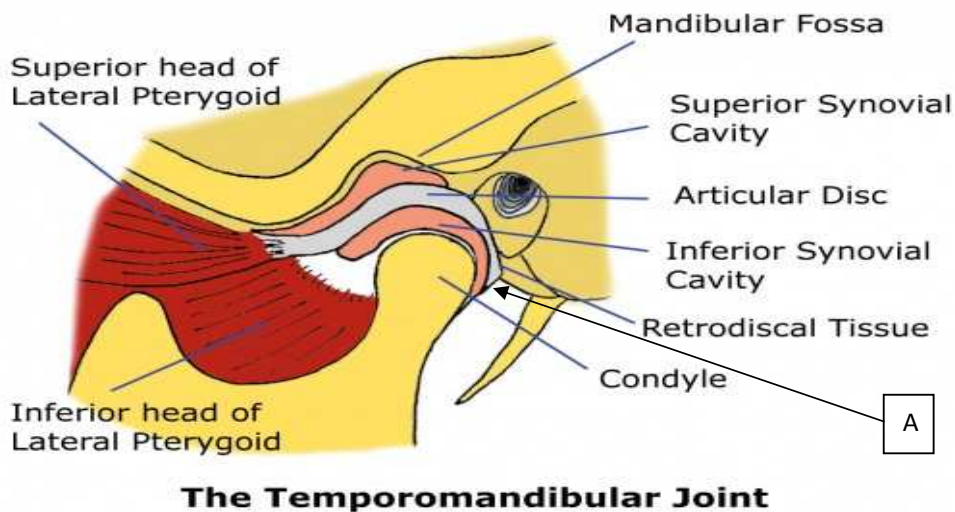


Figure 2. The temporomandibular joint (Mariner 2012:1).

Mouth opening comprises of three phases: the early phase, controlled by the temporomandibular ligament and eminence; the middle phase, and the late phase which is controlled by the sphenomandibular ligament and eminence (Standing *et al.*, 2008:536).

During the beginning of mouth opening each condyle rotates in the lower compartment inside its disc and continues rotating. The disc remains stationary. If the condyle shape is changed due to degenerative changes e.g. after trauma, or if the masticatory muscles are imbalanced

## Chapter 2: Literature study

with regards to each other, this normal rotary movement of the condyle will be impaired. If the mouth continues to open, the condylar head and articular disc rotates and translates forward and downward on the anterior concave surface of the glenoid fossa and the convex surface of the articular eminence (Levangie and Norkin 2001:190; Standing *et al.*, 2008:536). The temporomandibular ligament becomes taught and drives the condyle upwards and forward into the concavity of the overlying articular disc. This pushes the disc forward. The disc is stabilised by its tight attachment to the condyle via the inferior retrodiscal lamina (indicated “A” on figure 2). Forward condyle movement continues. The lingula of the mandible separates from the sphenoid spine tightening the sphenomandibular ligament (Levangie and Norkin 2001:192; Standing *et al.*, 2008:536). Elongation of any of these ligaments, responsible for maintaining joint congruence and stability, can create internal joint laxity resulting in the development of a TMJ derangement / dysfunction (De Leeuw 2008:161). TMJ dysfunction is defined as any interference with normal smooth joint movement (De Leeuw 2008:159).

As the jaw closes again, the superior retrodiscal lamina causes a posterior traction force on the disc with the lateral pterygoid muscle controlling this posterior movement. Mm. masseter, temporalis and the medial pterygoid muscles move the mandible back and upwards with help from the superior bilaminar lamina. The disc moves posterior, in tandem with the condyle and rotation is reversed. The joint surfaces are forced together causing shortening of the sphenomandibular and temporomandibular ligaments (Levangie and Norkin 2001:190).

When the mandible is moved into protrusion, the mandibular incisors are moved forward past the maxillary incisors, producing a temporary underbite. This is accomplished by translation of the condyle down the articular eminence (in the upper portion of the TMJ) with slight rotation taking place (in the lower portion of the TMJ) to allow the mandibular incisors to pass the maxillary incisors without contact (Levangie and Norkin 2001:190-191). During retrusion all points of the mandible moves posteriorly. The mandibular condyle and articular disc slides posteriorly on the articular surface of the temporal bone, and movement is controlled by the tightening of the temporomandibular ligament and the space occupied by the retrodiscal tissue (Moore and Dalley 1999:926; Levangie and Norkin 2001:190-191). It is evident that any changes in condyle shape can negatively impact on this anterior and posterior condyle translation, resulting in a lack of TMJ mobility, and therefore cause TMJ dysfunction.

A lateral mandibular movement is defined as the movement of the center of the mandible away from the midline (Levangie and Norkin 2001:192). As the mandible moves laterally, the lateral condyle rotates around a vertical axis, with the contralateral condyle performing translation anteriorly (Levangie and Norkin 2001:192).

#### **2.4 Surgical treatment protocols for mandibular fractures**

As seen above, TMJ anatomy and arthrokinematics are intricate and complex, and a surgical treatment choice would require a thorough patient and TMJ assessment.

The treatment options for mandibular condyle fractures are dependent on the patient's age, the presence of other mandibular or maxillary fractures, whether it is a unilateral or bilateral condyle fracture as well as the level and displacement of the fracture. The state of dentition, dental occlusion, the surgeon's experience, imaging, and physical examination findings also have an impact on the surgical treatment (Zachariadis *et al.*, 2006:421).

The oldest treatment protocol for mandibular fractures is closed reduction and internal fixation and was the preferred treatment by maxillofacial surgeons (Gonzalez *et al.*, 1992:223; Andreasen, Jensen, Kofod, Schwartz and Hillerup 2008:17). Currently, however, open reduction and internal fixation (ORIF) surgery is becoming the main treatment of choice for mandibular fractures, with an average of 182.6 ORIF's being done per annum in a Johannesburg Public Hospital setting (Desai 2006:22; Feng *et al.*, 2009:46).

Closed reduction of mandibular fractures is in the most part accompanied by a period of intermaxillary fixation, allowing stable jaw fixation (Roccia, Tivolaccini, Dell'acqua and Fasolis 2005:252). Intermaxillary fixation consists of the application of arch bars to the teeth through interdental wires, where maxillary fixation is then implemented through thin wires binding the jaws together (Rikhotso and Ferretti 2008:223). Release of the fixation occurs gradually with the use of guided elastics or the cutting of the wires after two, four or usually six weeks (Hwang *et al.*, 2002:711; Rikhotso and Ferretti 2008:223).

Treatment by closed reduction is less operator sensitive than surgical treatment, it preserves the vascularity of the fracture site, and has a reduced risk of nerve lesions and occlusal

dysfunction. Added advantages are shorter hospitalisation and less expenses incurred due to hardware required (Andreasen *et al.*, 2008:18).

The other treatment method, ORIF surgery, comprises of surgeons accessing the fracture site via an intra-oral and extra-oral approach where repositioning and splinting are then performed with plates and / or wires (Andreasen *et al.*, 2008:17). Rigid internal fixation for a two week period, via intra-osseous wires, provides stabilisation and allows early mobilisation, ensuring early function and a decrease in swelling (Feng *et al.*, 2009:46). The patient can only open their mouth to a certain fixed degree and a special diet is prescribed.

ORIF surgery patients tend to show better radiologic results and a quicker return to work compared to patients treated with closed reduction and maxillo-mandibular fixation (Feng *et al.*, 2009:46). This method does not only have economic advantages due to less sick leave taken from work, but occlusal function is quickly restored and fracture repositioning is optimised (Andreasen *et al.*, 2008:18).

## **2.5 Complications after mandibular condyle fractures**

Mandibular condyle fractures are classified as TMJ macrotrauma that may cause degeneration of the articular cartilage or cause the production of inflammatory and pain mediators (Yun and Kim 2005:1576-1577; De Leeuw 2008:160). Trauma is also thought to change the mechanical properties of the disc, altering its function as a stress absorber (Yun and Kim 2005:1576). After trauma to the mandibular condyles there may be limited mandibular movement, to a varying extent, due to muscle spasm, oedema and haemarthroses (Zachariadis *et al.*, 2006:422).

Dysfunction of normal TMJ mechanics may result in various TMJ movement disturbances. Trauma is regarded as a major factor leading to TMJ dysfunction as the TMJ's articulating disc does not have the ability to repair and remodel, leading to long term disc problems (Levangie and Norkin 2001:187; Görgü *et al.*, 2002:356). A delicate balance exists in all synovial joints between the rate of tissue breakdown and repair. If this balance is disturbed it may result in the remodeling of the internal cartilage, causing intrinsic changes within the joint (De Leeuw 2008:161). This results in a painful and dysfunctional joint. TMJ dysfunctions such as ankylosis, malocclusion, internal derangements, chronic dislocation and

pain on the injured as well as the non-injured side may also occur after a condylar fracture is sustained (Zachariadis *et al.*, 2006:422).

Internal derangements refer to the malpositioning of the articular disc in relation to the condyle and the eminence, causing an interference with smooth joint movement (De Leeuw 2008:159). Disc derangements can occur with reduction or without reduction. A disc derangement with reduction occurs when the articular disc returns to its normal position on top of the condyle upon opening (Figure 3). Disc derangement without reduction occurs when the articular disc remains in a faulty position, limiting mouth opening (Figure 3) (De Leeuw 2008:160). Disc adherence and adhesions are respectively defined as a temporary sticking of the disc to the fossa or condyle or a fibrotic connection between these components. Both of these conditions hamper normal jaw movements (De Leeuw 2008:160).

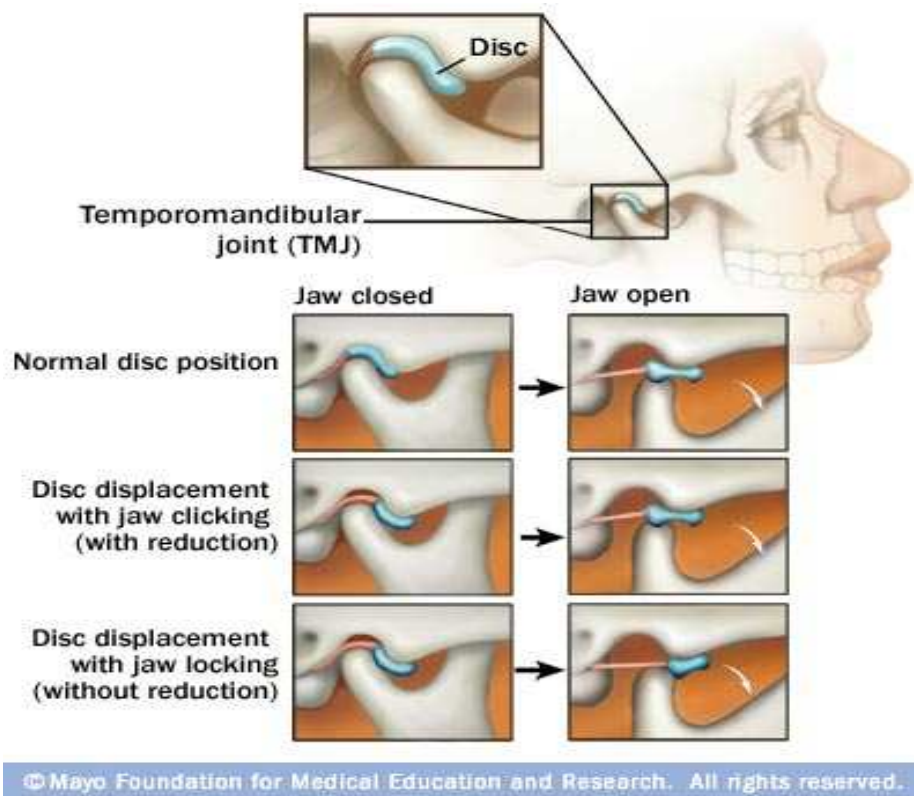


Figure 3. Temporomandibular joint movement patterns (Mayo Foundation for Medical Education and Research 2012).

Unfortunately, complications such as limited mouth opening and persistent or consistent pain, can and do occur with treatment of mandibular fractures, during any of the treatment phases

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(Zwieg 2009:93). Andreasen *et al.* (2008:18) found in a systematic review that ORIF methods showed a relatively higher risk for occlusal disturbances in comparison to closed reduction methods. Oral intubation and dental / surgical procedures requiring a sustained open-mouth position or excessive force has shown a high risk of leading to direct TMJ tissue injury (De Leeuw 2008:161).

Mandibular fractures treated with intermaxillary fixation may lead to periodontal problems as well as cranio-mandibular disorders. Cranio-mandibular disorders include facial pain, tension in masticatory musculature, poor chewing function, chin deviation, limited mouth opening as well as malocclusion (Thiele and Marcoot 1985:227; Bevilaqua-Grosso *et al.*, 2002:268; Chen, Feng, Tsay, Lai and Chen 2011:38). Intermaxillary fixation leads to mandibular dysfunction in one third of adult patients treated with this method of fixation, according to Worsaae and Thirn (1994:353). The length of jaw immobilisation is also believed to cause a significant reduction in gap size (Gonzalez *et al.*, 1992:223, Zachariadis *et al.*, 2006:427). According to South African and American research, intermaxillary fixation lasting more than two weeks, the absence of active physiotherapy, and poor patient compliance results in an increased risk for mandible hypomobility as well as a high risk of developing problems regarding mouth function (Thiele and Marcoot 1985:226; Rikhotso and Ferretti 2008:225). Active physiotherapy for post-surgical mandibular condyle fracture patients is defined as jaw exercises, specifically prescribed for mouth opening to minimise deviation and to reproduce the correct occlusal posture (Rikhotso and Ferretti 2008:223). Even though the period of intermaxillary fixation is on average only two weeks, when treated with ORIF surgery, patients included in Hwang *et al.*'s (2002:115) case study only regained full mandibular function 35 days after surgery, and this after being exposed to an intensive exercise regime.

In oral and maxillofacial surgery, trismus is a complication arising from traumatic and post-operative conditions involving the previously mentioned muscles of mastication and their attachments (Gonzalez *et al.*, 1992:227). Trismus refers to all conditions where there is a lack of adequate mouth opening (Gonzalez *et al.*, 1992:223). Surgical trauma to the mucosa, muscles and connective tissue, in combination with immobilisation are believed to contribute to the amount of trismus experienced by the patient post-operatively after a mandibular fracture (Gonzalez *et al.*, 1992:227). Mandibular deviation occurs with mouth opening,

resulting in uneven loads distributed to the condyles, and may be present regardless of the type of fracture (Zachariades *et al.*, 2006:427).

To limit long-term unwanted effects, complications should be recognised early and the appropriate treatment should be started before a minor complication becomes a complex one that is more difficult to manage (Zwieg 2009:93). Feng *et al.* (2009:46) stated that due to a lack of reasonable and effective post-surgical exercises, patients experienced a negative outcome pertaining to chewing function, occluding relation and fracture healing.

## **2.6 Prevention of complications**

### **2.6.1 Physiotherapeutic exercise**

A large number of studies have found that an ideal prognosis for mouth function cannot be obtained without the appropriate post-surgical functional exercises (Thiele and Marcoot 1985:227; Hwang *et al.*, 2005:116; Rikhotso and Ferretti 2008:226; Feng *et al.*, 2009:46; Trott 2011:5). Active and passive joint exercises for increasing TMJ range of motion is regarded as a key component in the post-surgical management of patients who underwent surgery in the TMJ region, and long-term follow-up is recommended (McCarty and Darnell 1993:300).

A fracture of the mandibular condyle can have a serious effect on all jaw movements, as well as function. In an immobile and unloaded joint, longitudinal bone growth may be impaired and will tend to show degenerative changes (Tanaka and Koolstra 2008:990). As bone fragments start to heal, controlled micro movements will accelerate bone formation and thus aid fracture repair (Andreasen *et al.*, 2008:17). Reasonable and effective post-surgical exercises will prevent displacement of fractured bone ends and stimulate remodeling, and therefore have a positive effect on the recovery of normal mandibular function (Tanaka and Koolstra 2008:990; Feng *et al.*, 2009:47).

The mandible has a rich blood supply and by three weeks post-fracture most mandibular fractures are united and consolidated (Trott 2011:5). Rigid internal fixation also provides adequate stabilisation and allows for early mobilisation and return to function (Zachariades *et al.*, 2006:433). Physiotherapists should encourage early removal of intermaxillary fixation, but leaving the wires and capping of the teeth in situ to retain the fracture stabilisation (Trott

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2011:5). This allows for exercises aiming at restoring normal function of all mandibular movements as well as improving tissue trophicity to prevent fibrosis which can result in pain and dysfunction (Feng *et al.*, 2009:46).

Rehabilitation (jaw exercises and active movements) after mandibular condyle fracture surgery is important for early functional recovery (Chen *et al.*, 2011:38). Physiotherapeutic jaw exercises (opening and closing, lateral movements and chewing exercises) have also been described as successful treatments for trismus and joint mobilisation (Dhanrajani and Jonaidel 2002:92). Active jaw exercises, after sustaining a condyle fracture, should be commenced as soon as pain allows (Brukner and Khan 2002:214). Patients are afraid to exercise into slight pain for fear of re-fracturing of the mandibular condyle or fear of the pain itself (Trott 2011:5). As Israel and Syrop (1997:74) found in their literature review, the physical stimulus of movement is essential for the maintenance of the structural and functional integrity of the TMJ. Gonzalez *et al.* (1992:227) proposed that a physiotherapy program together with shortening of the immobilisation period should hasten recovery of oral function. This is achieved by rather opting for surgical treatment of mandibular fractures where the intermaxillary fixation period is shorter, compared to the six weeks of intermaxillary fixation when opting for closed reduction.

Previous research studies investigating the effects of post-fracture exercise regimes varied in quality, dosage, exercise types and were all provided by the surgeons (plastic surgeons as well as maxillo-facial surgeons) with no physiotherapy demonstrations or interventions (Hwang *et al.*, 2002:709; Rikhotso and Ferretti 2008:223; Feng *et al.*, 2009:48).

Only one non-clinical study conducted by Trott (2011), described an empirically based physiotherapy intervention program following mandibular fractures. Trott's (2011) physiotherapy intervention program for patients who sustained mandibular fractures consisted of gentle, pain-free isometric jaw exercises (jaw opening and lateral deviation bilaterally) and light TMJ passive accessory movements applied to the mandibular condyle (lateral and inferior mandibular condyle glides). The isometric exercises and passive accessory TMJ movements were continued until intermaxillary fixation was removed. After removal of the fixation the exercise program was progressed to include active jaw exercises (with or without resistance) to improve jaw opening, jaw protrusion as well as lateral deviation to each side. TMJ passive accessory movements can be performed into increased joint resistance together with jaw muscle stretches and relaxation techniques which are also

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included in Trott's (2011) physiotherapy treatment program (Trott 2011:5-7). Although the exercise program provided by Trott (2011) was mainly compiled for mandibular fracture patients, and not specifically mandibular condyle fractures, Trott stated that even with fractures close to the TMJ the exercises were safe, provided that the exercise program was performed in consultation with the maxillo-facial surgeon (Trott 2011:5).

Hwang *et al.* (2002:709) investigated an exercise program for patients presenting with mandibular condyle fractures and focused on the use of guiding elastics, mouth opening exercises combined with protrusion and lateral movement, as well as passive stretches. The results of this case study showed both patients struggling with normal TMJ movement after removal of the fixation, but ultimately gaining normal range of motion at 30 - 35 days post-surgery (Hwang *et al.*, 2002:711). An exercise regime is described by Feng *et al.* (2009:48) focusing on slow active mouth opening movements with increased intensity, exercise progression and duration as the fracture healed. The results showed a significant improvement in gap range of motion (ROM) at one, four, eight and 12 weeks post-surgery. The gap ROM improved from 19.8 cm one week post-surgery to 42.3 cm at 12 weeks post-surgery (Feng *et al.*, 2009:47). A similar rehabilitation program was used by Hwang *et al.* (2002) following open reduction and internal fixation of condylar fractures. This program described a two week intermaxillary fixation period followed by mirror guided anterior movement exercises starting at 21 days post-surgery, and mirror guided lateral jaw movements starting at 28 days post-surgery. At 35 days post-surgery, more aggressive stretching and passive joint mobilisations by a physiotherapist was allowed (Hwang *et al.*, 2005:114-115). Gap ROM was evaluated eight weeks post-surgery and showed a gap ROM of 30 - 31mm being achieved, with 4 mm of lateral jaw movement measured. In contrast with the previous study, one participant only achieved a gap ROM of 21 mm at 12 weeks post-surgery, with a measured lateral movement of 3 mm (Hwang *et al.*, 2005:115-116).

A study by Rikhotso and Ferretti (2008) described non-progressing jaw exercises for mouth opening, performed by the patient in front of a mirror to minimize deviation and to reproduce the correct occlusal posture (Rikhotso and Ferretti 2008:223). At follow-up, patients demonstrated a definite decrease in gap size and correction of faulty mandibular movement patterns. Normal mouth opening is regarded as being between 40 mm and 50 mm (Levangie and Norkin 2001:190). Ninety-five percent of mandibular condyle fracture patients who

received no physiotherapy intervention had a maximal mouth opening of less than 40 mm at their six week follow-up, 35 % demonstrated mandibular deviation on the fractured side and 11.5 % demonstrated malocclusion upon biting (Rikhotso and Ferretti 2008:226). Therefore the results of this South African research study specifically highlighted the need for physiotherapy intervention in the treatment of mandibular condyle fractures (Rikhotso and Ferretti 2008:226).

No unifying criteria exists on the type and dose of post-surgical functional exercises with mandibular condyle fractures (Bevilaqua-Grosso *et al.*, 2002:27; Yun and Kim 2005:1576; Feng *et al.*, 2009:46). Many patients who had not received adequate post-surgical exercise programs experienced difficulty with mouth opening, broken bone ends of fractures were displaced and they experienced gap ROM bias (Feng *et al.*, 2009:47).

A tight surgical schedule does not always allow the surgeon the time to explain post-surgical exercises and to ensure the patients were executing these exercises correctly. Physiotherapists receive specific training in joint mobilisation and post-surgical exercises and advice, and it is within their scope of practise to explain the necessary rehabilitation program to any post-surgical patient (<http://www.physiosa.org.za>). After intermaxillary fixation release, the physiotherapist will consult with the patients more frequently than the maxillo-facial surgeons and therefore the physiotherapist would be in the ideal situation to supervise and progress the functional exercise program (Trott 2011:5).

No physiotherapy-based research has been found in the available literature regarding the physiotherapy management of mandibular condyle fractures.

### **2.6.2 Other physiotherapy treatment modalities**

As the condyle head forms part of the lower compartment of the TMJ, it is necessary to focus on the TMJ as part of the rehabilitation regime. As it is suggested in literature, facial trauma may be an etiologic factor in TMJ cartilage degeneration, and intra-articular pathology (Yun and Kim 2005:1576). It is therefore necessary for clinicians to recognise the importance of macrotrauma to the TMJ and provide adequate treatment for patients who sustained facial trauma (Yun and Kim 2005:1576). A physiotherapist should be able to effectively assess and safely treat TMJ pathologies and trauma with a thorough understanding of the unique anatomy and biomechanics of the temporomandibular joint. *“The aim of physiotherapy is to*

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*restore normal mandibular function by various physical techniques that serve to relieve musculoskeletal pain and promote healing of tissue” (Dimitroulis 1998:193).*

Physiotherapy treatment modalities for the TMJ include patient education, activity modification, muscle and joint exercises, myofascial therapy, acupuncture, manipulative therapy and referral to dental surgeons for occlusal splints (Cuccia, Caradonna and Caradonna 2011:102).

Pain and dysfunction of the TMJ retrodiscal tissue, due to overstretch of this tissue during trauma and / or surgery, should be addressed by limiting the degree of mouth opening (Langendoen *et al.*, 1997:196). Anterior-posterior joint mobilisations can be done once healing of the retrodiscal tissues have occurred, which may also assist in the management of this dysfunction (Langendoen *et al.*, 1997:196). Pain and dysfunction of retrodiscal tissues associated with disc displacements, should be treated with splint therapy, provided by the dental profession. However, physiotherapy can play a role in enhancing the splint effect via joint distraction techniques to stretch the joint capsule (Langendoen *et al.*, 1997:196). These therapeutic techniques are of physiotherapeutic nature, and thus should be applied by a physiotherapist who has knowledge in the cranio-mandibular field.

Various electrotherapy modalities, as well as passive accessory TMJ mobilisations can also be utilised to treat post-surgical pain and functional loss. As from day one until day seven post-surgery Transcutaneous Electrical Nerve Stimulation (TENS), ice therapy and pulsed ultrasound are advocated for treating pain and swelling due to the direct effect these modalities have on the blood supply to the injured area (Tarro 1988:285; Wilk and McCain 1992:533; Dijkstra in de Bont and Stegena 1996:179; Brukner and Kahn 2002:128). Joint adhesions are prevented during this stage by active jaw opening and closing exercises, within pain limits, as well as light grade I or grade II joint distractions to maintain tissue length (Dijkstra in de Bont and Stegena 1996:180). As the stages of healing progresses, so the exercise difficulty progresses, the strength of joint mobilisation increases, muscle strength and co-ordination is increased and muscle stretches are initiated (Dijkstra in de Bont and Stegena 1996:181). Post-inflammatory stiffness can be reduced by through-range and end of range active and passive joint mobilisation techniques (Maitland *et al.*, 2005:175).

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In oral and maxillofacial surgery, trismus is a complication arising from traumatic and post-operative conditions, causing oedema, fibrosis and subsequent muscle atrophy (Gonzalez *et al.*, 1992:227). Trismus can be treated by ultrasound therapy, which aids in softening the fibrous tissue and results in the gradual stretching of oral tissues, helping to lessen trismus (Pooja and Maneesha 2010:45).

### **2.7 Conclusion**

*“Physiotherapy plays a distinctive and supportive role in the overall management of TMJ dysfunctions”* (Langendoen *et al.*, 1997:197). Based on the positive effects found with exercise and manual therapy in McNeely, Olivio and Magee’s (2006:710) systematic review, it was justified for physiotherapists to partake in the rehabilitation of patients who sustained mandibular condyle fractures.

Physiotherapists are experts in developing and maintaining human function, as they have an advanced understanding of how the human body moves and what prevents it from moving optimally (<http://www.physiosa.org.za>). The Health Professionals Council of South Africa and the South African Society of Physiotherapy describes physiotherapists as being able to assess, treat and manage various injuries due to their competence in the field of pain relief, joint mobilisation, exercise therapy and correcting faulty movement patterns (<http://www.hpcsa.co.za>; <http://www.physiosa.org.za>). It is thus proposed that physiotherapists can provide an expert rehabilitative service to patients who have sustained mandibular condyle fractures, aiding quicker recovery, decreasing joint dysfunction after trauma, preventing and treating TMJ dysfunctions and pain, reduce in-hospital stay and reducing time demands on the surgeon regarding home advice and exercise prescription.

Although various studies have proposed different strategies regarding post-operative rehabilitative management of mandibular condyle fractures, no universal criteria have been published up to date (Bevilaqua-Grosso *et al.*, 2002:271; Yun and Kim 2005:1576; Feng *et al.*, 2009:46). Rikhotso and Ferretti (2008:226) emphasised the need for adequate and prompt physiotherapy treatment in condylar fracture patients.

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This study will provide the baseline for further possible clinical studies regarding post-operative physiotherapy intervention for mandibular condyle fracture patients, and the implementation of the proposed post-operative physiotherapeutic intervention program. The post-operative physiotherapy intervention program to be developed in this study will be developed using an evidence-based approach, which does not guarantee its efficacy in the prevention of complications amongst patients who underwent maxillo-facial surgery following a mandibular condyle fracture.

# CHAPTER 3

## Methodology: Needs analysis

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In this chapter the aim of the study, study design, the population, sample size, criteria for inclusion in the needs analysis, ethical considerations, methodological errors, the formulation of the needs analysis questionnaire, the pilot study, and methodology of the needs analysis questionnaire will be discussed. The needs analysis was performed as a questionnaire and forms the foundation of the formulation of the Delphi questionnaire; therefore it will be discussed separate from the Delphi methodology.

### **3.1. Research aim**

The aim of this section of the study was to perform a needs analysis amongst maxillo-facial surgeons and physiotherapists in South Africa, regarding the perceived need for a post-operative physiotherapy intervention program for patients who sustained mandibular condyle fractures.

### **3.2. Research question**

What is the perceived need for post-operative intervention for patients who sustained mandibular condyle fractures, in South Africa?

### **3.3. Study design**

A quantitative, non-experimental study, by means of a needs analysis questionnaire was performed.

### **3.4. Sample selection**

#### **3.4.1. Target population**

The target population was one adequately trained expert (physiotherapist and maxillo-facial surgeon) from each of the respected South African training institutions. Physiotherapy participants had to have a special interest in Orthopedic Manipulative Physical Therapy (OMPT) and in South Africa.

The Health Professionals Council of South Africa (HPCSA) and the Orthopedic Manipulative Physical Therapy (OMPT) special interest group were contacted to obtain the total number of adequately trained experts from all South African training institutions. There are 136 maxillo-facial surgeons and 1300 South African physiotherapists, from all South African training institutions, who have completed their post-graduate certificate in OMPT, and who are registered with the HPCSA (<http://www.hpcsa.co.za>). The National Executive Committee's chairperson of the OMPT special interest group in South Africa was contacted regarding the number of physiotherapists registered with the specific interest group specialising in the cranio-mandibular field. As of yet there is no special interest group for physiotherapists in South Africa specialising in the cranio-mandibular field.

The physiotherapists included in the needs analysis needed to be qualified physiotherapists, with a post-graduate certificate in OMPT, and practical experience in the treatment of patients presenting with cranio-mandibular disorders. Physiotherapists in the needs analysis were sourced from each of the eight physiotherapy training institutes in South Africa namely the University of Cape Town, University of the Western Cape, University of Stellenbosch, University of Pretoria, University of the Free State, University of KwaZulu Natal, University of Limpopo, and the University of the Witwatersrand. Each university's physiotherapy department was contacted and requested to nominate a participant for the needs analysis. If the nominated participant was unable to participate in the study, a recommendation to an appropriately trained physiotherapist from their university was accepted and the physiotherapist was contacted by the researcher for possible participation in the needs analysis.

Qualified maxillo-facial surgeons were sourced from each of the four South African universities providing this specialisation, namely the University of Pretoria, University of the Western Cape, University of the Witwatersrand and the University of Limpopo. The sourcing of participants was done by contacting each of the four universities' maxillo-facial surgery departments and requesting a nominee from their department for participation in the study. If the nominated participant could not partake in the study, a recommendation to an appropriately trained maxillo-facial surgeon from their university was accepted, and the maxillo-facial surgeon was contacted by the researcher.

Using this method input from seven of the eight physiotherapy, and all of the maxillo-facial surgery training institutions in South Africa were obtained.

### **3.4.2. Inclusion and Exclusion criteria**

Participants needed to represent each South African physiotherapy and maxillo-facial surgery training institution (eight institutions). The needs analysis would include one physiotherapist from each physiotherapy training institution in South Africa as well as one graduated maxillo-facial surgeon from each of the four South African maxillo-facial training institutions. The academic experience of the lecturers would be of valuable input, as this is a relatively new avenue of research for South African physiotherapy, very little physiotherapists have extensive clinical experience with this patient population.

Physiotherapists were included if they obtained a Bachelor's degree in Physiotherapy (B.Sc. or B. in Physiotherapy), an OMPT post-graduate certificate, and if they had a minimum of two years work experience in the cranio-mandibular field. The "cranio-mandibular field" describes physiotherapists working with "*different musculoskeletal conditions that involve the masticatory muscles, the temporomandibular joints and the associated structures*" (Mobilio and Catapano 2010:1).

The maxillo-facial surgeons were included if they obtained their specialisation degree in maxillo-facial surgery or a post-graduate qualification in maxillo-facial surgery.

Participants included in the needs analysis had to have regular internet or facsimile access, as the questionnaire was sent using an online research tool, SurveyMonkey™.

Participants had to be literate in English as international participants were to be included in the Delphi questionnaire, and the needs analysis will be used to compile round one of the Delphi questionnaire.

### **3.4.3. Sample size and sampling method**

As this study explored a relatively new area for physiotherapy research, a convenience sampling method was used to select appropriately trained participants for the needs analysis. Curricula vitae of participants were analysed by the researcher and possible participants were identified for inclusion in the needs analysis.

The needs analysis participants consisted of 11 participants:

- Four graduated maxillo-facial surgeons, one from each of the training institutions in South Africa
- Seven physiotherapists, representing seven of the eight South African physiotherapy training institutions.

Despite persistent electronic as well as telephonic requests made by the researcher, one South African physiotherapy training institution failed to provide, or nominate, a suitable participant representative from their institution.

### **3.5. Ethical considerations**

The study was approved by the Ethics Committee of the Faculty of Health Sciences of the University of the Free State (ECUFS NR: 05/2012) (Addendum A). After ethical approval was obtained, an amendment was made to the approved study protocol (Addendum B). The amendment addressed a typing error. The protocol stated that there were seven South African physiotherapy training institutions, where in actual fact there were eight South African physiotherapy training institutions which formed part of the target population. The amendment, together with justification as to why the amendment was required, was re-submitted and approved by the Ethics Committee. The study was meticulously conducted in line with the approved protocol.

All relevant information pertaining to the study was included in English, the language of choice during the conduction of this study. English was chosen as the language of choice as

### Chapter 3: Methodology: Needs analysis

some of the experts contacted to serve on the Delphi review panel were from abroad, thus making English the one language all reviewers were fluent in. The data obtained from the needs analysis were used to formulate the Delphi questionnaire, therefore English was the language of choice for the needs analysis as well.

The study invited experts in the field to participate in the study. A recruitment letter was electronically sent to identify experts as invitation for study participation (Addendum C). Curricula vitae of physiotherapists in the field of interest, as well as curricula vitae of maxillo-facial surgeons, eligible for possible participation were obtained by the researcher. The curricula vitae were acquired by the researcher by contacting all universities offering the above mentioned qualifications. Sifting of all curricula vitae produced possible reviewers meeting the inclusion and exclusion criteria.

As there were no clinical tests or treatments performed, there existed no harm or risk for any participants. Participants were made aware that they would not receive remuneration for participation in the study.

It was made clear to participants in the needs analysis that participation in the study was voluntary and that participants could withdraw from the study at any stage without negative consequences, should they choose to do so.

Anonymity and confidentiality were ensured during each stage of the research. Online questionnaire links were e-mailed separately to each needs analysis participant, to ensure anonymity. As the online questionnaires were anonymous, participants were asked to send the researcher an e-mail to confirm completion of the needs analysis questionnaire. This was in strict confidentiality between the researcher and the reviewer. Participants partaking in the study would have access to the final results in the form of a written thesis, without compromising anonymity.

One of the study outcomes could be that the study is published in an accredited journal and every care would then be taken for the needs analysis participants to remain anonymous.

The needs analysis questionnaire included an information sheet, as part of the recruitment letter, for participants to make an informed decision regarding participating and for participants to know what was to be expected during the study (Addendum C). A copy of the recruitment letter was sent to each of the participants. It was made apparent to participants in the recruitment letter, as well as in the needs analysis questionnaire, that by completing the questionnaire and submitting it to the researcher, the participant was giving informed consent.

### **3.6. Formulation of recruitment letter for needs analysis participants**

A recruitment letter (Addendum C) was compiled by the researcher using the ethical guidelines for research conduction, as outlined by the Ethics Committee of the Faculty of Health Sciences of the University of the Free State (<http://www.health.ufs.ac.za>).

As part of the recruitment letter, a shortened version of the literature review was compiled by the researcher and sent to participants to provide them with the reason for conduction of this specific study. The literature used was obtained from the completion of an extensive literature search, using the various search engines listed in chapter 2. Participants were also informed regarding the research aims and method of research conduction. Further information provided were the population to be included in the study, duration of the needs analysis, the method of questionnaire distribution, methods of return of completed questionnaires, approximate time it would take to complete the questionnaire as well as the contact details of the researcher for any queries or to request a copy of the protocol.

The ethical considerations were also outlined in the recruitment letter, as described in paragraph 3.5.

The contact details for the Ethics Committee of the Faculty of Health Sciences of the University of the Free State was provided, together with the report regarding the permission which was obtained from the Ethics Committee (Addendum C).

### **3.7. Formulation of the needs analysis questionnaire**

The needs analysis questionnaire (Addendum D) was formulated to obtain the maximum number of information from participants regarding their treatment, or proposed treatment, for patients who sustained mandibular condyle fractures. The questions were formulated using personal information gained from communication with maxillo-facial surgeons and available literature. Demographical information was also included in the questionnaire. Demographical data was collected in order to describe the participants of the study population. The literature used was obtained by conduction of an extensive literature search, as described in chapter 2.

Section A of the questionnaire was structured to obtain standard demographical data from participants. Section A was divided into sub-dimensions regarding profession, years of experience in the specific profession, gender, as well as working environment.

Section B was formulated to gain expert input, and not testing knowledge of participants, regarding possible mandibular functional loss, various treatment modalities for mandibular condyle fracture patients, listed precautionary measures routinely taken, and the duration of the listed precautionary measures for patients treated for mandibular condyle fractures. The questions in section B could contribute to methodological errors, as the online questionnaire was not completed in a closed, controlled environment. Participants would have been able to research their answers before submitting, therefore not truly relying on their own knowledge.

Acronyms of specific physiotherapeutic terminology within the questionnaire questions, which maxilla-facial surgeons might not have been familiar with was included as the needs analysis included both physiotherapists and maxilla-facial surgeons, two differing professions and some of the terminology might not have been clear to all participants.

Unbiased questions, providing acronyms for physiotherapeutic terminology, as well as conducting a pilot study to minimise incorrect question interpretation minimised misinterpreting questions by participants. The aim of the pilot study was to enhance the face validity of the needs analysis questionnaire. Piloting was done by two experts in the field, one physiotherapist and one maxillo-facial surgeon, to ensure that the study objectives were met.

### Chapter 3: Methodology: Needs analysis

See Table 3.1 for the formulation of the needs analysis questionnaire. See addendum D for the needs analysis questionnaire.

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
Section A: Demographics	Profession	1	Researcher
	Years of practise	2	Researcher
	Gender	3	Researcher
	Working environment	4	Researcher
Section B: Expert input	Number of participants currently treating mandibular condyle fracture patients in-hospital, as well as out of hospital	5; 6	Researcher
	Treatment modalities administered by participants currently treating patients who sustained mandibular condyle fractures	7	Researcher
	Percentage of patients reporting functional loss in hospital as well as on out-patient follow-up, following ORIF (open reduction and internal fixation) surgery	8; 10	Maxillo-facial surgeons; Researcher

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Percentage of patients reporting functional loss in hospital as well as on out-patient follow-up, following closed reduction	9; 11	Maxillo-facial surgeons; Researcher
	Precautionary measures to be considered when treating a mandibular condyle fracture patient, day one after ORIF surgery or closed reduction (open ended question).	12; 15	Researcher
	Duration of precautionary measures for patients who underwent ORIF surgery or closed reduction (open ended question)	13; 16	Researcher

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Physiotherapeutic treatment modalities participants felt were contra-indicated when treating a mandibular condyle fracture patient after ORIF surgery or closed reduction (open ended question)	14; 17	Researcher
	The need for physiotherapy intervention in post-surgical patients treated for mandibular condyle fractures	18	Maxillo-facial surgeons; Researcher; Thiele and Marcoot (1985); Hwang <i>et al.</i> (2005); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)
	The degree of need for physiotherapy intervention for mandibular condyle fracture patients	19	Maxillo-facial surgeons; Researcher; Thiele and Marcoot (1985); Hwang <i>et al.</i> (2005); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	The number of patients, treated by either ORIF surgery or closed reduction, who participants felt required physiotherapy	20; 21	Maxillo-facial surgeons; Researcher; Rikhotso and Ferretti (2008)
	Anatomical areas of the mandibular condyle requiring physiotherapy intervention after either ORIF surgery or closed reduction for a mandibular condyle fracture	22; 23; 24; 25	Maxillo-facial surgeons; Researcher
	Mandibular condyle fracture patients should all receive physiotherapy intervention as a preventative measure	26	Maxillo-facial surgeons; Researcher; Trott (2011)

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Mandibular condyle fracture patients should only receive physiotherapy intervention when complaining of functional impairment and pain	27	Researcher
	Participants' view of when a physiotherapist should evaluate and start treatment of mandibular condyle fracture patients treated with ORIF surgery or closed reduction	28; 29	Maxillo-facial surgeons; Researcher; Brukner and Khan (2002); Hwang <i>et al.</i> (2002); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)
	The number of physiotherapy visits deemed acceptable for mandibular condyle fracture patients, undergoing ORIF surgery or closed reduction (open ended question)	30; 31	Maxillo-facial surgeons; Researcher

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
Dimension	Sub-dimension	Indicators	
	The types of physiotherapy intervention possibly required by mandibular condyle fracture patients, day one after either ORIF surgery or closed reduction	32; 33	Researcher; Thiele and Marcoot (1985); McCarty and Darnell (1993); Dijkstra in de Bont and Stegena (1996); Bevilaqua-Grosso <i>et al.</i> (2002); Brukner and Khan (2002); Dhanrajani and Jonaidel (2002); Hwang <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Maitland <i>et al.</i> (2005) Yun and Kim (2005); Rikhotso and Ferretti (2008); Pooja and Maneesha (2010); Cuccia <i>et al.</i> (2011); Trott (2011)
	Symptoms warranting physiotherapy intervention, if mandibular condyle fracture patients are not routinely seen by a physiotherapist	34	Maxillo-facial surgeons; Researcher; Gonzalez <i>et al.</i> (1992); Dijkstra in de Bont and Stegena (1996); Langendoen <i>et al.</i> (1997); Dhanrajani and Jonaidel (2002); Pooja and Maneesha (2010); Cuccia <i>et al.</i> (2011)

**Table 3.1. Formulation of the needs analysis questionnaire.**

### **3.8. Pilot study**

The face validity of the study was enhanced by piloting the needs analysis questionnaire before sending the questionnaire to the participants. This was done to ensure that the questions were comprehensible, unbiased, and that the questionnaire was well-structured (Joubert, Bam and Cronje 2008:52). Piloting was done by two experts in the field, one physiotherapist and one maxillo-facial surgeon, to ensure that the study objectives were met by the questionnaire.

The needs analysis questionnaire, together with the recruiting letter, was sent electronically on the 30<sup>th</sup> of January 2012 to the two pilot study participants. Pilot study participants received two weeks to complete the questionnaire (13<sup>th</sup> of February 2012), with a reminder being sent one week prior to the completion deadline (6<sup>th</sup> of February 2012), to participants who have not returned the questionnaire at that time. However, both pilot study participants returned the questionnaire on the 3<sup>rd</sup> of February 2012, within one week of the pilot questionnaire being sent to them. After completion of the pilot study the only amendments which were made were spelling errors and question sequencing for easier reading.

The needs analysis questionnaire was also sent to a biostatistician for assessment of the questionnaire and correction of any errors before being sent to the participants. A corrected needs analysis questionnaire version and recruitment letter were sent to the biostatistician. The biostatistician also received a two week deadline for the return of the questionnaire and accompanying corrections (13<sup>th</sup> of February 2012). A reminder to complete the questionnaire was sent to the biostatistician one week before the deadline on the 6<sup>th</sup> of February 2012, and the questionnaire was returned to the researcher on the 8<sup>th</sup> of February 2012. The corrections made by the biostatistician consisted of question sequencing as well as correction of spelling errors.

All suggested amendments by the biostatistician and pilot study participants were complied to by the researcher.

### **3.9. Method of data collection**

The data required were documentary in nature and was obtained from the selected group of participants.

Participants in the needs analysis had a choice of working online and submit their questions directly by entering the submit button, or to print the online questionnaire and fax it to the researcher upon completion.

Participants complying to the inclusion and exclusion criteria, discussed earlier in this chapter, were contacted telephonically or via e-mail by the researcher. If participants were unable to participate in the study, the participant nominated another suitable candidate.

The response rate from participants was a potential source of bias. Non-responder rates were considered, as a too large number of non-responders could result in misleading results (Kelley, Clark, Brown and Sitzia 2003:264). The needs analysis consisted of eleven participants; a drop-out of three participants would then still yield reliable results.

Together with the electronic link to the online questionnaire, a recruitment letter was sent to all participants (Addendum C). This included the researcher's contact information if participants had any queries or would have liked to return the completed questionnaire by a means other than online completion. The recruitment letter also contained a short literature review regarding the study, the study aim and rationale, information regarding the completion of the questionnaire, as well as ethical considerations.

A comprehensive study instruction sheet was sent electronically to each participant to ensure that participants knew exactly what was to be expected of them for the duration of the study, to minimise incorrect completion and return of the completed questionnaires, resulting in eliminating or reducing participant drop-out rates (Addendum C). The time limit for the completion of the questionnaire was clearly indicated on the recruitment letter. It was made apparent to participants in the recruitment letter, and as an introduction to the questionnaire that by completing the questionnaire, and submitting it, the participant was giving consent for study participation.

SurveyMonkey™, an online research tool, was used to electronically send the needs analysis questionnaire to the eleven participants. As a registered post-graduate student at the University of the Free State, the researcher had free access to the research tool. SurveyMonkey™ enabled the researcher to compile the questionnaire, distribute it to the target population, track responses, send reminders to non-responders as well as analyse the results. SurveyMonkey™ was designed to ensure participant confidentiality, as all participants received an individual e-mail not indicating the full e-mail recipient list.

Time limits were set for the completion and return of the needs analysis questionnaire. After two weeks upon receiving the online link, a follow-up reminder was sent to the participants to encourage non-responders to comply. This would be done one week prior to the deadline for the needs analysis questionnaire completion. The online questionnaire, “Needs analysis to determine physiotherapy intervention for mandibular condyle fractures” (Addendum D), was sent out, after ethical clearance was obtained, on 27 February 2012. A two week completion deadline was set for the 12<sup>th</sup> of March 2012. A reminder, one week prior to the completion deadline was also sent via e-mail to all respondents on the fifth of March 2012. If a participant did not respond within the two week time limit, they were excluded from the study. Of the eleven participants a total of eight participants completed the needs analysis questionnaire by the deadline of the 12<sup>th</sup> of March 2012.

All correspondence with participants, the distribution of the recruitment letter and questionnaire, as well as the gathering of data from the returned questionnaires was done by the researcher.

### **3.10. Analyses**

The online research tool used to conduct this study, SurveyMonkey™, reported all results in a percentage. For each question there was an indication of how many participants answered the question, how many participants omitted the question, as well as any comments made by participants regarding the relevant question. The needs analysis questionnaire responses were analysed by the researcher. A biostatistician and the research supervisors verified the data

### Chapter 3: Methodology: Needs analysis

analyses and results. The results for each question, portrayed as percentages, were reported by the researcher in the form of tables, graphs and diagrams in the next chapter.

The results of the needs analysis, together with current literature, were used to compile the first round Delphi questionnaire.

# CHAPTER 4

## Results and discussion of needs analysis

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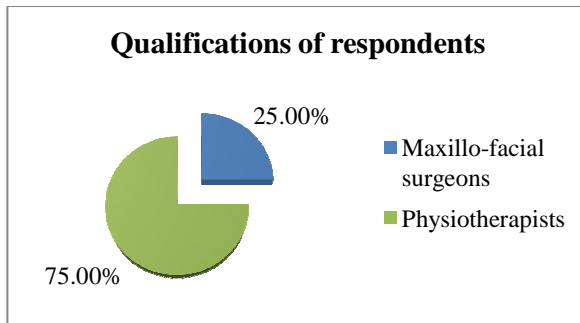
In this chapter the results obtained, after completion of the needs analysis questionnaire, will be illustrated by means of tables, graphs and diagrams. The results provided in this chapter will not be related to the literature, but a discussion of the literature will be included in the next chapter.

The needs analysis was conducted as described in the previous chapter, with a total of eleven participants one participant from each maxillo-facial training institution, and seven of the eight physiotherapy training institutions in South Africa.

The online questionnaire, “Needs analysis to determine physiotherapy intervention for mandibular condyle fractures” (Addendum D), was sent out electronically using the online research tool, SurveyMonkey™.

### 4.1. Demographical information

#### 4.1.1. Qualifications of participants

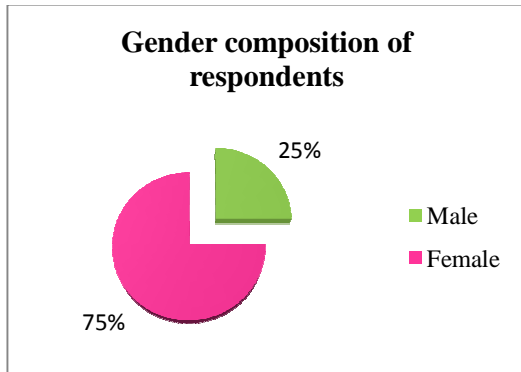


**n = 8**

#### **Graph 4.1. Qualifications of participants.**

A total of eight participants (72.7 %) completed the survey. The participants consisted of two maxillo-facial surgeons and six physiotherapists (Graph 4.1). It was expected that the majority of complying participants (86% of the physiotherapists versus 50% of the maxillo-facial surgeons) would be physiotherapists as this was a physiotherapy-based study and the topic should interest physiotherapists more than other professionals included in the study.

#### 4.1.2. Gender composition of participants

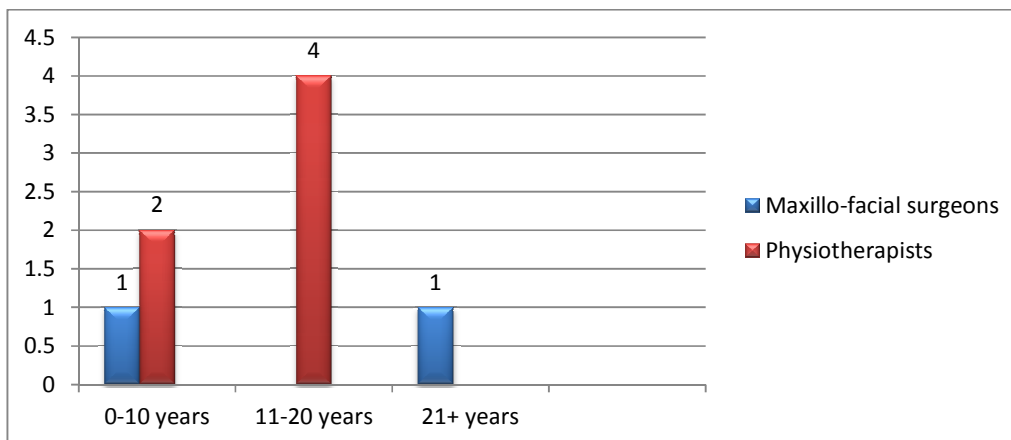


**n = 8**

**Graph 4.2. Gender composition of participants.**

Of the eight study participants, six were female (Graph 4.2). As the majority of participants were physiotherapists, it was expected for the male: female respondent ratio not to be equal. Physiotherapy was once seen as a predominantly female profession. In recent years this has changed, mostly due to the selection system at universities. Physiotherapy as a career has also expanded tremendously over the past few years, drawing more males to the profession.

#### 4.1.3. Years of practise of participants



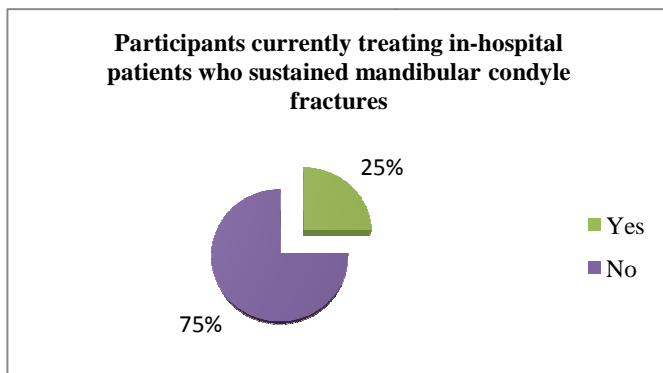
**Graph 4.3. Years of practise of participants.**

As seen in Graph 4.3 above, the majority of participants have had several years of practise in their respected fields, making them adequately experienced to participate in the study.

Four participants reported working in private practise, three as university lecturers and one reported working in both the public and the private sector. The result regarding work environment distribution was satisfactory for the study, as the results were obtained not only from academics but also from participants with first hand practical knowledge regarding the treatment protocols for patients who sustained mandibular condyle fractures.

## **4.2. Other information**

### **4.2.1. Participants currently treating in-hospital patients who sustained mandibular condyle fractures**

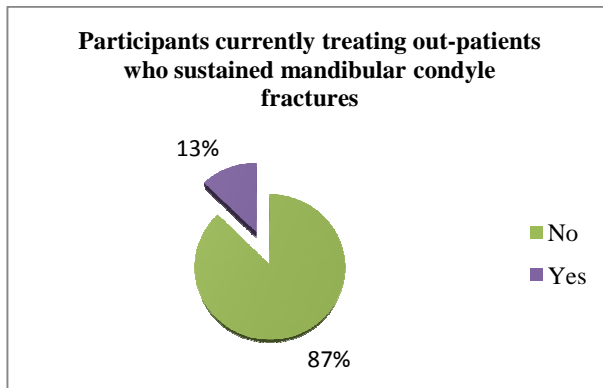


**n = 8**

#### **Graph 4.4. Participants currently treating in-hospital patients who sustained mandibular condyle fractures.**

A total of 75 % of participants do not currently treat in-hospital patients who sustained mandibular condyle fractures (Graph 4.4). The two participants currently treating this patient population were maxillo-facial surgeons. One physiotherapist does not routinely treat mandibular condyle fracture patients, but has practical experience with this patient population.

#### 4.2.2. Participants currently treating out-patients who sustained mandibular condyle fractures



**n = 8**

#### Graph 4.5. Participants currently treating out-patients who sustained mandibular condyle fractures.

The results in the two graphs above (Graph 4.4 and 4.5) indicate that the majority of participants are not currently treating patients who sustained mandibular condyle fractures, resulting in expert opinion mostly provided by the maxillo-facial surgeons. The low number of participants currently treating mandibular condyle fracture patients could be due to the fact that a number of participants are currently working in a university setting, preventing or limiting them from doing hands-on patient treatments. However, the participants chosen for the needs analysis met specific inclusion and exclusion criteria, making them experienced in their field of practise. All the physiotherapists included had the required experience in the cranio-mandibular field of practise, but not necessarily the practical experience in treating mandibular condyle fracture patients. Participants also had to be representative of each training institution in South Africa, excluding some experts meeting the inclusion criteria whose training institution was already represented.

A major contributor to the results depicted in Graphs 4.4 and 4.5, regarding the small number of participants currently treating mandibular condyle fracture patients, is the fact that this is a study into an area where, currently in South Africa, there has not been any physiotherapeutic research done and very few physiotherapists are treating patients who sustained mandibular condyle fractures.

#### 4.2.3. Treatment modalities currently utilised by participants

##### Maxillo-facial surgeons (n=2)

- Open reduction and internal fixation
- Closed reduction

##### Physiotherapists (n=1)

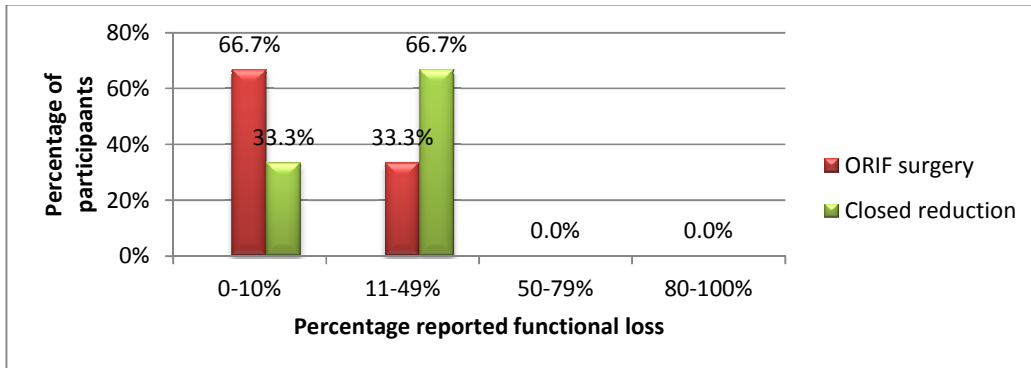
- Ice / heat
- Ultrasound / laser
- Soft tissue mobilisation

**n = 3**

#### **Diagram 4.1. Treatment modalities currently utilised by participants.**

The one physiotherapist who had experience in treating patients with mandibular condyle fractures, indicated mainly the use of ice / heat therapy, ultrasound and laser therapy as well as soft tissue mobilisation as chosen physiotherapeutic treatment techniques (Diagram 4.1).

**4.2.4. Reported in-hospital functional loss following ORIF surgery or closed reduction**

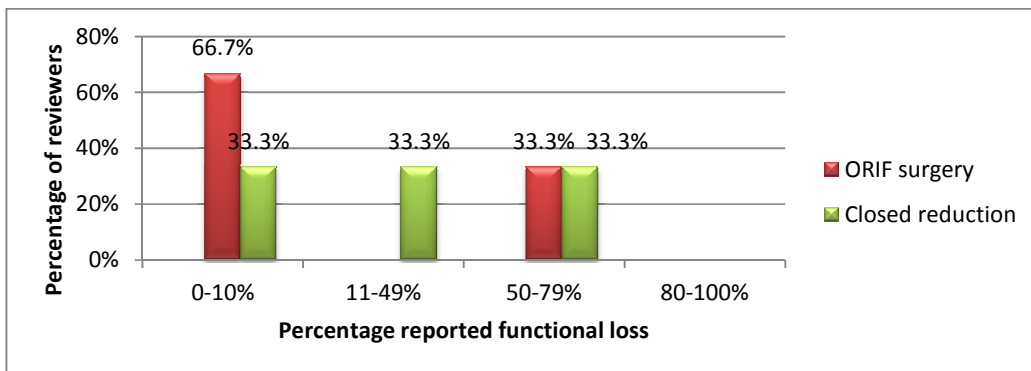


n = 3

**Graph 4.6. Reported in-hospital functional loss following ORIF surgery or closed reduction.**

Through multiple choice questions with percentage options ranging from 0 – 10 %, 11 – 49 %, 50 – 79 % and 80 – 100 %, it was determined from the participants that patients who sustained mandibular condyle fractures, tend to report in-hospital functional loss. Only 0 – 10 % of patients treated by open reduction and internal fixation reported in-hospital functional loss, where as 11 – 49 % of patients treated by closed reduction reported in-hospital functional loss (Graph 4.6).

**4.2.5. Reported functional loss at follow-up following ORIF surgery or closed reduction**



n = 3

**Graph 4.7. Reported functional loss at follow-up following ORIF surgery or closed reduction.**

## Chapter 4: Results and discussion of needs analysis

At out-patient follow-up, as illustrated by Graph 4.7, the reported functional loss percentage, according to the participants, varied between 0 and 10 % (n = 2 maxillo-facial surgeons) and 50 – 79 % (n = 1 physiotherapist) for patients treated with ORIF surgery. For patients treated by closed reduction the responses varied between 0 and 10 % (n = 1 maxillo-facial surgeon), 11 – 49 % (n = 1 physiotherapist) and 50 – 79 % (n = 1 maxillo-facial surgeon).

As reliable patient statistics were only obtained from three participants who had practical experience in treating mandibular condyle fracture patients, results should be compared with the data collected from the Delphi questionnaires. The combination of the needs analysis and Delphi questionnaire results regarding reported functional loss by mandibular condyle fracture patients, would provide more information regarding the clinical presentation of patients who sustained mandibular condyle fractures. As the members of the Delphi review panel did not consist of the same participants as the needs analysis questionnaire, the review panel members might have had more experience in the field, and results would produce a better indication as to the number of patients complaining of functional loss after sustaining mandibular condyle fractures (See Chapters 5 and 6).

<b>Statement regarding physiotherapy intervention</b>	<b>Percentage response</b>	
All mandibular condyle fractures, regardless of anatomical area of the fracture, require physiotherapy intervention (n = 7)	Yes = 100 %	
All mandibular condyle fracture patients should receive physiotherapy intervention (n = 7)	<b>As preventative measure</b>	<b>Only when complaining of functional impairment and pain</b>
	Agree = 85.7 %	Agree = 28.6 %
	Disagree = 14.3 %	Disagree = 71.4 %
Need for physiotherapy intervention for mandibular condyle fracture patients treated by ORIF (n = 7)	0 – 10 % = 14.3 % 50 – 79 % = 28.6 % 80 – 100 % = 57.1 %	
Need for physiotherapy intervention for mandibular condyle fracture patients treated by closed reduction (n = 6)	50 – 79 % = 33.3 % 80 – 100 % = 67.7 %	

**Table 4.1. Responses indicating physiotherapy intervention required for patients who sustained mandibular condyle fractures.**

Results tabulated in Table 4.1 indicated that participants all agreed that (regardless of the anatomical area of the condyle fractured) all mandibular condyle fracture patients should receive physiotherapy intervention. All participants unanimously agree that there is a need for physiotherapy intervention for in-hospital patients, who sustained mandibular condyle fractures, and that physiotherapy intervention for this patient population should be given as a preventative measure. As illustrated by the needs analysis results, physiotherapy intervention should not only be given when patients complain of functional impairment and pain, but as a routine preventative measure.

It was noted that 0 – 10 % (n = 1 maxillo-facial surgeon), 50 – 79 % (n = 2 physiotherapists) and 80 – 100 % (n = 4: 1 maxillo-facial surgeon and 3 physiotherapists) of participants reported that patients, treated by ORIF surgery would require physiotherapy intervention. Two participants (n = 2 physiotherapists) reported a 50 – 79 %, and four participants (n = 4: 2

## Chapter 4: Results and discussion of needs analysis

maxillo-facial surgeons and 2 physiotherapists) reported an 80 – 100 % need for physiotherapy intervention for patients with mandibular condyle fractures, treated by closed reduction.

No conclusion could be made as to when the first physiotherapy evaluation and treatment should be commenced or how many in-hospital visits would be deemed adequate for patients who sustained mandibular condyle fractures, treated by either ORIF surgery or closed reduction. A possible reason for the wide variety in responses by participants may be due to the fact that only three participants (two maxillo-facial surgeons and one physiotherapist) had practical experience with patients sustaining mandibular condyle fractures, and the other participants were answering according to their knowledge, and not practical experience.

Open-ended questions were posed to participants as to the possible pre-cautionary measures, and their duration, to be considered for mandibular condyle fracture patients treated by either ORIF surgery or closed reduction. The responses regarding these possible post-ORIF and closed reduction pre-cautionary measures, and the duration of these pre-cautionary measures, elicited a variety of responses from participants. For both mandibular condyle fracture patients who underwent ORIF surgery or closed reduction, it was deemed unsafe by participants to administer the treatment modalities tabulated in Table 4.2 (open-ended questions).

**4.3. Physiotherapeutic interventions, including pre-cautionary measures, for mandibular condyle fracture patients following ORIF surgery or closed reduction**

<b>Pre-cautionary measure</b>	<b>Response count for post-ORIF surgery (n = 6)</b>	<b>Response count for patients treated by closed reduction (n = 5)</b>
Soft diet	2	0
No ultrasound directly over the surgical area	1	1
No resisted exercises	1	1
No forced movements stressing the joint	1	1
No interferential current therapy over the surgical area	1	1
No dry needling over the surgical area	1	1
Will contact surgeon regarding specific precautionary measures	1	1
Prevent bleeding and infection	1	1
Mandibular and TMJ problems are not taught in our undergraduate curriculum. We do however give handouts to the students and refer to it as a self study topic.	1	1

**Table 4.2. Pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient, after ORIF surgery or closed reduction.**

## Chapter 4: Results and discussion of needs analysis

Experts, in most part, agreed regarding the pre-cautionary measures considered when treating mandibular condyle fracture patients, following ORIF surgery or closed reduction (Table 4.2). This resulted in the same results being obtained regarding the proposed pre-cautionary measures to be considered (Table 4.2). A 'soft diet' after ORIF surgery was the only answer provided twice by participants. The validity of the answers provided by participants could have been compromised due to the low number of participants currently treating mandibular condyle fracture patients. However, as stated previously, all participants had the required pre- and post-graduate training to make them knowledgeable in this field

<b>Duration of pre-cautionary measures</b>	<b>Response count for ORIF surgery patients (n = 5)</b>	<b>Response count for closed reduction patients (n = 5)</b>
Two weeks	1	2
Three weeks	-	1
Six weeks	1	-
Not currently treating this patient population, and do not feel comfortable giving an answer	2	2

**Table 4.3. Duration of pre-cautionary measures for mandibular condyle fracture patients following ORIF surgery and closed reduction.**

The responses tabulated above (Tables 4.2 and 4.3) were used to formulate a section of the Delphi questionnaire. When analysing the results, it was found that participant responses indicated an adherence to pre-cautionary measures for two or six weeks when treating mandibular condyle fracture patients treated by ORIF surgery, and two or three weeks for mandibular condyle fracture patients treated by closed reduction.

## Chapter 4: Results and discussion of needs analysis

The responses regarding physiotherapy intervention following ORIF surgery or closed reduction for mandibular condyle fracture patients are tabulated below, as proposed by participant's answers to the proposed open-ended questions open-ended questions (Table 4.4).

<b>Treatment modality</b>	<b>Response count for suitability after ORIF surgery (n = 7)</b>	<b>Response count for suitability after closed reduction (n = 5)</b>
Facial muscle massage	1	1
Passive TMJ mobilisations by physiotherapist	3	2
Facial muscle stretches	0	0
Active jaw exercises	2	2
Isometric jaw muscle exercises	3	3
Cervical postural advice	4	3
Ultrasound therapy	5	5
Transcutaneous Electrical Stimulation (TENS)	2	2
Ice therapy	5	3

**Table 4.4. Physiotherapeutic treatment modalities for mandibular condyle fracture patients following ORIF surgery and closed reduction.**

As noted by a participant, there would be pain and swelling in the facial area after medical treatment of a mandibular condyle fracture, inevitably resulting in a decrease in TMJ range of motion and jaw function.

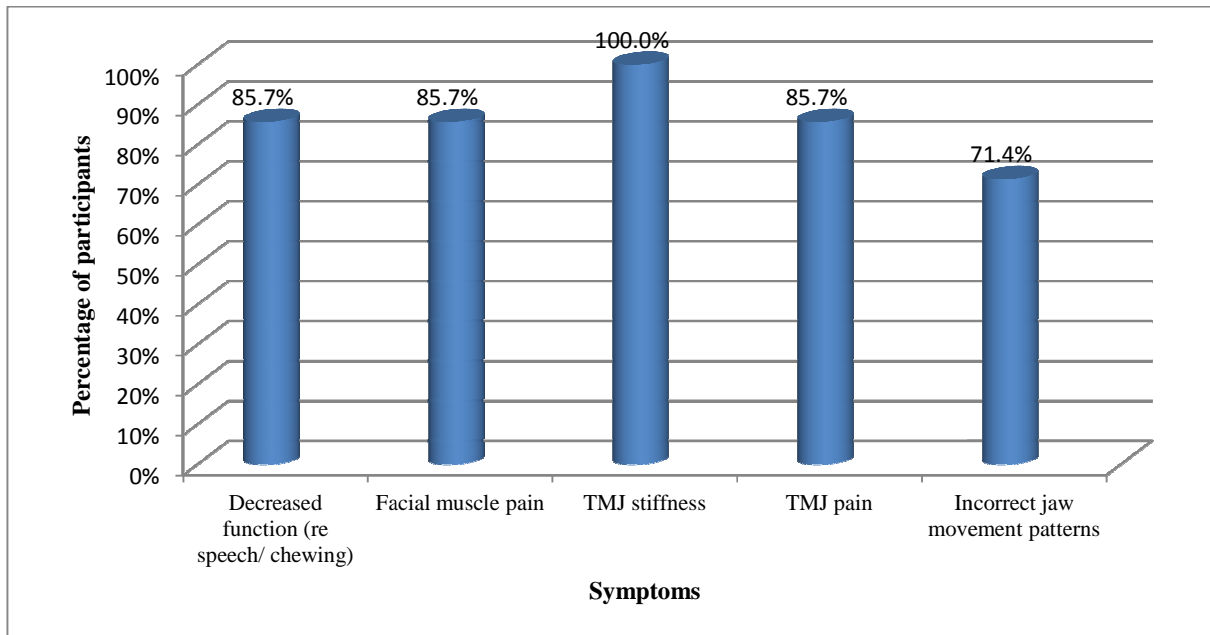
Active jaw exercises were indicated by only a few participants as a treatment intervention, possibly due to differing question interpretation by participants, in spite of the pilot study

## Chapter 4: Results and discussion of needs analysis

being conducted. This suggested that the wording “active jaw exercises” might not have conveyed the correct manner of exercise execution to all participants, as it could be interpreted as exercises done against resistance. It was commented by one of the participants (maxillo-facial surgeon) that active jaw movements, within limits of pain, would without a doubt be required by patients treated by ORIF surgery and closed reduction for mandibular condyle fractures.

Forty two percent of participants felt that passive accessory TMJ mobilisation was adequate and safe to perform day one after ORIF surgery. The results obtained regarding the in-hospital use of passive accessory TMJ mobilisation may indicate that the definition of passive joint mobilisations, included in the question, might not have been apparent enough to convey the exact anatomical joint movement executed by the physiotherapist. The question / statement regarding passive accessory TMJ mobilisation was adjusted during the Delphi questionnaire, by simplifying the definition of passive TMJ mobilisations to accommodate all participants.

**4.4. Symptoms warranting physiotherapeutic intervention, if patients are not routinely seen by a physiotherapist**



**n = 8**

**Graph 4.8. Symptoms warranting physiotherapeutic intervention, if patients are not routinely seen by a physiotherapist.**

The following symptoms were highlighted as requiring physiotherapeutic intervention by participants (Graph 4.8):

1. TMJ joint stiffness (100 %)
2. TMJ pain (85.7 %)
3. Facial muscle pain (85.7 %)
4. A loss of function regarding speech and chewing (85.7 %)
5. Incorrect jaw movements (71.4 %)

The results obtained during the needs analysis regarding symptoms requiring physiotherapeutic intervention indicated that, according to the experts included in this study, physiotherapy has a valuable and important role to play in the treatment of patients who sustained mandibular condyle fractures, treated by either one of the two reduction modalities.

## **5. Conclusion**

It is the opinion of the needs analysis participants that there is a proposed need for physiotherapy intervention for patients who sustained mandibular condyle fractures treated by ORIF surgery or closed reduction.

One limitation of the needs analysis could be the fact that only three (one physiotherapist and two maxillo-facial surgeons) of the eight responding participants had experience in treating this patient population. As this study explored a new avenue for physiotherapy treatment, the low rate of therapists (one out of the six physiotherapists included in this needs analysis) with practical experience in treating mandibular condyle fracture patients was to be expected. Even though all participants did not have practical experience with patients who sustained mandibular condyle fractures, all participants were adequately trained, pre- and post-graduate, to provide valuable expert knowledge and opinions regarding in-hospital physiotherapy treatment for mandibular condyle fracture patients.

Only three (two maxillo-facial surgeons and one physiotherapist) out of eight participants responded to questions pertaining to the percentage of mandibular condyle fracture patients complaining of and experiencing functional loss after ORIF surgery or closed reduction.

In the next chapter the methodology of the Delphi questionnaire, compiled using the information gathered from the needs analysis, available literature and personal communication between maxillo-facial surgeons and the researcher, will be discussed in detail.

# CHAPTER 5

## Methodology: Delphi questionnaire

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In this chapter the study aim, study design, population, inclusion and exclusion criteria for the Delphi questionnaire, ethical considerations, methodology and methodological errors will be described in detail. The formulation of the Delphi questionnaire rounds and informed consent forms, the conduction of the pilot study and data analyses will also be discussed.

### **5.1. Research aim**

The aim of this questionnaire was to determine the possible content of a proposed post-operative physiotherapeutic intervention program for patients who have sustained mandibular condyle fractures, using the Delphi technique. By following the above mentioned steps, a standardised physiotherapeutic intervention programme for patients who sustained mandibular condyle fractures was developed.

### **5.2. Research question**

What is the possible content of a proposed post-operative physiotherapeutic intervention program for patients with mandibular condyle fractures in South Africa?

### **5.3. Study design**

The Delphi questionnaire was formulated utilising the needs analysis results together with additional information obtained from the relevant literature, and from personal communication between the researcher and maxillo-facial surgeons. A Delphi questionnaire is regarded as an effective technique to gather data from experts and to achieve convergence of opinion regarding a new field of physiotherapy treatment (Hsu and Sandford 2007:1).

*“The Delphi method has been identified as being suitable to produce information that is useful for decision making, through a series of questionnaires aimed at experts”* (Rowe 2010:10).

Raine (2006:183) stated that the Delphi technique is an effective research tool, which maintains anonymity of reviewers, and explores expert opinions. It has been well documented that the Delphi technique tends to produce relatively reliable forecasts (Yousuf 2006:10). Tomasik (2010:325) advised that this method of research should be used judiciously and only after careful preparation to produce reliable and valid results.

Members of the Delphi review panel were carefully selected according to the specific inclusion and exclusion criteria regarding the reviewers' field of expertise.

#### **5.4. Sample selection**

##### **5.4.1. Target population**

The Delphi review panel consisted of experts in the maxillo-facial, dentistry and physiotherapy fields in South Africa and abroad.

In South Africa there are 136 maxillo-facial surgeons, 5185 dental surgeons and 1300 physiotherapists [who have completed their post-graduate certificate in Orthopedic Manipulative Physiotherapy (OMPT) registered with the Health Professionals Council of South Africa (HPCSA) in 2012 (<http://www.hpcsa.co.za>). The South African OMPT special interest group was contacted, via their National Executive Committee chairperson, regarding the number of physiotherapists registered with any OMPT specific interest group specialising in the cranio-mandibular field. Currently there is no special interest group for physiotherapists in South Africa specialising in the cranio-mandibular field.

Maxillo-facial surgeons were sourced from academic institutions / hospitals as well as private hospitals providing maxillo-facial surgery services. The researcher telephonically contacted all maxillo-facial surgery private practises who were listed either in the telephone directories or practices which provided their contact details on the internet. All government hospitals currently providing maxillo-facial surgery services were also telephonically contacted. The maxillo-facial surgeons were included if they had completed their specialisation degree in maxillo-facial surgery or a post-graduate qualification in maxillo-facial surgery.

Physiotherapists, included in the Delphi questionnaire rounds, all obtained a Bachelor's degree in Physiotherapy (B. or B.Sc. Physiotherapy), an OMPT post-graduate certificate, with a special interest in the cranio-mandibular field and / or a minimum of two years work experience in the cranio-mandibular field. The OMPT special interest group of the South African Society of Physiotherapy (SASP) was contacted via their website to provide information regarding physiotherapists who have completed their post-graduate certificate in OMPT. Contact details for these possible members of the Delphi review panel were obtained via their private practises, telephone directories, their internet websites or their university affiliation.

The dental surgeons included in the Delphi review panel obtained a Bachelor of Dental Surgery (B.Ch.D.) degree and had at least five years work experience in the dental surgery field. Dental surgeons were sourced from private dental surgery practises. The researcher telephonically contacted five dental surgery private practises per South African province who were listed either in the telephone directories or provided their contact details on the internet. Due to the number of dental surgeons to be included in the Delphi questionnaire according to the ratio, not all South African listed dental surgery practises were contacted. The reason for the inclusion of dental surgeons was that many post-surgery patients complain to their dentist regarding continuing trismus, as they struggle to get an appointment with their surgeon, or their surgeon's practise is located in another town which makes an appointment difficult. Dental surgeons are also currently the health professionals referring most patients with TMJ disorders, resulting from trauma, to physiotherapists and maxillo-facial surgeons (Langendoen *et al.*, 1997:191).

International maxillo-facial surgeons and dental surgeons were included if they had obtained their respected degrees, with the dental surgeons having had a minimum of five years working experience in the dental surgery field. International physiotherapists were required to have obtained their physiotherapy degree provided in their country, with a special interest in cranio-mandibular disorders or who were affiliated with a cranio-mandibular special interest group, and / or had a minimum of two years working experience in the cranio-mandibular field.

References for international physiotherapists, with a special interest in cranio-mandibular disorders, international dental surgeons and international maxillo-facial surgeons were obtained by the researcher using electronic telephone directories and information posted on their respected websites. International physiotherapy special interest groups focusing on cranio-mandibular disorders were contacted electronically to obtain references for appropriate candidates. Possible candidates for inclusion in the Delphi review panel were contacted by the researcher and requested to supply a short curriculum vitae. The curricula vitae obtained from the candidates were reviewed and candidates satisfying the inclusion criteria were approached to participate on the Delphi review panel.

The ratio of South African: international reviewers were aimed to be 2:1. As the research regarding post-surgical exercise therapy is more advanced abroad, the researcher deemed it necessary to include international reviewers. More South African experts were recruited as the study aimed at promoting awareness of a new physiotherapy field in South Africa, and focused on the South African environment and patients.

#### **5.4.2. Inclusion and Exclusion criteria**

The Delphi review panel consisted of maxillo-facial surgeons, dental surgeons and physiotherapists practising in South Africa and abroad.

Physiotherapists all obtained a Bachelor's degree in Physiotherapy (B.Sc. or B. in Physiotherapy), an OMPT post-graduate certificate, had a special interest in the cranio-mandibular field, and a minimum of two years work experience in the cranio-mandibular field. The cranio-mandibular field describes physiotherapists working with "*different musculoskeletal conditions that involve the masticatory muscles, the temporomandibular joints and the associated structures*" (Mobilio and Catapano 2010:1).

The maxillo-facial surgeons were included if they obtained their specialisation degree in maxillo-facial surgery or a post-graduate qualification in maxillo-facial surgery.

The dental surgeons obtained a Bachelor of Dental Surgery (B.Ch.D.) degree and had a minimum of five years work experience in the dental surgery field.

The researcher opted to include a total of 20 members for the Delphi review panel, based on previous Delphi review sample sizes, and decided on a ratio of 2:1:2 (surgeons: dental surgeons: physiotherapists). As maxillo-facial surgeons and physiotherapists are the main professionals dealing with mandibular condyle fracture patients, their ratio was higher. In total 42 recruitment letters (Addendum F) were electronically sent out to candidates satisfying the inclusion criteria.

The Delphi questionnaire was sent using an online research tool, SurveyMonkey™. Reviewers were excluded if they did not have regular internet or facsimile access, as this was the distribution choice for the questionnaires. During round one of the questionnaire participants had the option of either completing the questionnaire online, or print a copy and return it to the researcher via facsimile. Both options were available during the first questionnaire round, thereafter participants would continue with the option they chose during the first round.

As this study included national and international reviewers, English was the chosen language for the data forms as well as the informed consent forms.

### **5.4.3. Sample size and selection**

The Delphi review panel included South African and international maxillo-facial surgeons, dental surgeons and physiotherapists. The researcher aimed to obtain a ratio of 2:1:2 (surgeons: dental surgeons: physiotherapists), with an optimal total of 20 reviewers, based on previous Delphi review sample sizes. In a homogeneous group, a smaller sample size (10 to 15 people) may yield sufficient results according to Skulmoski, Hartman, and Krahn (2007:10). In previous physiotherapy studies, using the Delphi technique, the sample sizes ranged from 12 to 25 with an average of 16 participants between the four studies (Dorey 2000:413; Barker and Burns 2001:289; Opie and Taylor 2008:292; Carnes, Mullinger and Underwood 2010:2). As most of the above-mentioned studies had more than one researcher,

it was deemed acceptable for the study to have 20 members on the Delphi review panel, generating enough input as well as adequate provision for possible reviewer drop-out. Of the 20 members on the review panel it was deemed satisfactory for seven to be international experts, satisfying the 1:2 ratio between national and international members.

As this study explored a relatively new area for physiotherapy research, a convenience sampling method was used to select appropriately trained members of the Delphi review panel. The researcher reviewed the curricula vitae of all participants and identified candidates meeting the inclusion and exclusion criteria for participation in the Delphi review panel. A list containing their name, contact information as well as reason for their consideration for study participation, was compiled by the researcher. A recruitment letter (Addendum F), informed consent form (Addendum G) and instruction leaflet (Addendum H) was compiled by the researcher following the ethical guidelines provided by the Ethics Committee of the Faculty of Health Sciences at the University of the Free State (<http://www.health.ufs.ac.za>). Possible Delphi review panel members were contacted telephonically or via e-mail and all received the compiled recruitment letter (Addendum F), instruction leaflet (Addendum H) and an informed consent form (Addendum G) for possible study participation.

Members of the Delphi review panel willing to participate in the study were asked to acknowledge receipt of the recruitment letter as well as to give informed consent for participation. Informed consent was obtained by reviewers completing and returning the consent form to the researcher via either e-mail or facsimile (Addendum G). The return of informed consent from participants tends to take approximately two to three weeks according to Hung, Altschuld and Lee (2008:192). The recruitment letter and informed consent form was sent out to 42 possible review panel members with a two week time limit for the return of completed informed consent forms. After one week a reminder was electronically sent out to all possible review panel members who have not responded. The time-limit of two weeks for return of completed informed consent forms had to be extended to three weeks, as only 15 possible review panel members had replied after two weeks. After three weeks, 21 possible review panel members had returned completed informed consent forms. The 20 members of the review panel who provided informed consent, and satisfied the ratios set by the researcher regarding profession and South African or international practise, were included in the Delphi review panel.

The Delphi round one review panel consisted of eight physiotherapists, eight maxillo-facial surgeons and four dental surgeons. Of these 20 members of the Delphi review panel it was deemed acceptable for seven to be international experts, satisfying the 1:2 ratio. The researcher thought it to be optimal to have three international physiotherapists, three international maxillo-facial surgeons and one international dentist on the Delphi review panel. Unfortunately only two international physiotherapists and two international maxillo-facial surgeons complied with the time limit set for the return of the completed informed consent forms. Therefore, only two international physiotherapists and two international maxillo-facial surgeons could be included in the Delphi questionnaire. Two international dental surgeons complied with the timely return of the completed informed consent forms, and were both included in the study.

International review panel members completing round one of the Delphi questionnaire consisted of one physiotherapist, one maxillo-facial surgeon and two dental surgeons, out of 16 respondents, not entirely satisfying the optimal ratio. The four international members of the Delphi review panel completed all three Delphi questionnaire rounds, resulting in one maxillo-facial surgeon, two dental surgeons and one physiotherapist, out of the 12 reviewers completing the third and final Delphi questionnaire round. Though the ratio regarding the various professions was not met during round one of the Delphi questionnaire, due to many international reviewers contacted not supplying informed consent, the aim of the study could still be achieved even though there was less international input, as this was a study aimed specifically at a South African population. However, during the third and final Delphi questionnaire round the international: national ratio of 1:2 was met, resulting in sufficient international input received from reviewers.

### **5.5. Ethical considerations**

The study was approved by the Ethics Committee of the Faculty of Health Sciences of the University of the Free State (ECUFS NR: 05/2012) (Addendum E). After ethical approval was obtained, an amendment was made to the approved study protocol (Addendum B). The amendment made was regarding the increase in the size of the Delphi review panel. The amendment, together with justification as to why the amendment was required, was submitted

and approved by the Ethics Committee. The study was meticulously conducted in line with the approved protocol.

Information regarding the study was included in English, the language of choice during the conduction of this study. English was the language of choice as some of the experts contacted to serve on the Delphi review panel were from abroad, making English the language all reviewers were fluent in.

As no clinical tests or treatments were performed, there existed no harm or risk for any study participants.

Participants were informed that a possible outcome of the study could be that the study will be published in an accredited journal, and that every care will be taken for the Delphi reviewers to remain anonymous.

It was explained to members of the Delphi review panel that participation in the study was voluntary, that they may withdraw from the study during any stage, and that there would be no negative consequences should they do so. No remuneration would be provided for study participation.

The first stage of the Delphi questionnaire included a recruitment letter in order for review panel members to make an informed choice regarding study participation (Addendum F). The recruitment letter also provided information for reviewers explaining exactly what would be expected of them during each questionnaire stage. The approximate time frame for completion of the study was also indicated to participants. A copy of the informed consent form was sent to each of the review panel members (Addendum G). By completing and returning the informed consent form or an electronic letter of acceptance to the researcher, the reviewers were giving consent. The signed informed consent documents or acceptance letters were kept by the researcher for record keeping purposes.

The Delphi questionnaire format was characterised by strict anonymity of all members serving on the review panel. Anonymity and confidentiality was ensured during each stage of

the research, and no personally identifiable information was gathered or distributed to fellow reviewers. Participants remained anonymous to each other. When online questionnaire links were e-mailed, each member of the Delphi review panel was e-mailed separately, ensuring anonymity. As the online research tool used during the conduction of the study, SurveyMonkey™, logs reviewer responses, the researcher could track the reviewer response rates. This was in strict confidentiality between the researcher and the reviewer. This also allowed the researcher to send individual reminders, one week before the two week completion deadline, to only those reviewers who had not completed the questionnaire. This avoided the unnecessary sending of completion reminders to the compliant reviewers.

Participants partaking in the study would have access to the final results of the study, in the form of a written document, without compromising anonymity.

#### **5.6. Formulation of the recruitment letter**

The recruitment letter (Addendum F) was formulated by extracting relevant literature from the literature review, as stipulated in chapter 2. This contained the rationale for the study, research aims, population to be included in the study, the method of research conduction, duration of the Delphi study, contact details of the researcher for any queries or to request a copy of the protocol, as well as supporting literature for the conduction of the study.

#### **5.7. Formulation of the informed consent form**

The Ethics Committee of the Faculty of Health Sciences at the University of the Free State was consulted regarding the necessary information required for inclusion in an informed consent form when research is being conducted (<http://www.health.ufs.ac.za>). The ethical considerations were clearly indicated in the informed consent form (Addendum G). This included the fact that participation in the study was voluntary, and that by completing and returning a signed informed consent form or a letter agreeing participation, the participants were voluntarily agreeing to participate in this research study.

It was made clear that participants would remain anonymous towards each other. Participants' data would be treated confidentially at all times. Absolute confidentiality could

not be guaranteed due to the fact that personal information may be disclosed if required by law. Participants may withdraw from the study at any given moment during the completion of the questionnaire, no remuneration would be provided for study participation, no costs would be incurred by participants, and as there were no treatments applied, there were no risks to participants.

The permission obtained from the Ethics Committee at the Faculty of Health Sciences of the University of the Free State, together with the Ethics Committee's contact details, were also included in the informed consent form.

Attached to the informed consent form was the review member's information and permission form. This was completed and returned to the researcher if the reviewer gave consent to participate in the research study. Reviewers were required to provide their title, full names and surname, contact number, facsimile number, e-mail address and signature. The researcher's contact details were once again provided.

### **5.8. Formulation of the instruction leaflet**

Once informed consent for study participation was obtained from all the members of the Delphi review panel, reviewers all received an electronically sent instruction leaflet.

The instruction leaflet contained information regarding the completion of the Delphi questionnaire rounds (Addendum H).

Participants were given the choice of working online and submit their opinions directly by entering the submit button, or print the online questionnaire and fax the completed copy to the researcher. Both options were available during the first round, thereafter participants continued with the option that they chose during the first round. Each questionnaire was estimated to take no more than 25 - 30 minutes.

Three rounds were foreseen during the Delphi questionnaire in order to obtain the most accurate and safe functional exercises and dosages for compiling an intervention protocol for patients with mandibular condyle fractures in South Africa.

Details regarding the content and structure of the first round of the Delphi questionnaire were clearly described. Questions / statements with possible options, regarding physiotherapy intervention and a proposed intervention program for post-surgical mandibular condyle fracture patients were included in the questionnaire. Participants had to indicate which option suited their opinion the best. Participants were also allowed to comment in allocated blocks below each question / statement.

After each round a summary of the questions where 80 % consensus was reached, was drafted and electronically sent to the review panel (Addenda J, L and N). These options were excluded from the questionnaire for the following round. Any new relevant options noted under “comments” were added to the questionnaire for the following round.

The following rounds of the questionnaire consisted of questions not reaching consensus and comments made on each of the questions / statements. This process was followed until 80 % consensus was reached on the questions / statements, or stability was reached. Stability was reached when the statements, still not achieving consensus, were receiving no new comments from reviewers indicating that a saturation point has been reached.

Once again the researcher’s contact details were included if more information was required by any of the Delphi review panel members.

### **5.9. Formulation of the Delphi questionnaire**

The first Delphi questionnaire round was structured to obtain reviewers’ expert opinion regarding physiotherapeutic interventions which should be included in a proposed physiotherapeutic intervention program for patients who sustained mandibular condyle fractures.

Demographical information was also obtained from reviewers to acquire the study population. It was decided by the researcher and the research supervisors to include demographical information, as the Delphi review panel did not consist of the same participants as the needs analysis. Also included were questions regarding reviewers’ current involvement in the treatment of mandibular condyle fracture patients, treatment techniques reviewers would use or are using for treating patients with mandibular condyle fractures, and the percentages of their patients reporting any functional loss. Due to the lack of needs

## Chapter 5: Methodology: Delphi questionnaire

analysis responses regarding certain practical aspects relating to the treatment of mandibular condyle fracture patients, some questions were repeated in the Delphi questionnaire. This was done to obtain more accurate data pertaining to the treatment techniques utilised by reviewers and patients reporting functional loss.

The data obtained from the needs analysis participants regarding pre-cautionary measures and duration of pre-cautionary measures, were listed for members of the Delphi review panel to select from as multiple choice questions (Addendum I).

Due to the identified need for physiotherapy intervention, questions 17 to 61 of the Delphi questionnaire were formulated using current literature as well as personal communication between the researcher and maxillo-facial surgeons. Questions 17 to 61 addressed the physiotherapeutic interventions required by in-hospital mandibular condyle fracture patients, an aspect not covered by the needs analysis study. The needs analysis was used to consult experts in the maxillo-facial surgery and physiotherapeutic (specialising in cranio-mandibular disorders) fields to identify if there is a need for physiotherapy intervention for patients who sustained mandibular condyle fractures, questions regarding specific physiotherapeutic exercises and exercise dosages, were not included.

After completion of the needs analysis questionnaire by participants, the results were analysed by the researcher and the first round of the Delphi questionnaire was compiled. The questionnaire was divided into two sections: demographical information and the second, proposed physiotherapeutic management of mandibular condyle fracture patients. The researcher, in co-operation with the research supervisors, came to a decision that the incidence of complications following mandibular condyle fractures, treated by ORIF surgery or closed reduction would also be included in the first round of the Delphi questionnaire. This was done to attain more input from reviewers regarding patients with mandibular condyle fractures, as only a few needs analysis participants had practical experience treating patients with mandibular condyle fractures. Information regarding the incidence of mandibular complications was only included during the first round of the Delphi questionnaire due to the fact that no consensus was needed for statistical purposes.

Various treatment techniques cited in the available literature, but not noted by needs analysis participants, were also added to the physiotherapy treatment options for the Delphi questionnaire as participants might not have had extensive clinical experience in the field. These techniques included jaw muscle stretches (Hwang *et al.*, 2002; Hwang *et al.*, 2005; Feng *et al.*, 2009) and lateral and anterior mandibular movements (Thiele and Marcoot 1985; Hwang *et al.*, 2002; Hwang *et al.*, 2005; Feng *et al.*, 2009). The studies conducted by Thiele and Marcoot (1985) and Rikhotso and Ferretti (2008) also described active jaw movements done in front of a mirror with light handed pressure guiding the correct mandibular movements. A study conducted by Bevilaqua-Grosso *et al.* (2002) also indicate electrotherapy modalities, jaw muscle strengthening exercises and massage therapy as treatment modalities for mandibular condyle fractures.

Questions were formulated using wording cautiously and conducting a pilot study to minimise misinterpretation of questions. Piloting of each Delphi questionnaire round was done by two experts in the field, one physiotherapist and one maxillo-facial surgeon, to ensure unbiased and unambiguous questions.

As the Delphi questionnaire review panel included physiotherapists, maxillo-facial surgeons and dental surgeons, some of the physiotherapeutic terminology might not have been clear to all reviewers. Therefore, acronyms were included for specific physiotherapeutic terminology which maxilla-facial and dental surgeons might not have been familiar with. All participants were requested to answer questions regarding pre-cautionary measures to be considered when treating a mandibular condyle fracture patient, after either ORIF surgery or closed reduction, irrespective if they were currently treating this patient population or not. The input collected regarding possible pre-cautionary measures would produce a variety of practical as well as theoretical insights.

The section regarding exercises and exercise dosages included questions regarding what each exercise or movement encompassed. By obtaining consensus regarding the execution of exercises and movements the researcher aimed at ensuring that all review panel members were in agreement and no ambiguity existed regarding the execution of exercises and movement.

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In Table 5.1 the formulation of the first round of the Delphi questionnaire is illustrated. See addendum I for the Delphi questionnaire.

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
Section A: Demographics	Profession	1	Researcher
	Years of practise	2	Researcher
	Gender	3	Researcher
	Working environment	4	Researcher
Section B: Expert input	Number of reviewers currently treating mandibular condyle fracture patients in-hospital, as well as out of hospital	5; 6	Researcher
	Treatment modalities currently administered by reviewers currently treating mandibular condyle fracture patients	7	Researcher
	Treatment modalities considered by reviewers not treating mandibular condyle fracture patients	8	Researcher
	Percentage of patients reporting functional loss in hospital as well as on out-patient follow-up, following ORIF surgery	9; 11	Maxillo-facial surgeons; Researcher

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Percentage of patients reporting functional loss in hospital as well as on out-patient follow-up, following closed reduction	10; 12	Maxillo-facial surgeons; Researcher
	Pre-cautionary measures to be considered when treating a mandibular condyle fracture patient, day one after ORIF surgery or closed reduction	13; 15	Needs analysis
	Duration of pre-cautionary measures for patients who underwent ORIF surgery or closed reduction	14; 16	Needs analysis
	The need for all mandibular condyle fracture patients to receive physiotherapy intervention as a preventative measure	17	Maxillo-facial surgeons; Needs analysis

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Participants' view of when a physiotherapist should evaluate and start treatment of mandibular condyle fracture patients treated with ORIF surgery or closed reduction	18; 19	Maxillo-facial surgeons; Needs analysis; Brukner and Khan (2002); Hwang <i>et al.</i> (2002); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)
	The number of physiotherapy visits deemed acceptable for mandibular fracture patients, undergoing ORIF surgery or closed reduction	20; 21	Maxillo-facial surgeons; Needs analysis
	Professional responsible for administration and evaluating progression of post-surgical exercise regimes and advice	22	Maxillo-facial surgeons; Researcher; Trott (2011)

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Advice, exercises and other physiotherapy techniques to be included in an in-hospital intervention program	23; 24; 26; 28; 30; 34; 36; 38	Needs analysis; Maxillo-facial surgeons; Rocabado (1983); Thiele and Marcoot (1985); Morrone and Makofsky (1991); Worsaae and Thirn (1994); Bevilaqua-Grosso <i>et al.</i> (2002); Nicolakis <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Zachariades <i>et al.</i> (2006); Buescher (2007); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)
	Time frame for post-surgical and postural advice to be given to the patient	25; 39	Maxillo-facial surgeons; Thiele and Marcoot (1985); Morrone and Makofsky (1991); Bevilaqua-Grosso <i>et al.</i> (2002); Trott (2011)
	Commencement of exercises and stretches	27; 29; 31	Maxillo-facial surgeons; Thiele and Marcoot (1985); Worsaae and Thirn (1994); Bevilaqua-Grosso <i>et al.</i> (2002); Hwang <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)
	Commencement of massaging of the facial muscles	35	Maxillo-facial surgeons; Bevilaqua-Grosso <i>et al.</i> (2002)
	Commencement of temporomandibular joint passive mobilisations	37	Maxillo-facial surgeons; Hwang <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Trott (2011)

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Jaw exercises to be done in front of a mirror to prevent incorrect mandibular deviation	32	Maxillo-facial surgeons; Thiele and Marcoot (1985); Morrone and Makofsky (1991); Hwang <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Zachariades <i>et al.</i> (2006); Rikhotso and Ferretti (2008); Trott (2011)
	Jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation	33	Maxillo-facial surgeons; Rocabado (1983); Thiele and Marcoot (1985); Morrone and Makofsky (1991); Nicolakis <i>et al.</i> (2002); Trott (2011)
	Duration of an isometric masticatory muscle contraction	40	Rocabado (1983); Thiele and Marcoot (1985); Morrone and Makofsky (1991); Trott (2011)
	Duration of a jaw muscle stretch	57	Thiele and Marcoot (1985); Morrone and Makofsky (1991)
	Definitions of active jaw exercises	44; 48; 52; 56	Morrone and Makofsky (1991); Levangie and Norkin (2001); Hwang <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Feng <i>et al.</i> (2009); Trott (2011)
	Number of repetitions of each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretch to be done in one set	41; 45; 49; 53; 58	Researcher; Rocabado (1983); Morrone and Makofsky (1991); Trott (2011)

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Number of set repetitions for each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretches to be done	42; 46; 50; 54; 59	Researcher; Rocabado (1983); Morrone and Makofsky (1991)
	Number of daily sets of repetitions for each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretches to be done	43; 47; 51; 55; 60	Researcher; Rocabado (1983); Morrone and Makofsky (1991); Trott (2011)
	Application of ice to surgical area directly after surgery	61	Needs analysis; Maxillo-facial surgeons; Dijkstra (1996)

**Table 5.1. Formulation of Delphi questionnaire: Round 1.**

### **5.10. Pilot study**

The face validity of the study was facilitated by piloting the Delphi questionnaire before distribution to the members of the Delphi review panel. This was done to ensure that the questions were comprehensible, unbiased and that the questionnaire was well-structured (Joubert *et al.*, 2008:52). Piloting was done by two experts in the field, one physiotherapist and one maxillo-facial surgeon, to ensure that the study objectives were met by the set questions.

The Delphi round one questionnaire pilot study, together with the recruitment letter, informed consent form and instruction leaflet were sent electronically to the two pilot study

participants on the 19<sup>th</sup> of March 2012. Pilot study participants received two weeks to complete the questionnaire, with a reminder being sent on the 26<sup>th</sup> of March 2012 if participants had not returned the questionnaire. However, both pilot study participants returned the questionnaire by the 22<sup>nd</sup> of March 2012. After completion of the pilot study it was requested, by the biostatistician, to clarify two physiotherapeutic intervention terms. Classifications of the two physiotherapeutic intervention terms: “passive temporomandibular joint mobilisations” (joint mobilisation done by the therapist) and “isometric muscle contraction” (muscle contraction without movement) were included in the questions. This was done to clarify the exact meaning of each of these terms to all reviewers. The only other amendments which were made, were spelling errors.

The Delphi round one questionnaire was also sent to a biostatistician for assessment of the questionnaire and correction of any errors before being sent to members of the Delphi review panel. Included were also an electronic copy of the recruitment letter, informed consent form and instruction leaflet. The Delphi round one questionnaire was sent to the biostatistician on the 19<sup>th</sup> of March 2012. The biostatistician was also given a two week deadline for the return of the questionnaire and accompanying corrections. The biostatistician returned the questionnaire, together with corrections, to the researcher on the 21<sup>st</sup> of March 2012. The corrections made by the biostatistician consisted of question sequencing and correction of spelling errors.

All suggested amendments by the biostatistician and pilot study participants were complied to by the researcher.

### **5.11. Method of data collection**

The data required were obtained from the Delphi questionnaire, completed by the selected group of reviewers. Members of the Delphi review panel should be able to offer an informed opinion regarding the subject and be committed to the group process according to Hung *et al.* (2008:192).

### **5.11.1. Delphi questionnaire: Round 1**

Reviewers complying with the inclusion and exclusion criteria, discussed previously in this chapter, were contacted telephonically or via e-mail by the researcher. If reviewers were unable to participate in the study, the reviewer nominated another suitable candidate for possible inclusion.

All reviewers received the electronic link to the online questionnaire, a recruitment letter (Addendum F), informed consent form, (Addendum G) and instruction leaflet (Addendum H). The recruitment letter included the researchers contact information if reviewers had any queries or would have liked to return the completed questionnaire by means other than online completion. The recruitment letter also contained a short literature review regarding the study, the study aim and rationale, information regarding questionnaire completion as well as ethical considerations. The time limit for questionnaire completion was clearly indicated on the recruitment letter. It was made clear to participants that by completing and submitting the informed consent form or an electronic letter of acceptance, the reviewer was giving consent. The signed informed consent documents or acceptance letters were kept by the researcher for record keeping purposes.

An instruction leaflet was sent electronically to each Delphi review panel member, ensuring that reviewers understood what was expected of them for the duration of the study (Addendum H). The instruction leaflet contained the following information:

- Instructions regarding completion of the questionnaire.
- Methods of returning the completed questionnaire.
- Time limits set for questionnaire completion.
- The composition of subsequent rounds.
- The inclusion of reviewer comments as well as the reporting, per questionnaire round, of questions achieving consensus.

The instruction leaflet was compiled to minimise incorrect completion and return of questionnaires, and ensuring a thorough understanding of the Delphi questionnaire method to decrease reviewer drop-out.

The Delphi questionnaires were electronically sent using SurveyMonkey™, an online research tool, to the 20 members of the Delphi review panel (Table 5.2). The researcher, as a registered post-graduate student at the University of the Free State, acquired free access to SurveyMonkey™. By using SurveyMonkey™ the researcher was able to compile the questionnaire, make amendments to the questionnaire, distribute it to the target population, track responses, send reminders to non-responders as well as analyse the results. Participant confidentiality was ensured at all times when using SurveyMonkey™, as all participants received an individual e-mail not indicating the full e-mail recipient list.

Time limits were set for completion of the Delphi questionnaire rounds. After two weeks upon receiving the online link, a follow-up reminder was sent to non-responding reviewers to encourage reviewers to comply (Table 5.2). This was done one week prior to the deadline for the Delphi round one questionnaire completion. The online questionnaire, “Delphi questionnaire to determine physiotherapy intervention for mandibular condyle fractures” was sent out on the 26<sup>th</sup> of March 2012 (Addendum I). A completion deadline was set for the 13<sup>th</sup> of April 2012, 17 days after the questionnaire was sent to the review panel, to accommodate the public holidays during the first week of April 2012. A reminder, one week prior to the completion deadline was also sent via e-mail to all reviewers on the second of April 2012. Hung *et al.*'s (2008:193) study advocated that an inter-round interval should be no more than three to four weeks to ensure the maintenance of reviewer enthusiasm.

A Delphi review panel member was excluded from subsequent Delphi questionnaire rounds if he / she failed to respond within the two-week time frame, for completion of the Delphi questionnaire. Of the 20 Delphi review panel members a total of 16 reviewers completed round one of the Delphi questionnaire by the cut off date, 13<sup>th</sup> of April 2012.

Response rates from members of the Delphi review panel were a potential source of bias, as the original sample size could decrease due to reviewer drop-out. . As the Delphi questionnaire consisted of various questionnaire rounds, the researcher acknowledged the different rounds when choosing the sample size. Non-responder rates were included when choosing the sample size, as a too large number of non-responders could result in misleading results (Kelley *et al.*, 2003:264). As stated previously, the Delphi study consisted of 20 members of the Delphi review panel, to generate sufficient input and to provide for reviewer

drop-out, while maintaining reliability. A drop-out resulting in 12 Delphi reviewers who completed the study would still deliver reliable and accurate results. Participation-out was prevented by contacting reviewers personally either telephonically or via e-mail as well as by sending weekly reminders encouraging non-responders to complete the Delphi questionnaire rounds within the required time frame. Kelley *et al.* (2003:264) stated that participants who are recruited personally tend to have a higher response rate.

Another cause for bias could be that there was a decrease in only a certain group of reviewers, resulting in the sample size not equally representing all professions as included in the original sample size. Thus, a conscious effort was made by the researcher to ensure the maintenance of all of the reviewers' interest and to diminish reviewer drop-out.

The online questionnaires were anonymous to fellow reviewers, but not to the researcher. This was in strict confidentiality between the researcher and the reviewer. A member of the Delphi review panel would be removed from subsequent questionnaire rounds if he / she did not respond within the time limit of two weeks for questionnaire completion.

The researcher analysed and processed the data after each Delphi questionnaire round. If consensus had not been reached by the reviewers on all questions, information was extracted from the questionnaire responses and fed back to the reviewers for consideration and further deliberation during the second round. Any relevant comments or questions logged by reviewers during a questionnaire round, was also incorporated into the next rounds' question formulation. The researcher drafted a report detailing the questions which achieved consensus during round one which was electronically sent to all reviewers before commencement of the second round of the Delphi questionnaire (Addendum J).

Consensus was defined as 80 % agreement between participants regarding a question's answer. Hung *et al.* (2008:193) states that various authors define their own acceptable consensus percentage, ranging from as low as 51 % up to 80 %. For this study 80 % was regarded as consensus being reached.

### **5.11.2. Delphi questionnaire: Round 2**

As illustrated in Table 5.2, the second round of the Delphi questionnaire was sent to the 16 complying Delphi review panel members on the 23<sup>rd</sup> of April 2012 (Addendum K). The two week deadline for completion of round two of the Delphi questionnaire was set for the 7<sup>th</sup> of May 2012. A reminder, one week prior to the completion deadline was also sent via e-mail to all reviewers on the 30<sup>th</sup> of April 2012 (Table 5.2). A total of 14 members of the Delphi review panel completed the second round of the Delphi questionnaire by the cut-off date, resulting in a reviewer drop-out of two. After completion of round two of the Delphi questionnaire, a report detailing the questions achieving consensus was again drafted by the researcher and sent electronically to the 14 complying reviewers (Addendum L).

### **5.11.3. Delphi questionnaire: Round 3**

The third and final Delphi questionnaire round was compiled by the researcher, with amendments made according to reviewer comments (Addendum M). The third questionnaire round was sent electronically to the 14 complying members of the Delphi review panel on the 14<sup>th</sup> of May 2012 (Table 5.2). The two week deadline for questionnaire completion was set for the 28<sup>th</sup> of May 2012. A reminder, one week prior to questionnaire completion deadline, was sent electronically to non-responders on the 21<sup>st</sup> of May 2012 (Table 5.2).

By the 28<sup>th</sup> of May 2012 twelve members of the Delphi review panel submitted their completed third round questionnaires. Questions reaching consensus during the third and final questionnaire round, was again drafted by the researcher and sent electronically to all members of the review panel (Addendum N).

A drop-out of two reviewers occurred during round two and round three, with a total of eight reviewers dropping out of the Delphi study during the duration of the study.

All correspondence with members of the review panel including the distribution, collection and reporting of questionnaire rounds was solely done by the researcher. Data analyses and compiling of subsequent questionnaire rounds was also done by the researcher, with the research supervisors confirming results obtained.

After the third round, if consensus had not been reached on all questions, the stability of the questions not reaching consensus was evaluated. A measurement of the stability of participants' responses, for the questions not reaching consensus, was done by the researcher (Hsu and Sandford 2007:4). Stability was reached when the questions / statements, still not achieving consensus, received no new comments from reviewers indicating that a saturation point had been reached. Questions / statements not achieving 80 % consensus will be discussed in chapters 6 and 7.

	<b>Delphi round 1</b>	<b>Delphi round 2</b>	<b>Delphi round 3</b>
<b>Date questionnaire was sent to reviewers</b>	26/ 3/ 12	23/ 4/ 12	14/ 5/ 12
<b>Date reminders were sent to reviewers</b>	2/ 4/ 12	30/ 4/ 12	21/ 5/ 12
<b>Cut-off date for reviewer responses</b>	13/ 4/ 12	7/ 5/ 12	28/ 5/ 12
<b>Number of reviewers responded</b>	16	14	12
<b>Number of reviewer drop-out</b>	4	2	2

**Table 5.2. Summary of the procedure of Delphi questionnaire rounds**

### **5.12. Analyses**

SurveyMonkey™, the online research tool used to conduct this study, reported all results as a percentage. For each question the number of reviewers answering the question, the number of reviewers who omitted the question, as well as any comments made by reviewers regarding the relevant question was indicated. The data obtained by the three Delphi questionnaire rounds was analysed by the researcher, in conjunction with the research supervisors who were responsible for verifying data analyses. As the Delphi method is concerned with achieving inter-reviewer consensus per question, illustrated as a percentage, the results could be analysed with ease by the researcher. No assistance from a biostatistician was required.

In Tables 5.3 and 5.4 the formulation of subsequent Delphi questionnaire rounds two and three, following previous questionnaire round result, are illustrated.

<u>Conceptualisation</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
Expert input	Pre-cautionary measures to be considered when treating a mandibular condyle fracture patient, day one after ORIF surgery or closed reduction	1; 3	Delphi questionnaire round 1; Reviewer comments
	Duration of pre-cautionary measures for patients who underwent ORIF surgery or closed reduction	2; 4	Delphi questionnaire round 1; Reviewer comments
	Participants' view of when a physiotherapist should evaluate and start treatment of mandibular condyle fracture patients treated with ORIF surgery or closed reduction	5; 6	Delphi questionnaire round 1; Reviewer comments

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	When should post-surgical and postural advice be given to the patient	7	Delphi questionnaire round 1; Reviewer comments
	Only answered by maxillo-facial surgeons and dentists: Safety regarding the commencement of active jaw exercises and isometric jaw muscle contractions, intra- and extracapsular mandibular condyle fractures, treated by closed reduction	8; 9	Reviewer comments
	The number of physiotherapy visits deemed acceptable for mandibular fracture patients, undergoing ORIF surgery or closed reduction	10; 11	Delphi round 1 questionnaire, Reviewer comments
	In-hospital physiotherapy visits should consist of passive TMJ mobilisations	45	Delphi round 1 questionnaire, Reviewer comments

<u>Conceptualisastion</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Definition of active jaw opening exercise	12	Delphi questionnaire round 1; Reviewer comments
	Commencement of exercises and stretches	13; 14; 23	Delphi questionnaire round 1; Reviewer comments
	Commencement of massage/ electro-massage of the facial muscles	26	Delphi questionnaire round 1
	Commencement of temporomandibular joint passive mobilisations	46	Delphi questionnaire round 1; Reviewer comments
	Duration of an isometric masticatory muscle contraction	47; 48	Delphi questionnaire round 1
	Duration of a jaw muscle stretch	15; 16	Delphi questionnaire round 1
	Jaw exercises to be done in front of a mirror to prevent incorrect mandibular deviation	24	Delphi questionnaire round 1; Reviewer comments
	Jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation	25	Delphi questionnaire round 1; Reviewer comments

<u>Conceptualisastion</u>		<u>Operationalisation</u>	<u>Source</u>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Number of repetitions of each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretch to be done in one set	17; 18; 27; 28; 33; 34; 39; 40; 49; 50	Delphi questionnaire round 1; Reviewer comments
	Number of set repetitions for each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretch to be done	19; 20; 29; 30; 35; 36; 41; 42; 51; 52	Delphi questionnaire round 1; Reviewer comments
	Number of daily set repetitions for each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretch to be done	21; 22; 31; 32; 37; 38; 43; 44; 53; 54	Delphi questionnaire round 1; Reviewer comments

**Table 5.3. Formulation of Delphi questionnaire: Round 2.**

See addendum K for Delphi questionnaire, round 2.

<b><u>Conceptualisastion</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
Expert input	Pre-cautionary measures to be considered when treating a mandibular condyle fracture patient, day one after ORIF surgery	1	Delphi questionnaire round 1, 2
	Pre-cautionary measures to be considered when treating a mandibular condyle fracture patient, after closed reduction with or without intermaxillary fixation still in-situ	3; 4	Delphi questionnaire round 1, 2; Reviewer comment
	Duration of pre-cautionary measures for patients who underwent ORIF surgery or closed reduction	2; 6	Delphi questionnaire round 1, 2

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Participants' view of when a physiotherapist should evaluate and start treatment of mandibular condyle fracture patients treated with ORIF surgery or closed reduction	6; 8	Delphi questionnaire round 1, 2; Reviewer comments
	Time frame for post-surgical and postural advice to be given to the patient	7	Delphi questionnaire round 1, 2; Reviewer comments
	Only answered by maxillo-facial surgeons and dentists: Safety regarding the commencement of active jaw exercises and isometric jaw muscle contractions for extracapsular mandibular condyle fractures, treated by closed reduction	9	Delphi questionnaire round 2

<b><u>Conceptualisation</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	The number of physiotherapy visits deemed acceptable for mandibular fracture patients, undergoing ORIF surgery or closed reduction	10; 11	Delphi questionnaire round 1, 2
	In-hospital physiotherapy visits should consist of passive TMJ mobilisations	28	Delphi questionnaire round 1, 2; Reviewer comments
	Commencement of exercises and stretches	12; 17; 21	Delphi questionnaire round 1, 2; Reviewer comments
	Commencement of massage / electro-massage of the facial muscles	24	Delphi questionnaire round 1, 2
	Commencement of temporomandibular joint passive mobilisations	29	Delphi questionnaire round 1, 2; Reviewer comments
	Duration of an isometric masticatory muscle contraction	30; 32	Delphi questionnaire round 1, 2
	Duration of a jaw muscle stretch	18; 35	Delphi questionnaire round 1, 2

<b><u>Conceptualisastion</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Jaw exercises to be done in front of a mirror to prevent incorrect mandibular deviation	22	Delphi questionnaire round 1, 2; Reviewer comments
	Jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation	23	Delphi questionnaire round 1, 2; Reviewer comments
	Number of repetitions for each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretches to be done at one time	13; 14; 20; 26; 31; 33	Delphi questionnaire round 1, 2; Reviewer comments
	Number of daily repetitions for each masticatory jaw muscle contraction, active jaw exercises and jaw muscle stretches to be done	15; 16; 19; 27; 34	Delphi questionnaire round 1, 2; Reviewer comments

<b><u>Conceptualisastion</u></b>		<b><u>Operationalisation</u></b>	<b><u>Source</u></b>
<b>Dimension</b>	<b>Sub-dimension</b>	<b>Indicators</b>	
	Posterior-Anterior/ Anterior-Posterior condyle movement may give rise to a dysfunction of the lower jaw compartment and should be avoided	25	Reviewer comments

**Table 5.4. Formulation of Delphi questionnaire: Round 3.**

See addendum M for Delphi questionnaire, round 3.

The results for each question, portrayed as percentages, will be reported in the form of tables, graphs and diagrams in the next chapter.

The results of the Delphi questionnaire were used to compile a suggested physiotherapeutic intervention protocol for mandibular condyle fracture patients (Addendum O).

# CHAPTER 6

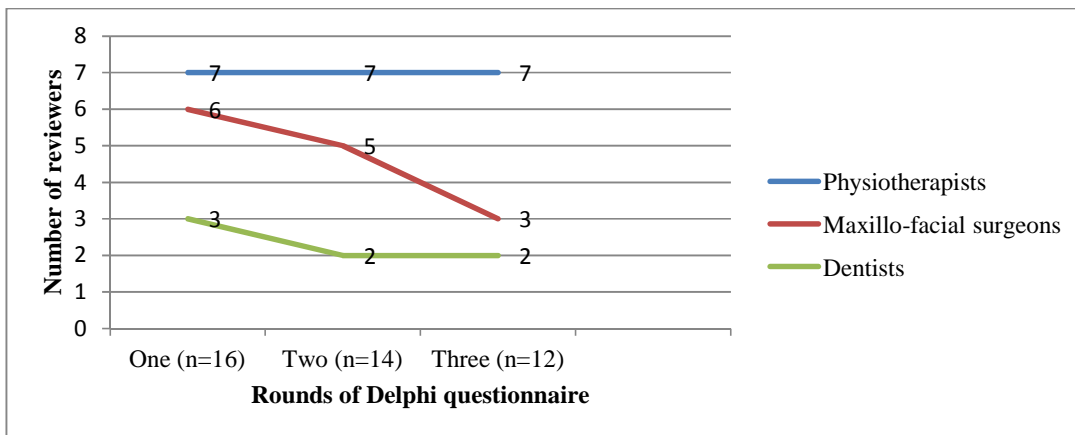
## Results and discussion of Delphi questionnaire

In this chapter the results obtained from the Delphi review panel are discussed using charts and tables. The results are organised and presented in two sections. The first section depicts general demographical information, and the second knowledge and opinion. The results provided in this chapter will not be related to the literature, but a discussion of the literature will be included in the next chapter.

### 6.1. Demographical information

The demographical information obtained included the response rates between rounds, number of international or national members of the review panel, gender composition and the qualification(s) of the members of the review panel. Information was also obtained with regards to the work place, as well as the number of years members of the review panel have been practising in their specific professional area.

#### 6.1.1. Response rates for the Delphi questionnaire rounds

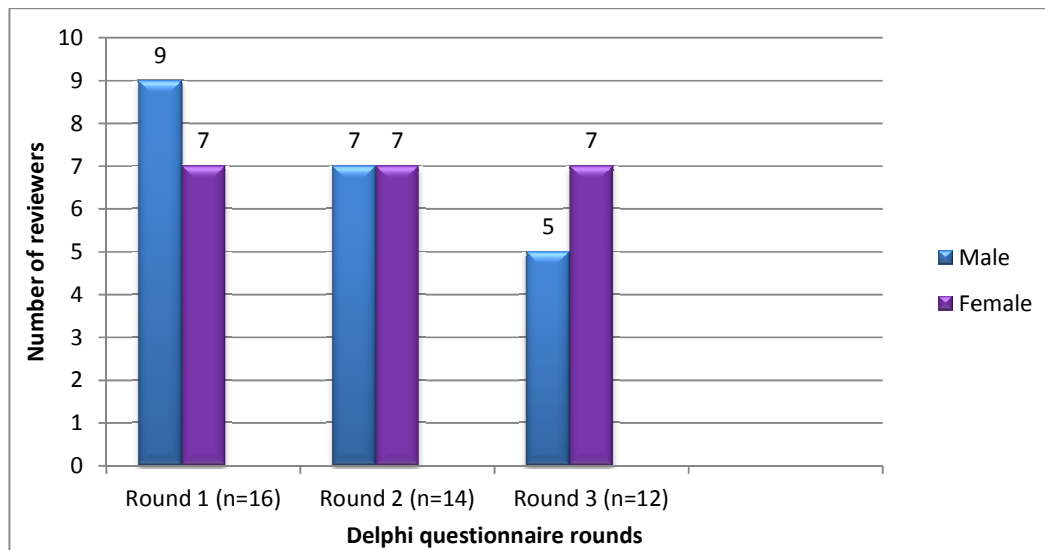


**Graph 6.1. Response rates for the three Delphi questionnaire rounds.**

As could be expected, the response rate declined between rounds one and three (Graph 6.1). Initially 20 review panel members were included in round one of the questionnaire, the second round included 16, and the third and final round 14. As the study was predominantly a physiotherapy based study, it could be expected of physiotherapists to be more compliant with their responses due to their interest in the topic and the fact that physiotherapists are increasingly encouraged to participate in research which is seen as an important aspect of

their professional role (Kamwendo. 2002:23). The nature of a Delphi questionnaire may also have contributed to the declining response rates, as the same questionnaire is repeatedly sent out until consensus is reached between members of the review panel. This may result in review panel members not demonstrating as much interest in the topic in subsequent rounds.

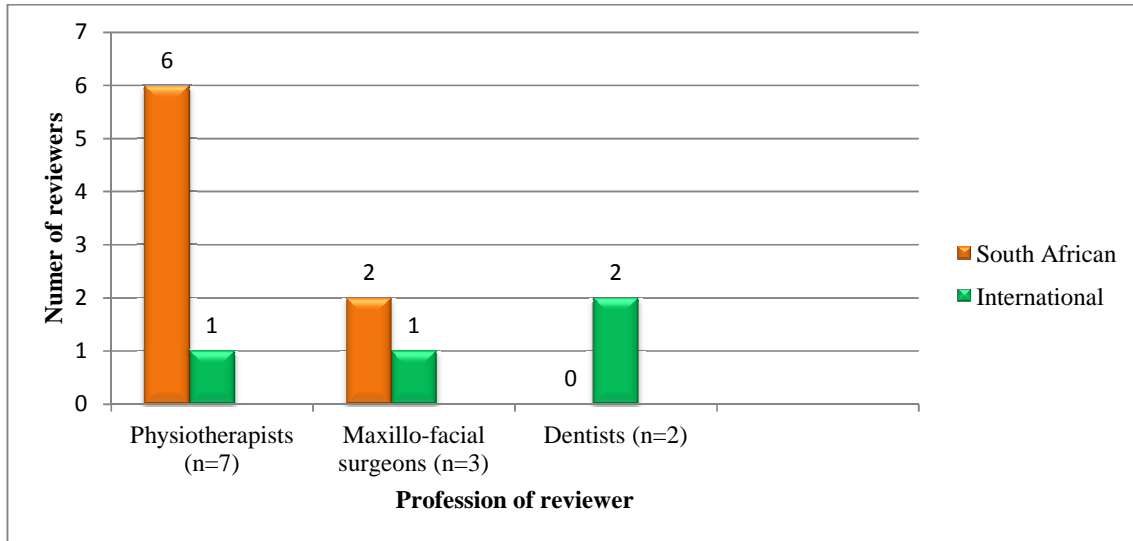
### 6.1.2. Gender composition of members of the Delphi review panel



**Graph 6.2. Gender composition of members of the Delphi review panel.**

It was found that during round one of the Delphi questionnaire the majority of review panel members were male (Graph 6.2), whilst during the final round the majority of review panel members were female. The gender composition could be attributed to the fact that the majority of members of the review panel who completed all three rounds were physiotherapists. The gender distribution was comparative during all three rounds of the Delphi questionnaire, as there was never a difference of more than two when comparing the number of male to female participants.

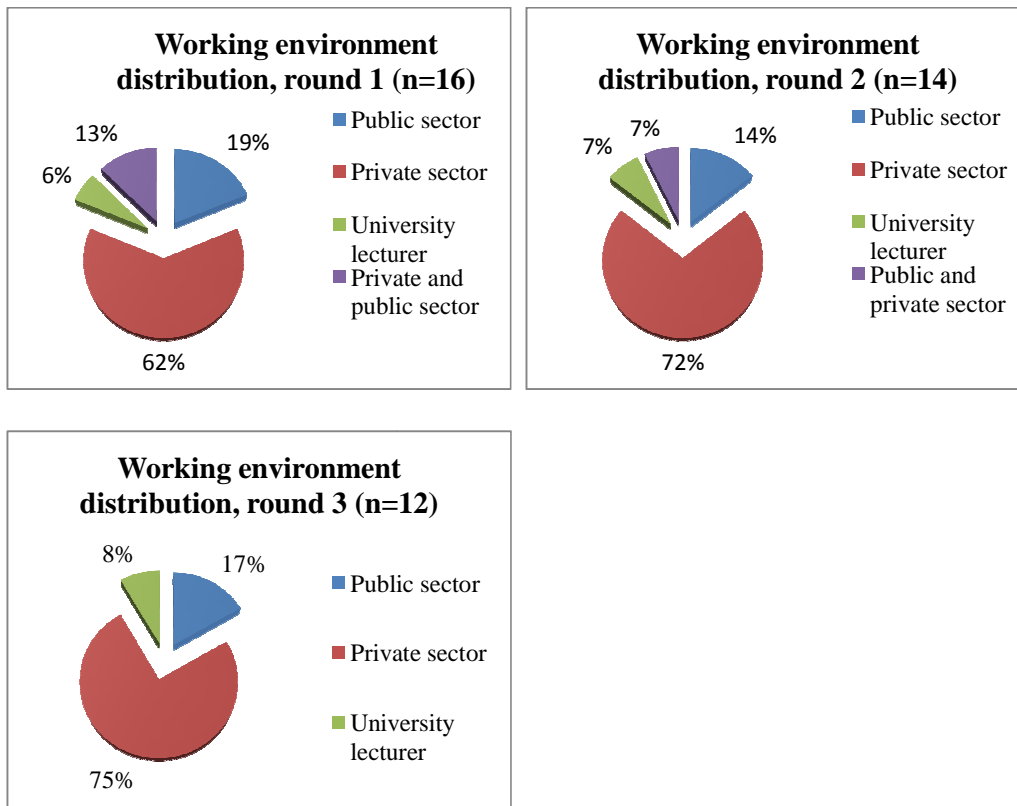
### 6.1.3. Review panel members' nationality



**Graph 6.3. Nationality of members of the review panel in the third and final round of the Delphi questionnaire.**

The Delphi review panel consisted of experts in the maxillo-facial, dentistry and physiotherapy fields in South Africa and abroad (Graph 6.3). The final questionnaire round of the Delphi study obtained a ratio of 3,5:1,5:1 (7 physiotherapists: 3 surgeons: 2 dental surgeons) regarding the interdisciplinary compilation of the review panel. The ratio of South African versus international members of the review panel was 2:1 during the third and final questionnaire round, but the ideal number of international:national physiotherapists were not met. Only two international physiotherapists and two international maxillo-facial surgeons complied by returning of the completed informed consent forms. Therefore, only two international physiotherapists and two international maxillo-facial surgeons could be included in the Delphi questionnaire. One South African physiotherapist had extensive international work experience in the field of cranio-mandibular therapy, but was not practising abroad therefore the physiotherapist was not included in the international category.

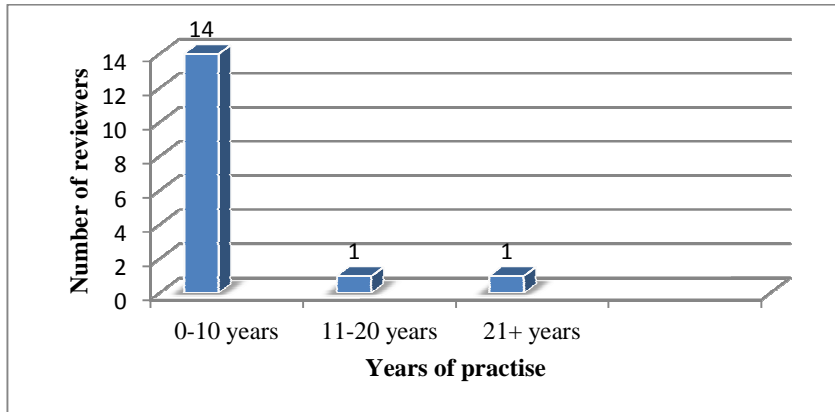
**6.1.4. Working environment distribution of review panel members**



**Graph 6.4. Working environment distribution of review panel members.**

The majority of members of the review panel were practising in the private sector (Graph 6.4). As the physiotherapeutic treatment of mandibular condyle fractures is still a fairly unexplored area in South Africa, it could have lead to the increased number of privately employed members of the review panel, who has had some post-graduate input, participating in the study. Currently, in the South African academic hospitals and healthcare institutions, very few physiotherapists had exposure to mandibular condyle fracture patients, as the maxillo-facial area is a relatively new area explored by physiotherapists.

### 6.1.5. Years of practise of review panel members



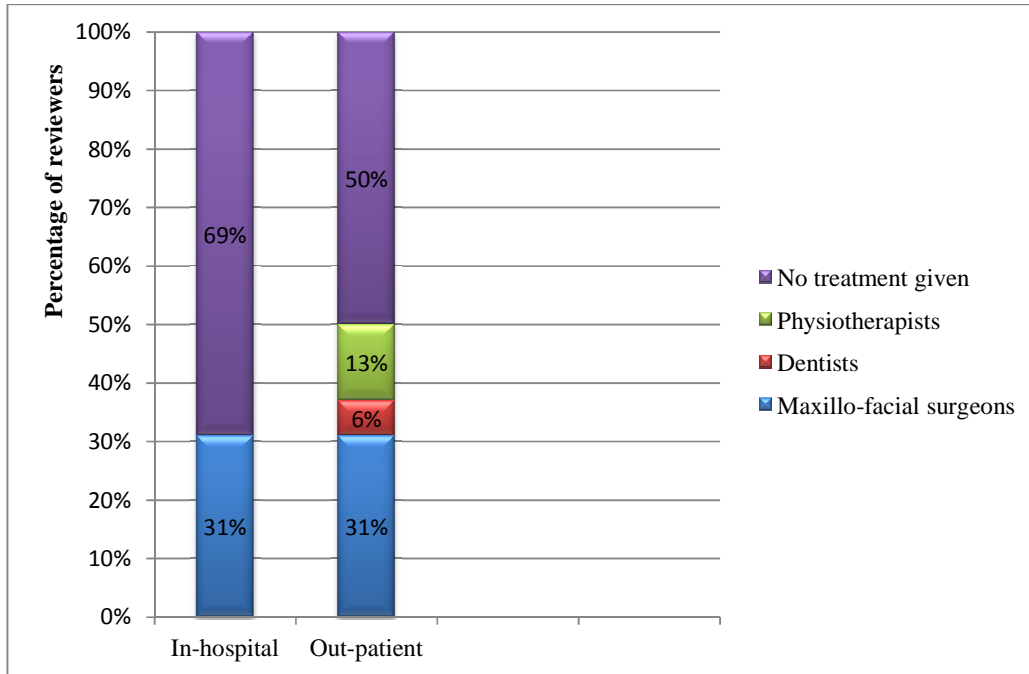
**n = 16**

**Graph 6.5. Years of practise of review panel members.**

As shown in Graph 6.5, most members of the review panel reported working in their current profession for 0 - 10 years. Maxillo-facial surgery is a specialisation within dental surgery and therefore requires completion of a further qualification. Due to the fact that maxillo-facial surgeons have to complete several examinations before they are qualified as maxillo-facial surgeons, it was expected that some members of the review panel reported only two to three years of maxillo-facial surgery practice. The fewer number of years practised by maxillo-facial surgeons would be acceptable, as this would still include years of practical in-theatre training leading up to their specialisation degree in maxillo-facial surgery. All physiotherapists and dental surgeons had five or more years of experience in their respective professions. One international physiotherapist reported 35 years of practice.

## **6.2. Treatments provided by members of the review panel**

### **6.2.1. Members of the review panel currently treating in-hospital and out of hospital mandibular condyle fracture patients**

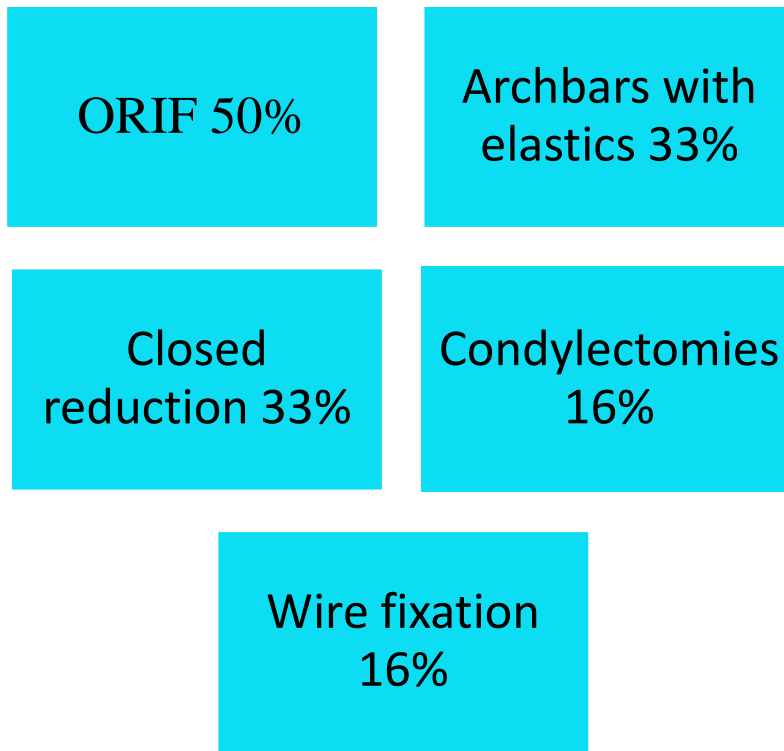


**n = 16**

#### **Graph 6.6. Members of the review panel currently treating in-hospital and out of hospital mandibular condyle fracture patients.**

The results regarding members of the review panel currently treating in- and out of hospital mandibular condyle fracture patients, depicted in Graph 6.6 were to be expected, as this is a relatively new field for physiotherapeutic intervention in South Africa. Currently most in-hospital patients treated for mandibular condyle fractures are only seen by the maxillo-facial surgeons. Two physiotherapists and one dentist are currently involved in the treatment and rehabilitation of mandibular condyle fracture patients in an out-patient setting. One international reviewer indicated that mandibular condyle fracture patients abroad are already receiving routine physiotherapeutic management.

**6.2.2. Maxillo-facial treatment (medical) currently provided for patients presenting with mandibular condyle fractures**



**n = 3**

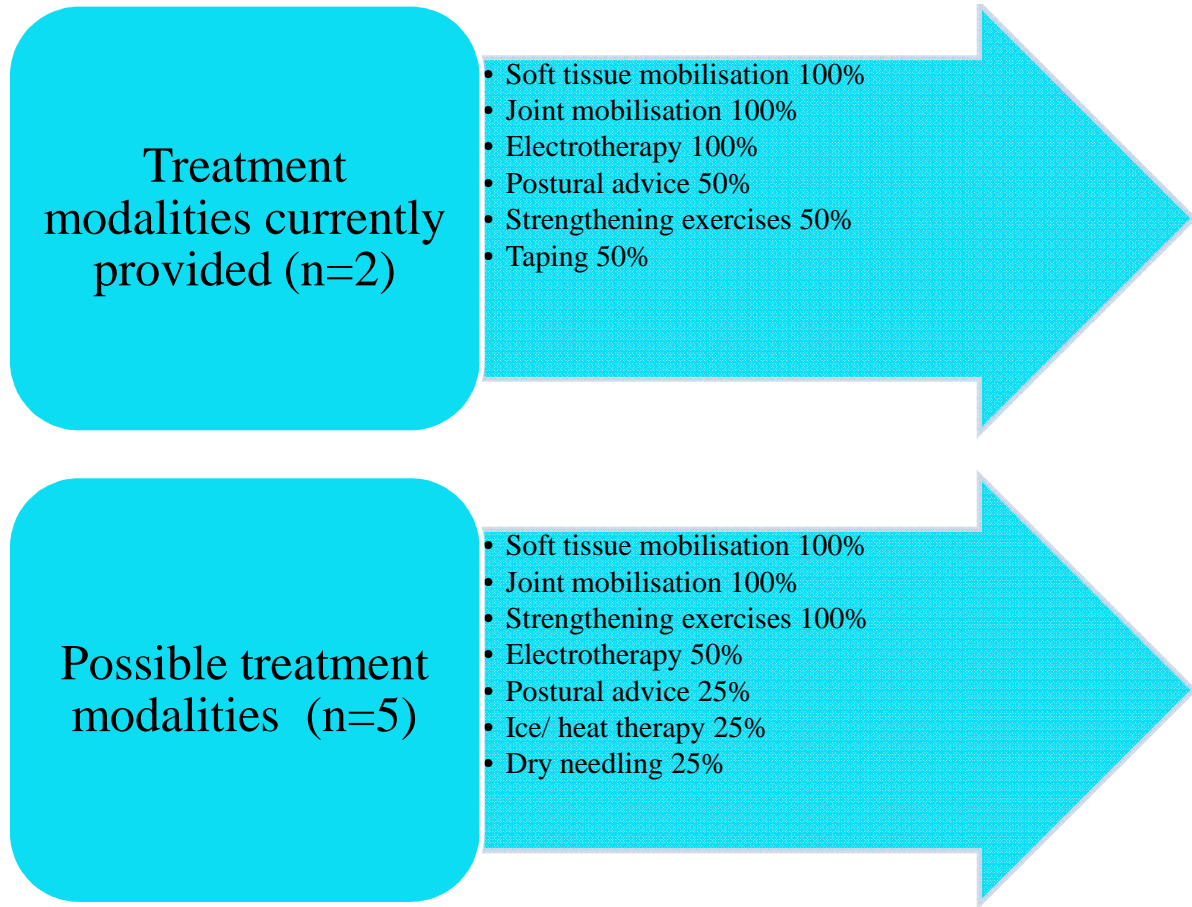
ORIF= Open Reduction and Internal Fixation surgery

**Diagram 6.1. Maxillo-facial treatment (medical) currently provided for patients presenting with mandibular condyle fractures.**

It is illustrated in the above diagram (Diagram 6.1) that the major medical intervention currently provided by the members of the review panel in the maxillo-facial surgery field, is open reduction and internal fixation (ORIF) surgery. Treatment depends largely on the injury type sustained by the patient. Displaced fractures and bilateral condyle fractures usually require ORIF surgery. Intracapsular condyle fractures are usually treated conservatively, or in severe cases the condylar head is removed to prevent future TMJ ankylosis.

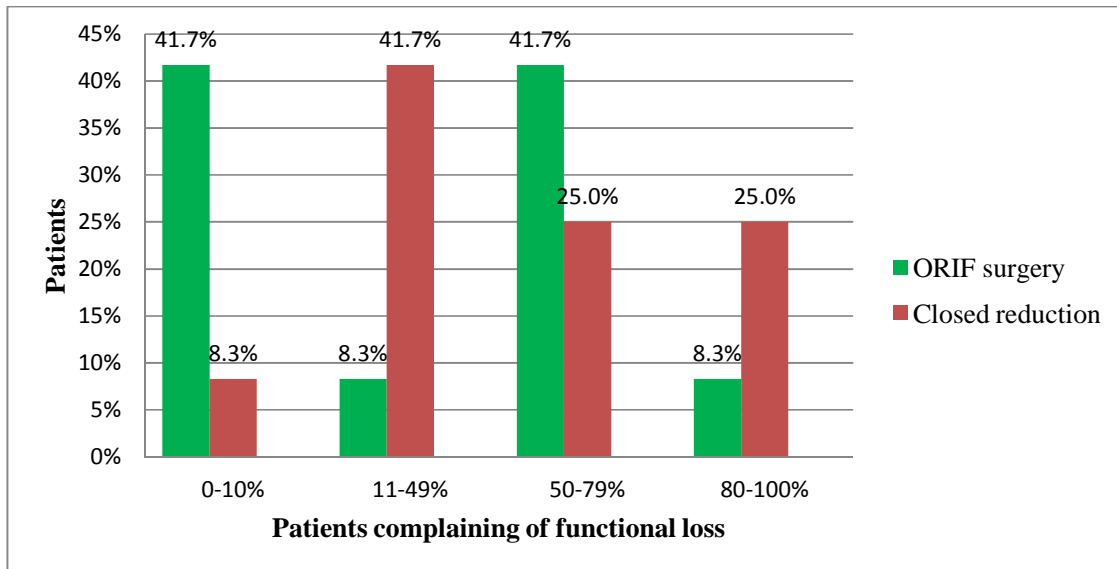
### 6.2.3. Treatment modalities provided by physiotherapists

Below are the treatment modalities provided by the two review panel physiotherapists currently treating mandibular condyle fracture patients (Diagram 6.2). Illustrated in the bottom arrow part of the diagram are the treatment modalities which physiotherapists, not currently treating patients who sustained mandibular condyle fractures, would consider for mandibular condyle fracture patients.



**Diagram 6.2 Treatment modalities provided by physiotherapists.**

**6.2.4. Number of patients complaining of in-hospital functional loss, following ORIF surgery and closed reduction for mandibular condyle fractures**

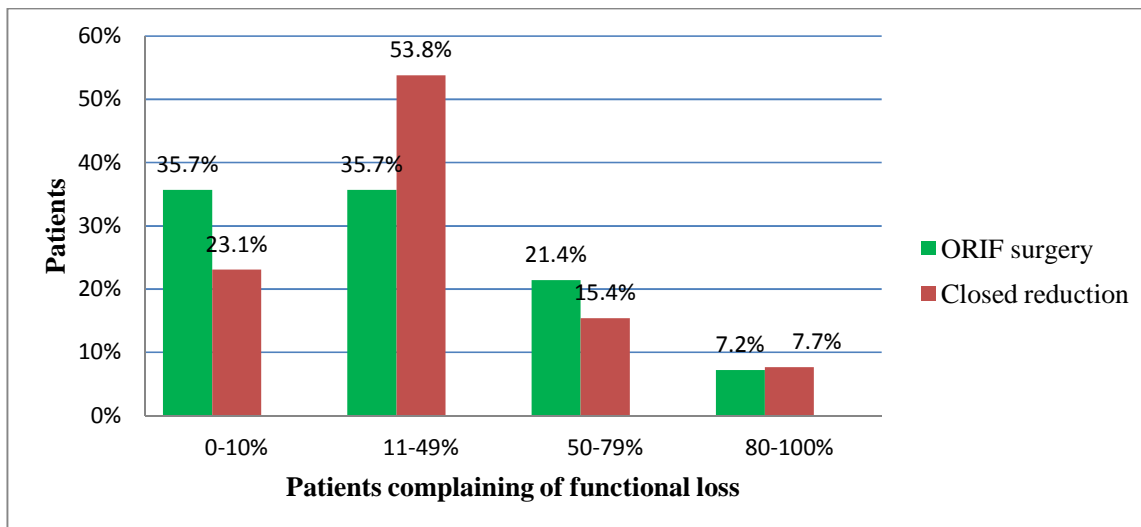


**n = 13**

**Graph 6.7. Number of patients complaining of in-hospital functional loss, following ORIF surgery and closed reduction for mandibular condyle fractures.**

The results in Graph 6.7 indicates that review panel members had different experiences regarding patients reporting in-hospital functional loss after mandibular condyle fractures, treated by ORIF surgery. Review panel members reported that 0 – 10 % (41.7 % of responding review panel members) and 50 – 79 % (41.7 % of responding review panel members) of mandibular condyle fracture patients, treated by ORIF surgery, tended to demonstrate marked in-hospital functional loss. However, the majority of members of the review panel (41.7 % of review panel members) reported that 11 – 49 % of mandibular condyle fracture patients, treated by closed reduction tended to demonstrate in-hospital functional loss. The in-hospital functional loss reported by mandibular condyle fracture patients may be due to soft tissue damage and swelling resulting from the injury and subsequent reduction.

### 6.2.5. Number of patients complaining of functional loss at follow-up, following ORIF surgery and closed reduction for mandibular condyle fractures



n = 13

#### Graph 6.8. Number of patients complaining of functional loss at follow-up, following ORIF surgery and closed reduction for mandibular condyle fractures.

Members of the review panel reported that patients, treated by closed reduction tend to report more functional loss at out-patient follow-up (Graph 6.8). The greater part of the review panel members reported that between 0 – 10 % and 11 – 49 % (35.7 % of review panel members for both options) of mandibular condyle fracture patients, treated by ORIF surgery tended to demonstrate functional loss at follow-up. For mandibular condyle fracture patients treated by closed reduction, this reported functional loss at follow-up was 11 – 49 % (53.8 % of review panel members).

When analysing the above mentioned results, it should be taken into account that only a few members of the review panel had practical experience with patients who sustained mandibular condyle fractures. The members of the review panel not currently treating mandibular condyle fracture patients refrained from answering questions regarding reported functional loss. The difference in patient compliance between private and public sector patients should also be considered as having a possible influence on the functional outcomes of this patient population, as public sector patients may tend to demonstrate less compliance with out-patient follow-ups, possibly due to various socio-economic factors.

**6.2.6. Pre-cautionary measures and duration of pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient following ORIF surgery or closed reduction**

Pre-cautionary measures to be considered following ORIF surgery	Round 1 (n = 16)		Round 2 (n = 14)		Round 3 (n = 12)	
	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None
Ultrasound directly over the surgery area	62.5 %	None	42.9 %	None	18.2 %	Stability
Interferential current therapy directly over surgery area	37.5 %	None	42.9 %	None		
No resisted exercises	43.8 %	None	50 %	None	36.4 %	Stability
Active movements within limits of pain	75 %	None	50 %	None	45.5 %	Stability
No end range joint movements	37.5 %	None	64.3 %	None		
Dry needling in the facial area	12.5 %	None	7.1 %	None	0 %	Concensus
Maintaining a soft diet	68.8 %	None	64.3 %	None	63.6 %	Stability
All of the above	-	-	21.4 %	None	36.4 %	Stability

**Table 6.1. Pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient, following ORIF surgery.**

Pre-cautionary measures to be considered following closed reduction	Round 1 (n = 16)		Round 2 (n = 14)		Round 3 (n = 12)	
	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None
Ultrasound directly over the surgery area	50 %	N	23.1 %	N	} 50 %	Stability
Interferential current therapy directly over surgery area	37.5 %	N	15.4 %	N		
No resisted exercises	50 %	N	46.2 %	N	41.7 %	Stability
Active movements within limits of pain	62.5 %	N	53.8 %	N	} 50 %	Stability
No end range joint movements	50 %	N	61.5 %	N		
Dry needling in the facial area	6.3 %	N	0 %	Consensus	-	Consensus
Maintaining a soft diet	56.3 %	N	53.8 %	N	50 %	Stability
All of the above	-	-	15.4 %	N	8.3 %	Stability

**Table 6.2. Pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient, following closed reduction.**

The options for ultrasound and interferential current therapy, as well as the options for “active movements within limits of pain” and “no end range joint movements” were grouped together by the researcher. This grouping of similar treatment interventions was done to simplify questionnaire answering.

When analysing the results regarding pre-cautionary measures to be considered when treating mandibular condyle fracture patients, clear inter-round discrepancies were noted (Tables 6.1 and 6.2). Results regarding pre-cautionary measures to be considered varied between rounds. This will be discussed in detail in the next chapter.

Duration of pre-cautionary measures	Round 1 (n = 16)		Round 2 (n = 14)		Round 3 (n = 12)	
	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None
2 weeks	6.3 %	None	14.3 %	None	16.7 %	Stability
3 weeks	31.3 %	None	14.3 %	None	8.3 %	Stability
4 weeks	18.8 %	None	14.3 %	None	16.7 %	Stability
5 weeks	6.3 %	None	0 %	None	-	-
6 weeks	37.5 %	None	57.1 %	None	58.3 %	Stability

**Table 6.3. Duration of pre-cautionary measures for mandibular condyle fractures treated with ORIF surgery.**

Duration of pre-cautionary measures	Round 1 (n = 16)		Round 2 (n = 14)		Round 3 (n = 12)	
	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None	Response %	Consensus/ Stability/ None
1 week	7.1 %	None	0 %	-	-	-
2 weeks	28.6 %	None	7.1 %	None	16.7 %	Stability
3 weeks	66.7 %	None	14.3 %	None	33.3 %	Stability
6 weeks	-	-	78.6 %	None	50 %	Stability

**Table 6.4. Duration of pre-cautionary measures for mandibular condyle fractures treated with closed reduction.**

Pre-cautionary measures to be considered and the duration of the listed pre-cautionary measures, varied considerably between Delphi questionnaire rounds (Table 6.3 and 6.4). The variation in answers could be due to the loss of reviewer interest as well as declining response rates. However, it was found that six weeks demonstrated a relatively consistent high response rate regarding the adherence to pre-cautionary measures in general for mandibular condyle fracture patients, treated by either ORIF surgery, or closed reduction.

**6.2.7. Statements regarding physiotherapy intervention which achieved consensus during round one of the Delphi questionnaire**

<b>Statement</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Disagree</b>	<b>Strongly disagree</b>	<b>Consensus/ Stability/ None</b>
All mandibular condyle fracture patients should receive physiotherapy as a preventative measure	81.3 %	18.7 %	0 %	0 %	Consensus
In-hospital visits should consist of post-surgical advice for ORIF surgery patients	62.5 %	31.3 %	6.2 %	0 %	Consensus
In-hospital visits should consist of advice for closed reduction patients	62.5 %	37.5 %	0 %	0 %	Consensus
In-hospital visits should consist of active jaw exercises	37.5 %	43.8 %	18.8 %	0 %	Consensus
In-hospital visits should consist of isometric jaw muscle exercises	37.5 %	50 %	6.3 %	6.3 %	Consensus
In-hospital visits should consist of jaw muscle stretches	12.5 %	68.8 %	6.3 %	12.5 %	Consensus
In-hospital visits should consist of massaging of the facial muscles	25 %	62.5 %	12.5 %	0 %	Consensus
In-hospital visits should consist of cervical postural advice	43.8 %	43.8 %	12.5 %	0 %	Consensus
An active lateral mandibular exercise comprises of the patient protruding the mandible then slightly moving it to the side	12.5 %	81.3 %	6.3 %	0 %	Consensus
An active mandibular protrusion exercise comprises of the patient moving the mandible forward as far as pain allows	37.5 %	62.5 %	0 %	0 %	Consensus

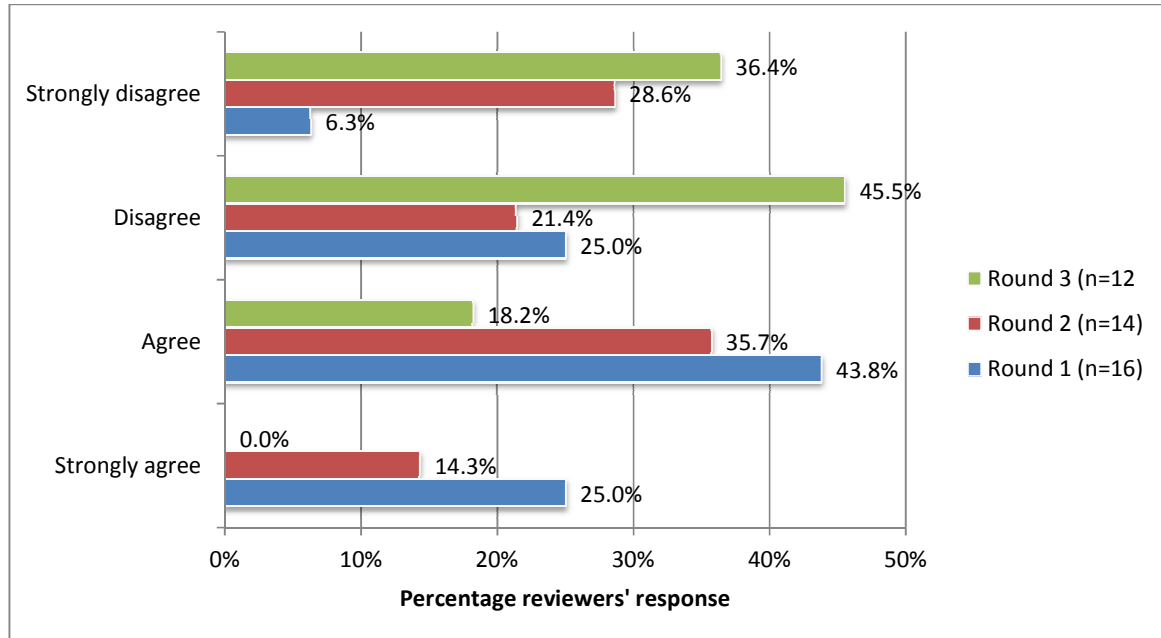
Statement	Strongly agree	Agree	Disagree	Strongly disagree	Consensus/ Stability/ None
Stretching of the jaw muscles is done by progressively wedging tongue depressors in the incisal space, increasing the number of depressors as pain allows.	20 %	66.7 %	0 %	13.3 %	Consensus
Ice can be applied to the surgery area straight after surgery to decrease pain and swelling.	56.3 %	31.3 %	6.3 %	6.3 %	Consensus

**Table 6.5. Statements regarding physiotherapy intervention achieving consensus during round one of the Delphi questionnaire.**

The options “strongly agree” and “agree” were grouped together, and the options “disagree” and “strongly disagree” were grouped together. This was done due to the fact that options “strongly agree” and “agree” convey the exact same meaning, although one option is merely a stronger version than the other option. The same reasoning was followed when grouping the options “disagree” and “strongly disagree” together. This grouping was done to simplify result analysis and interpretation. Further research could attempt to decrease answer options available (agree, disagree or undecided) to eliminate the grouping process during result analysis. Consensus was reached on the majority of statements, indicating inter-reviewer agreement regarding physiotherapeutic interventions to be included in an in-hospital exercise protocol, to be universal.

### 6.2.8. Statements achieving consensus in later Delphi questionnaire rounds

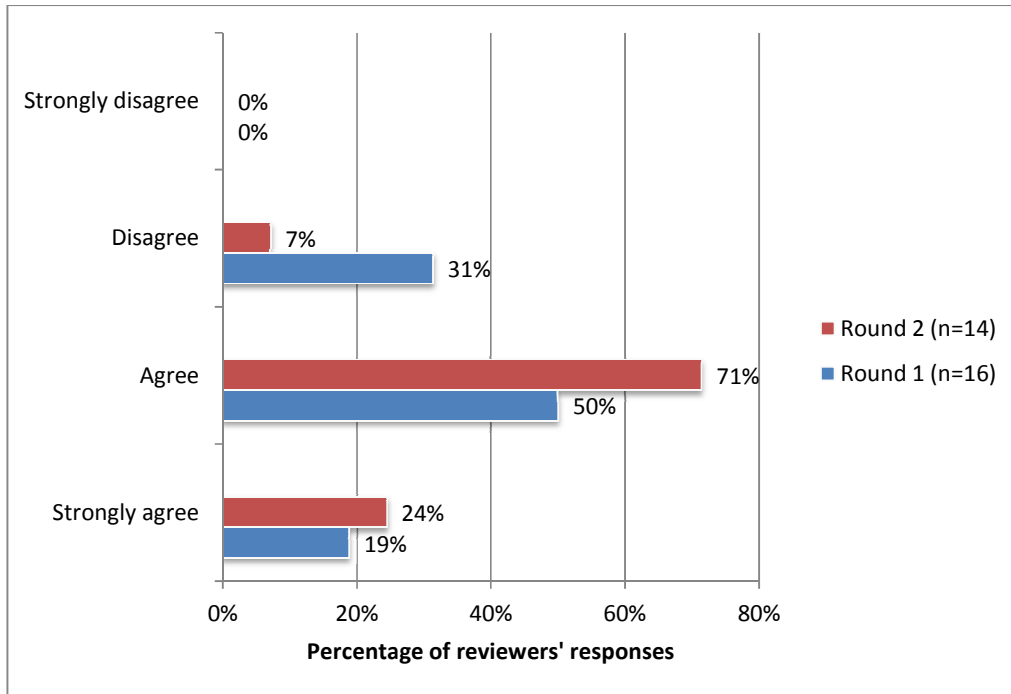
#### 6.2.8.1 In-hospital visits should consist of passive accessory temporomandibular joint mobilisations



**Graph 6.9. Graph depicting results regarding in-hospital passive accessory temporomandibular joint mobilisations.**

From the results depicted in Graph 6.9, as well as review panel comments, it was clear that the members of the review panel's understanding as to what passive joint mobilisations entail was not clear. During round one of the questionnaire the description of passive mobilisations of the temporomandibular joint was: "joint mobilisation done by the therapist". Due to three members of the review panel's comments, this description was adjusted for the second round of the questionnaire, reading: "passive joint mobilisation done by the therapist into joint resistance". During the third and final round of the Delphi questionnaire, the definition was again altered due to two review panel members' comments. The definition was then given as: "joint mobilisation done by the physiotherapist by moving the condyle head in relationship to the mandible". Consensus was reached by the third round.

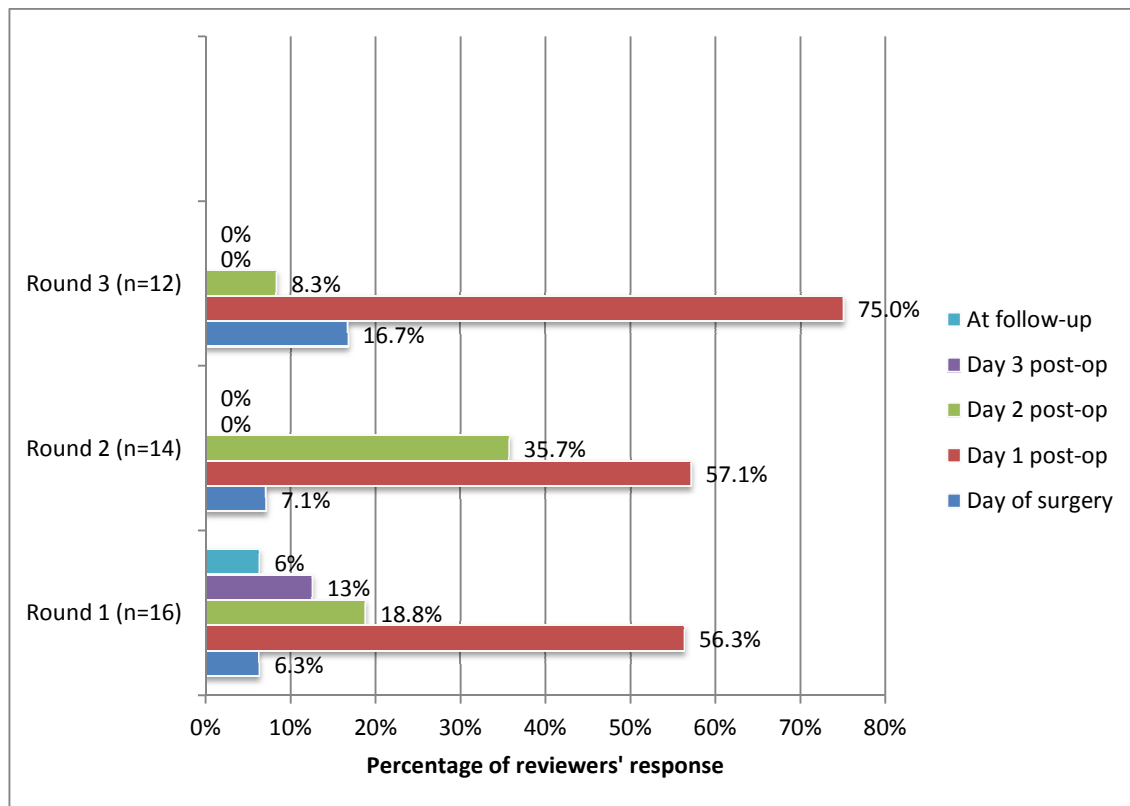
**6.2.8.2. Active jaw opening exercise comprises of the patient slightly protruding the mandible and then opening and closing the mouth**



**Graph 6.10. Graph depicting results regarding what an active jaw opening movement entails.**

In Graph 6.10 it is seen that no consensus was reached after the completion of round one of the Delphi questionnaire regarding the definition of an active jaw opening movement. During the second round the question was rephrased due to two reviewer comments to: “An active jaw opening exercise comprises of the patient gently opening and closing the mouth”. After the adjustment was made, consensus was reached between members of the review panel.

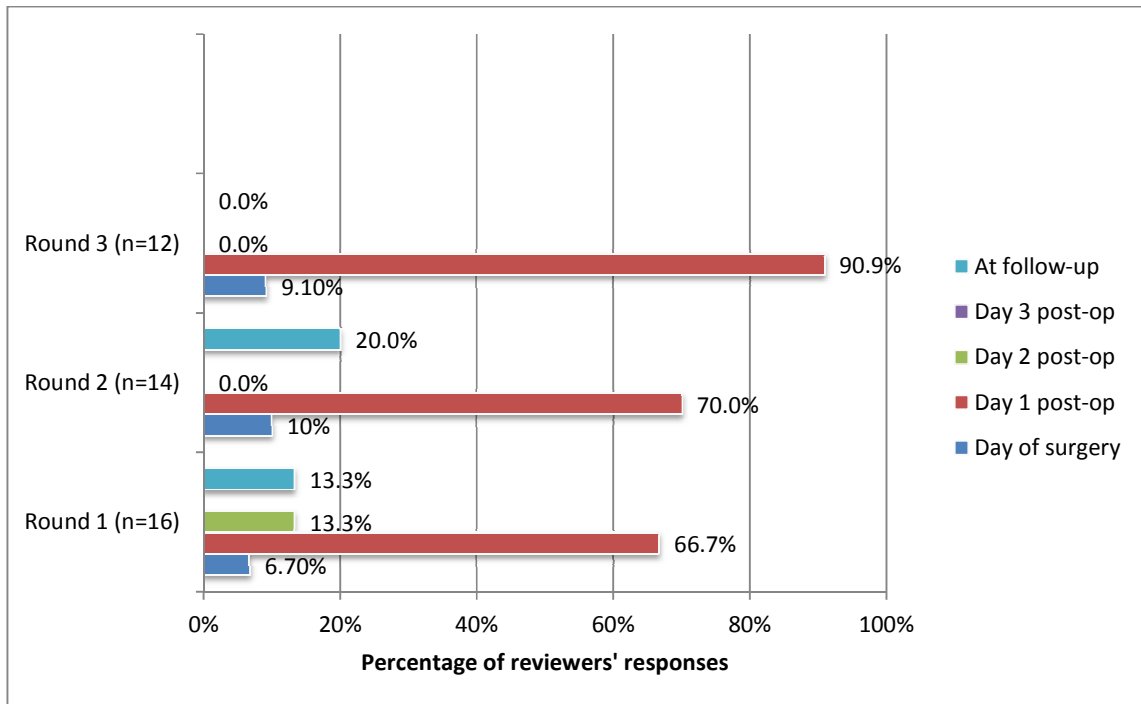
### 6.2.8.3. Commencement of physiotherapy evaluation and treatment of mandibular condyle fractures, treated with ORIF surgery or closed reduction



**Graph 6.11. Commencement of physiotherapy evaluation and treatment of mandibular condyle fractures, treated with ORIF surgery.**

During the third and final Delphi questionnaire round, stability was reached regarding the commencement of physiotherapy evaluation and treatment for mandibular condyle fracture patients, treated with ORIF surgery (Graph 6.11). Seventy-five percent of Delphi review panel members felt a physiotherapist should commence evaluation and treatment day one after ORIF surgery.

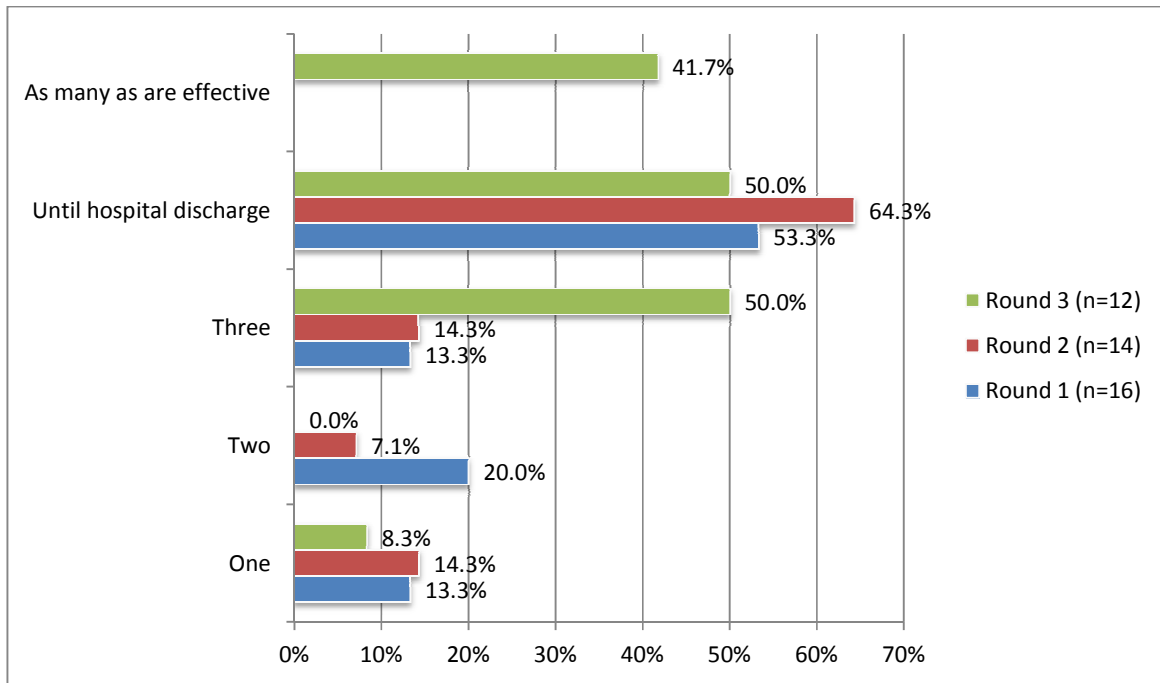
The fact that only stability was reached may be due to the fact that each patient requires a different type of ORIF approach, presents differently after surgery, and may have other complications resulting from their injury. Clear communication between the surgeon and physiotherapist is therefore of utmost importance to ascertain the treatment required, fracture stability and pre-cautionary measures to be adhered to.



**Graph 6.12. Commencement of physiotherapy evaluation and treatment of mandibular condyle fractures, treated with closed reduction.**

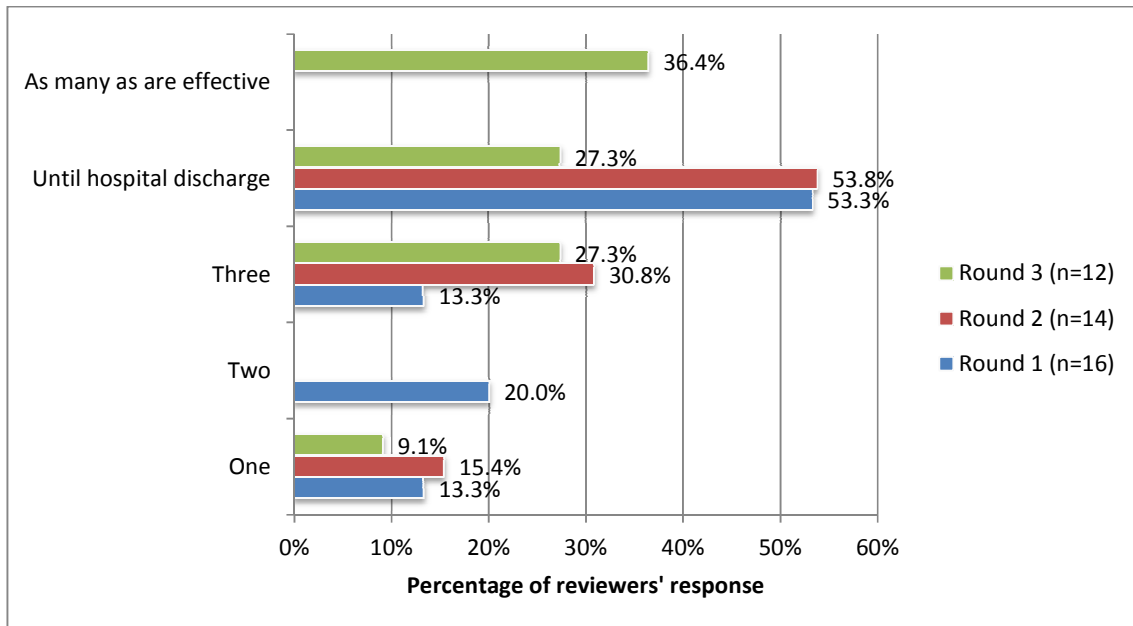
Consensus was reached amongst review panel members during the final questionnaire round, regarding the commencement of physiotherapy evaluation and treatment for mandibular condyle fracture patients, treated by closed reduction (Graph 6.12). The majority of Delphi review panel members (90.9 %) felt a physiotherapist should commence evaluation and treatment day one after closed reduction of a mandibular condyle fracture.

**6.2.8.4 Number of in-hospital physiotherapy visits deemed adequate for mandibular condyle fractures, treated by ORIF surgery or closed reduction**



**Graph 6.13. Number of in-hospital physiotherapy visits deemed adequate for mandibular condyle fractures treated with ORIF surgery.**

During round three of the Delphi rounds 50 % of the review panel members, declining from round two's 64.3 %, were in agreement that a mandibular condyle fracture patient, treated by ORIF surgery, should receive three in-hospital physiotherapy visits (Graph 6.13). A total of 41.7 % of review panel members opted for the option "until hospital discharge" during the final questionnaire rounds. No new comments were received from members of the Delphi review panel.



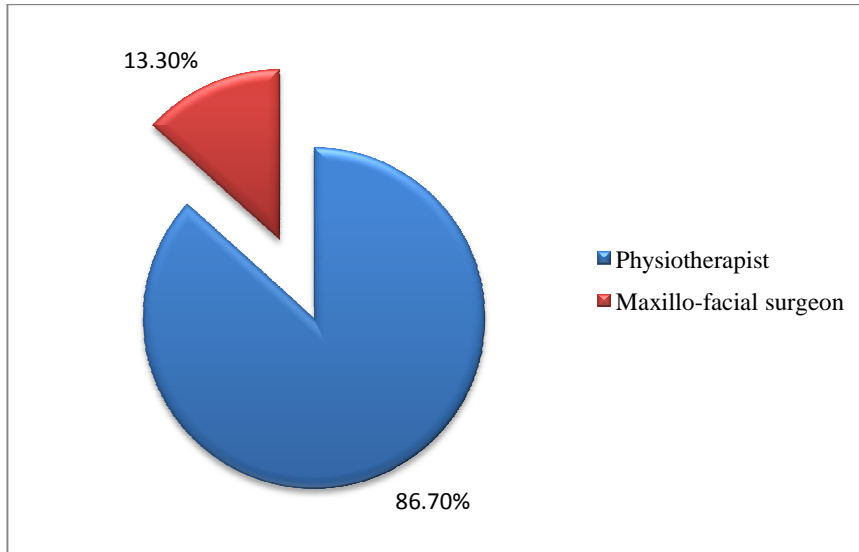
**Graph 6.14. Number of in-hospital physiotherapy visits deemed adequate for mandibular condyle fractures treated with closed reduction.**

During the final Delphi questionnaire round, 36.4 % of the review panel members were in agreement that a mandibular condyle fracture patient, treated by closed reduction, should receive as many in-hospital physiotherapy visits as deemed effective (Graph 6.14). During round one and two of the questionnaire 53.3 % (round one) and 53.8 % (round two) of review panel members felt that in-hospital physiotherapy visits for mandibular condyle fracture patients, treated by closed reduction, was adequate. No new comments were received from members of the Delphi review panel.

A tendency was noticed towards mandibular condyle fracture patients receiving physiotherapy treatment until the patient is discharged from hospital (Graphs 6.13 and 6.14). Under normal circumstances a patient is discharged from hospital day three after surgery. Although this trend is clearly seen, no consensus was reached during the final questionnaire round. Stability was reached by round three of the questionnaire as the percentages scored for the option “until hospital discharge” remained relatively the same through-out the rounds. In addition, from round two onwards no new comments were received from members of the review panel regarding these two questions. This may be due to the fact that each patient presents differently after surgery, requiring different methods of treatment or may present with other complications resulting from their injury.

### **6.3 Exercises and dosages**

#### **6.3.1. Execution and evaluation of progression of the post-surgical exercise regime and advice**



**n = 15**

**Graph 6.15. Execution and evaluation of progression of the post-surgical exercise regime and advice.**

From the results depicted in Graph 6.15, it is clearly seen that the majority of members of the review panel indicated that a physiotherapist should evaluate mandibular condyle fracture patients, treated by ORIF surgery or closed reduction, as well as execute and progress the post-surgical exercise program. One comment made by a reviewer was that consultation with the surgeon would aid the physiotherapist to compile a safe, patient specific exercise program.

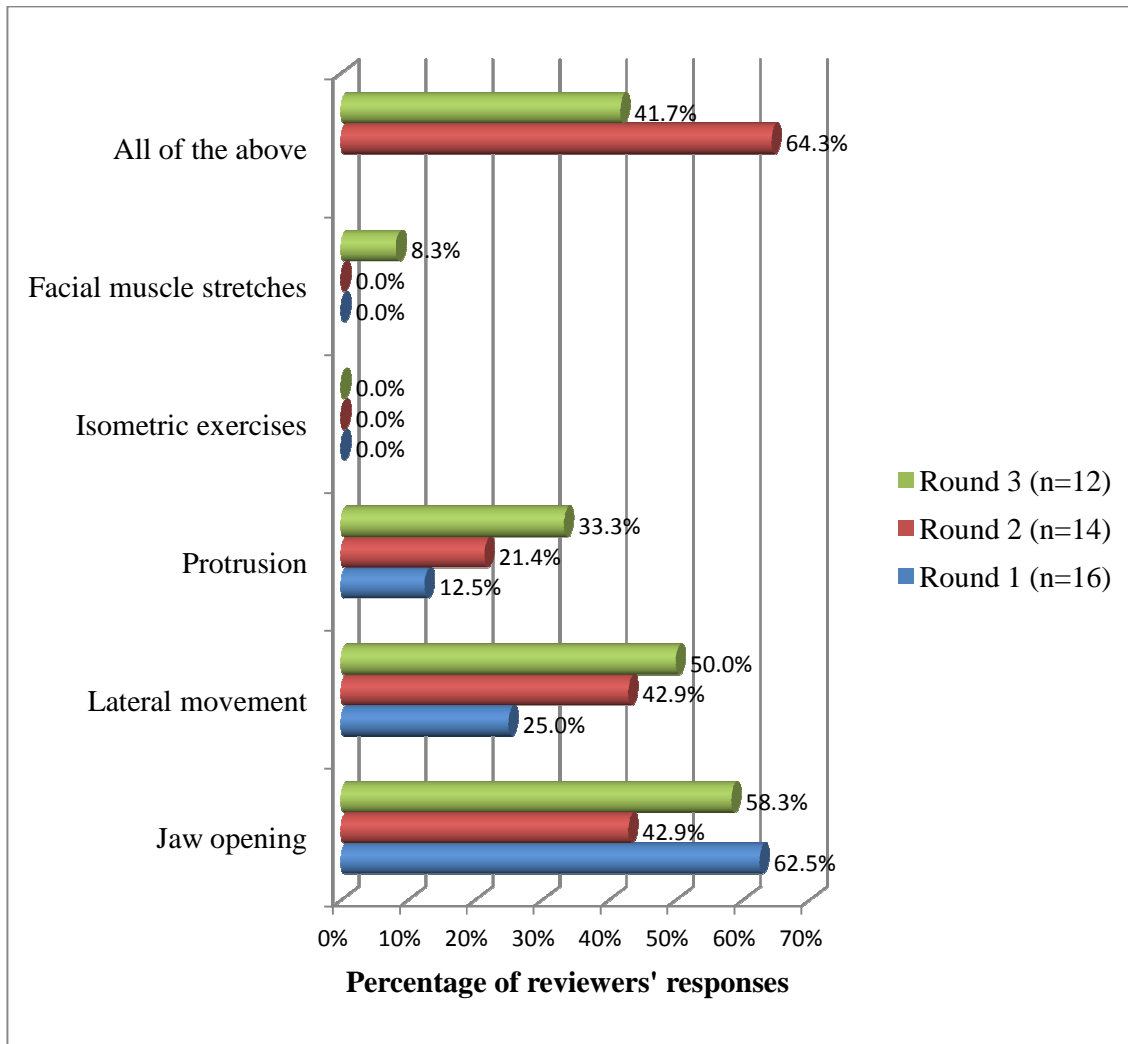
**6.3.2. Commencement of different treatment modalities for mandibular condyle fractures, treated with ORIF surgery or closed reduction**

Treatment	Commencement	Response %	Round (n = 12)	Consensus/ Stability/ None
Cervical and post-surgical advice	Day 1 post-surgery	66.7 %	3	Stability
Active jaw exercises	Day 1 post-surgery	72.7 %	3	Stability
Isometric jaw exercises	Day 1 post-surgery	66.7 %	3	Stability
Jaw muscle stretches	Out-patient follow-up/ after fixation removal	45.5 %	3	Stability
Massage of facial muscles	Day 1 post-surgery	50 %	3	Stability
Passive TMJ movements by therapist	Out-patient follow-up	58.3 %	3	Stability

**Table 6.6. Commencement of different treatment modalities for mandibular condyle fractures, treated with ORIF surgery or closed reduction.**

Members of the review panel’s answers reached stability regarding the commencement of all listed physiotherapeutic treatment interventions, but answers varied between rounds (Table 6.6). This may be due to a drop in reviewer response rate, as well as a loss of interest in the topic.

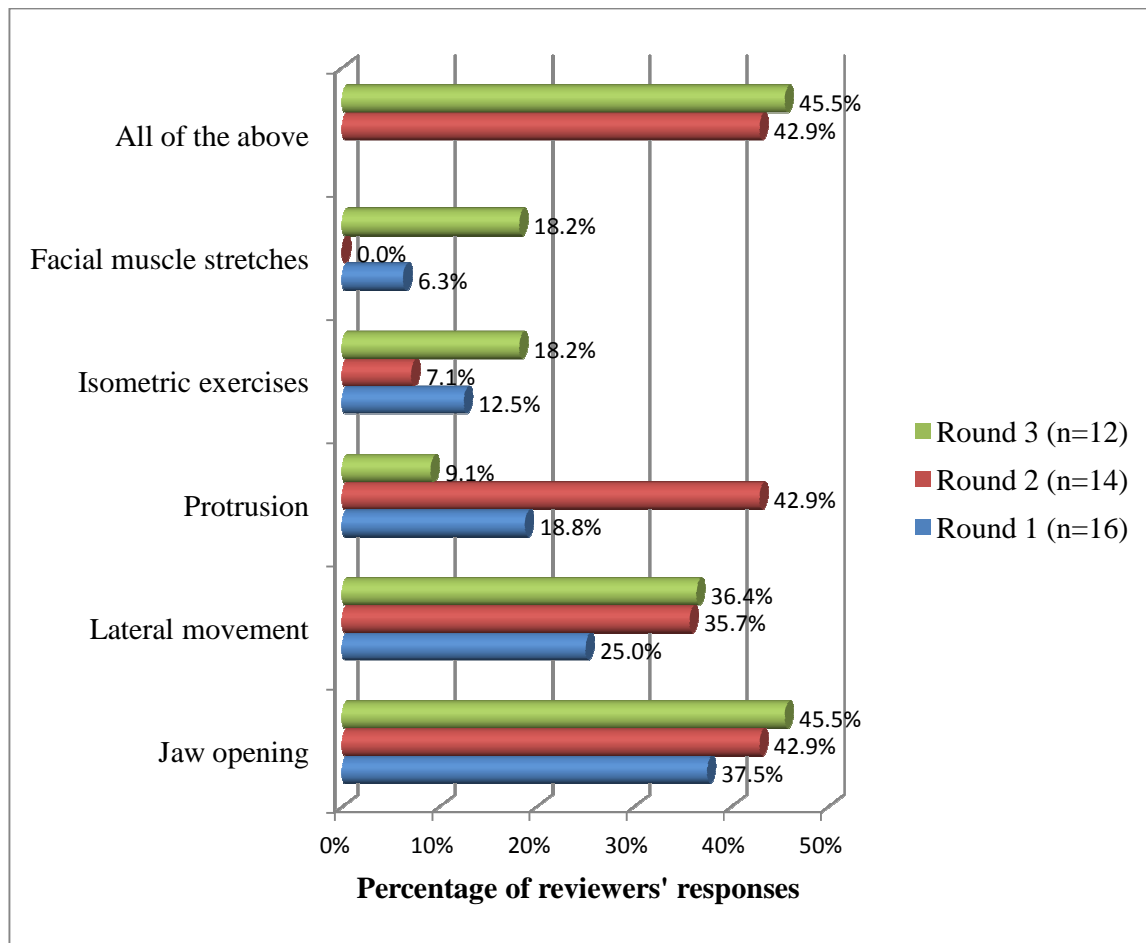
### 6.3.3. Jaw exercises to be done in front of a mirror to prevent incorrect mandibular deviation



**Graph 6.16. Jaw exercises to be done in front of a mirror to prevent incorrect mandibular deviation.**

Reviewer responses varied significantly between questionnaire rounds, indicating decreased reviewer attentiveness (Graph 6.16). However, there was an increased tendency in reviewer responses towards all exercises to be done in front of a mirror.

**6.3.4. Jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation**



**Graph 6.17. Jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation.**

Stability was reached, as seen in Graph 6.17, regarding jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation. Jaw opening and lateral movement were the two exercises which demonstrated the least fluctuation in responses between rounds, and the percentage responses remained relatively stable between rounds.

The option “all of the above” obtained a reviewer response rate of 45.5 % during the third and final questionnaire round.

**6.3.5. Questionnaire rounds one to three: Exercises and dosages**

Exercise	Repetitions in 1 set		Sets of repetitions		Repetitions per day		Contraction/ stretch held for		Source of exercise
		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None	
Isometric jaw muscle contractions	3 contractions per muscle (46.7 %)	None	3 (40 %)	None	3 (46.7 %)	None	10 sec (42.9 %)	None	Needs analysis; Maxillo-facial surgeons; Rocabado (1983); Morrone and Makofskry (1991); Nicolakis <i>et al.</i> (2002); Trott (2011)
Jaw opening	5 movements (62.5 %)	None	3 (62.5 %)	None	3 (56.3 %)	None	NA	-	Needs analysis; Maxillo-facial surgeons; Rocabado (1983); Thiele and Marcoot (1985); Morrone and Makofskry (1991); Worsaae and Thorn (1994); Bevilaqua-Grosso <i>et al.</i> (2002); Nicolakis <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Zachariades <i>et al.</i> (2006); Buescher (2007); Rikhotso and Ferretti (2008); Feng <i>et al.</i> (2009); Trott (2011)

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Exercise	Repetitions in 1 set		Sets of repetitions		Set repetitions per day		Contraction/ stretch held for		Source of exercise
		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None	
Lateral jaw movement	5 movements (62.5 %)	None	3 (62.5 %)	None	3 (62.5 %)	None	NA	-	Needs analysis; Maxillo-facial surgeons; Thiele and Marcoot (1985); Worsaae and Thorn (1994); Hwang <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Buescher (2007) Feng <i>et al.</i> (2009) Trott (2011)
Protrusion of jaw	3 movements (56.3 %)	None	5 (73.3 %)	None	3 (56.3 %)	None	NA	-	Needs analysis; Maxillo-facial surgeons; Worsaae and Thorn (1994); Hwang <i>et al.</i> (2005); Buescher (2007) Trott (2011)
Stretch	5 stretches (76.9 %)	None	3 (42.9 %)	None	3 (71.4 %)	None	5 sec (35.7 %)	None	Needs analysis; Maxillo-facial surgeons; Morrone and Makofskry (1991); Nicolakis <i>et al.</i> (2002); Hwang <i>et al.</i> (2005); Buescher (2007); Feng <i>et al.</i> (2009); Trott (2011)

**Table 6.7. Questionnaire round one: Exercises and dosages.**

No consensus regarding any exercise dosages could be reached after round one of the Delphi questionnaire, as illustrated in Table 6.7. Two exercises (jaw opening and lateral jaw movement) showed a high number of review panel members agreeing (62.5 %) on three sets of five repetitions done for each exercise. The results regarding exercise repetitions per day

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indicated that the majority of reviewers were leaning towards exercises being repeated three times per day.

Exercise	Repetitions in 1 set		Sets of repetitions		Set repetitions per day		Contraction/stretch held for		Source of exercise
		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None	
Isometric jaw muscle contractions	5 contractions per muscle (69 %)	None	3 (69 %)	None	3 (62 %)	None	5 sec (62 %)	None	Needs analysis; Delphi round 1
Jaw opening	5 movements (79 %)	None	3 (64 %)	None	3 (57 %)	None	NA	-	Needs analysis; Delphi round 1
Lateral jaw movement	5 movements (86 %)	Consensus	3 (70 %)	None	3 (70 %)	None	NA	-	Needs analysis; Delphi round 1
Protrusion of jaw	3 movements (64 %)	None	5 (69 %)	None	3 (69 %)	None	NA	-	Needs analysis; Delphi round 1
Stretch	5 stretches (100 %)	Consensus	3 (69 %)	None	3 (77 %)	None	5 sec (64 %)	None	Needs analysis; Delphi round 1

**Table 6.8. Questionnaire round two: Exercises and dosages.**

After completion of round two of the Delphi questionnaire consensus was reached regarding the number of jaw stretches to be done in one set, as well as the repetitions to be done in one set for lateral mandibular movement (Table 6.8). All other questions' percentages of review panel agreement improved between round one and round two of the questionnaire, except the daily repetitions of jaw opening exercise to be done by the patients.

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During the analysis of the results of round two, it was found that physiotherapists achieved consensus on a vast number of exercise related questions, namely:

- Repetitions to be done in one set for isometric masticatory muscle contractions, mandibular protrusion as well as lateral mandibular movement.
- Number of sets of repetitions to be done for a jaw muscle stretch and isometric masticatory muscle contraction.
- Daily set repetitions to be done for a jaw muscle stretch, isometric masticatory muscle contraction, mandibular protrusion and mandibular lateral movement.

Also found during the data analysis of the second questionnaire round, was that maxillo-facial surgeons and dentists only achieved consensus regarding two exercise dosage related questions, namely:

- Repetitions to be done in one set for a jaw opening exercise and lateral mandibular movement.

Exercise	Repetitions once off		Repetitions per day		Contraction/ stretch held for		Source of exercise
		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None	
Isometric jaw muscle contractions	5 contractions per muscle (63.3 %)	Stability	3 (77 %)	Stability	5 sec (66.7 %)	Stability	Needs analysis; Delphi round 2
Jaw opening	5 movements (70 %)	Stability	3 (83.3 %)	Consensus	NA	-	Needs analysis; Delphi round 2
Lateral jaw movement	5 movements (75 %)	Stability	3 (70 %)	Stability	NA	-	Needs analysis; Delphi round 2
Protrusion of jaw	3 movements (63.6 %)	Stability	3 (70 %)	Stability	NA	-	Needs analysis; Delphi round 2
Stretch	5 movements (100 %)	Consensus	3 (90 %)	Consensus	5 sec (63.6 %)	Stability	Needs analysis; Delphi round 2

**Table 6.9. Questionnaire round three: Exercises and dosages.**

Tables 6.7, 6.8 and 6.9 illustrates the varying responses regarding exercise dosages, where little consensus was reached for specific exercise dosages.

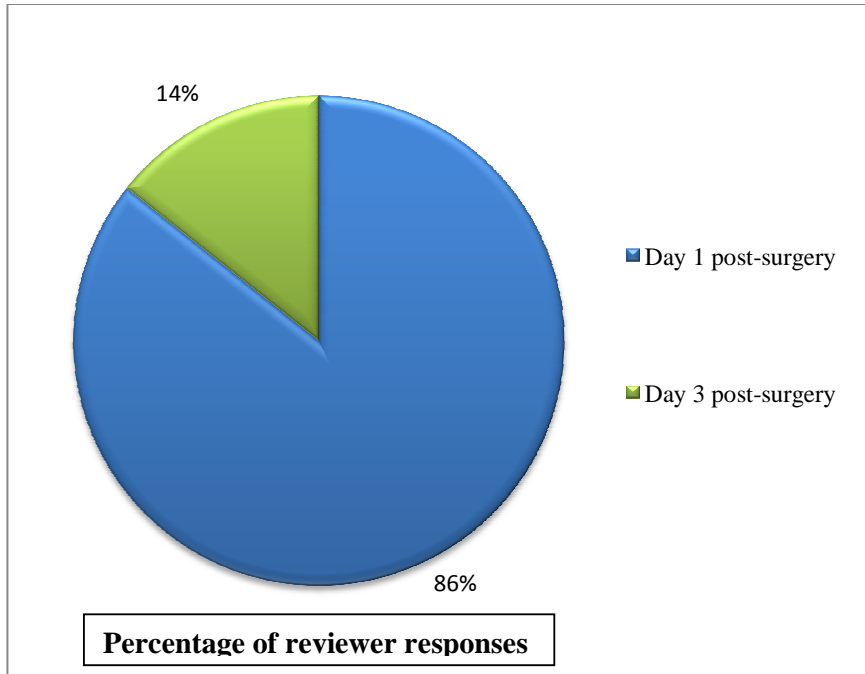
During round two of the Delphi questionnaire, there was a request by a reviewer to simplify the questions regarding exercise dosage. The researcher, together with the research supervisors and with acknowledgement of the reviewer’s comment, opted to combine the questions regarding the number of repetitions and the number of sets of those repetitions to be done, into one question. The question combination was done in an attempt to simplify the questions when read by members of the review panel. The question read: “How many repetitions should be done at one time”. The question might have proved easier for reviewers to understand. However, it was found that during round two of the questionnaire, consensus was reached regarding three sets of repetitions to be done for each masticatory muscle’s isometric muscle contraction (Graph 6.8). All questions had to be repeated as part of the third questionnaire round, as the question composition had been altered. When studying the results regarding the isometric contraction question from round three of the Delphi questionnaire, results illustrated that the majority of members of the review panel indicated that five

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repetitions of an isometric contraction per masticatory muscle, repeated three times per day, was deemed sufficient (Graph 6.9).

**6.4. Questions arising from members of the review panel's comments during the Delphi questionnaire rounds**

**6.4.1 Safety regarding the commencement of active jaw movements and isometric masticatory muscle contractions for intra- and extracapsular mandibular condyle fracture patients, treated with closed reduction. Only answered by dentists and maxillo-facial surgeons**

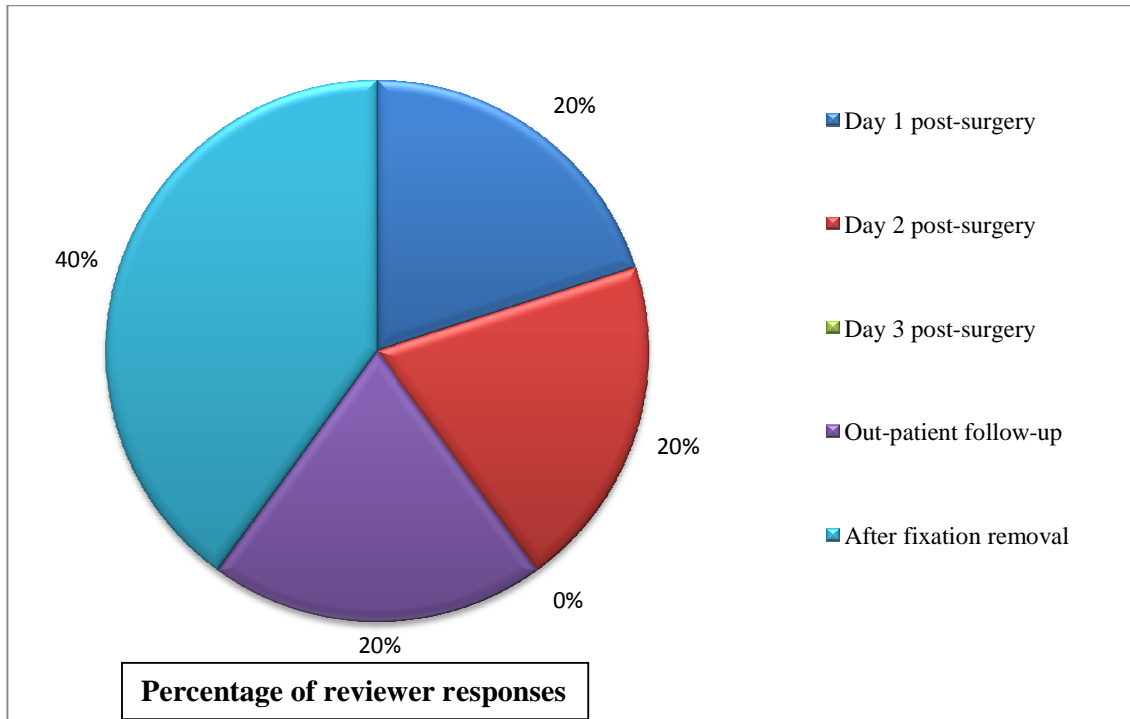


n = 7

**Graph 6.18. Safety regarding the commencement of active jaw movements and isometric masticatory muscle contractions for an intracapsular mandibular condyle fracture patient, treated with closed reduction.**

Consensus was reached between maxillo-facial surgeon and dentist members of the review panel regarding the commencement of active jaw movements and isometric masticatory muscle contractions for an intracapsular mandibular condyle fracture patient, treated by closed reduction (Graph 6.18). The selected review panel members, were in agreement that it was safe to start active jaw movements and isometric masticatory muscle contractions, day one after closed reduction of an intracapsular mandibular condyle fracture.

**6.4.2. Safety regarding the commencement of active jaw movements and isometric masticatory muscle contractions treated with closed reduction (extracapsular mandibular condyle fracture)**



n = 5

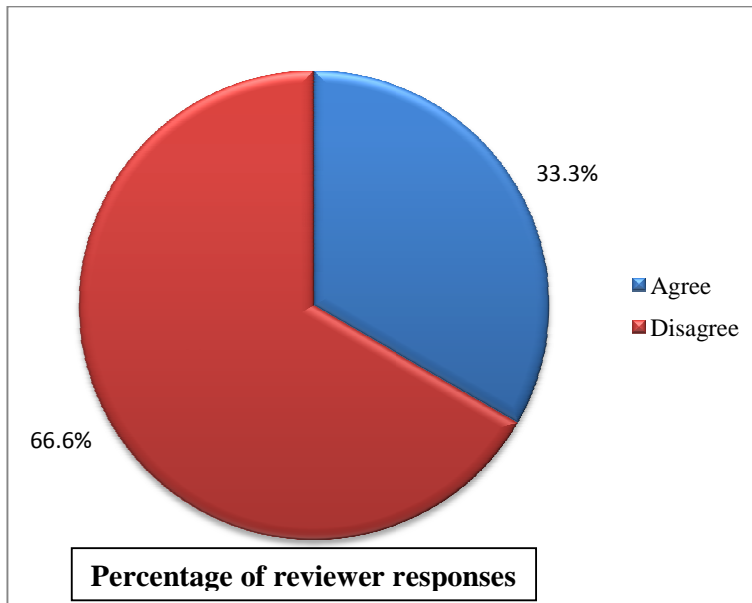
**Graph 6.19. Safety regarding the commencement of active jaw movements and isometric masticatory muscle contractions for an extracapsular mandibular condyle fracture patient, treated with closed reduction.**

No consensus could be reached by round three of the questionnaire regarding the commencement of jaw movements and isometric masticatory muscle contractions, when treating a patient with an extracapsular mandibular condyle fracture, treated by closed reduction (Graph 6.19).

The two questions posed regarding the safety of active and isometric jaw movements following closed reduction for an intra- and extracapsular mandibular condyle fracture, was only answered by the maxillo-facial surgeons and dentists (Graph 6.18 and 6.19). This was due to the fact that maxillo-facial surgeons and dentists' training is specifically specialised in the facial area. The fact that maxillo-facial surgeons and dentists are skilled in one particular

anatomical area ensured that the answers given would be accurate according to their field of specialisation. Refer to graphs 6.18 and 6.19.

#### **6.4.3. Posterior-Anterior / Anterior-Posterior condyle movement may give rise to a dysfunction of the lower jaw compartment**



**n = 12**

#### **Graph 6.20. Posterior-Anterior / Anterior-Posterior condyle movement may give rise to a dysfunction of the lower jaw compartment.**

One reviewer was of the opinion that a posterior-anterior / anterior-posterior condyle movement (as happens within the TMJ during mandibular protrusion) could give rise to a dysfunction of the lower jaw compartment and should be avoided. The question regarding the safety of a posterior-anterior / anterior-posterior condyle movement was then posed to reviewers. No consensus could be reached by the third round addressing the use of posterior-anterior / anterior-posterior condyle movement (Graph 6.20). Although stability was reached indicating posterior-anterior / anterior-posterior mandibular condyle movements to be safe, the maxillo-facial surgeon responsible for the patient should be contacted to ensure the safety of a mandibular protrusion movement following a mandibular condyle fracture.

In the next chapter a summary of the results of the Delphi questionnaire rounds will be discussed in detail.

# CHAPTER 7

## Summary of the conducted research, discussion and recommendations

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In this chapter a brief summary of the conducted research is given, followed by the study discussion and recommendations.

### **7.1. Summary and discussion of the conducted research**

#### **7.1.1. Aim of the study**

The aim of the study was to perform a needs analysis amongst maxillo-facial surgeons and physiotherapists in South Africa, regarding the perceived need for a post-operative physiotherapy intervention program for patients who sustained mandibular condyle fractures. Furthermore, the study also aimed to compile a proposed post-operative physiotherapeutic intervention program for patients who have sustained mandibular condyle fractures, by utilising the Delphi method.

#### **7.1.2. Literature review**

A brief summary of the literature review is given to illustrate the rationale for the conducted research.

The complications caused by trauma to the temporomandibular joint (TMJ) are far reaching in their effects and not always immediately apparent after trauma or surgery (Zachriadis *et al.*, 2006:429). Mandibular fractures are classified as TMJ macrotrauma and may result in limited mandibular movement, cause degeneration of the articular cartilage, alter the mechanical properties of the articular disc or cause the production of inflammatory and pain mediators (Yun and Kim 2005:1576-1577; Zachariadis *et al.*, 2006:422; De Leeuw 2008:160).

A number of studies have found that an ideal prognosis for mouth function cannot be obtained without the appropriate post-surgical functional exercises (Thiele and Marcoot 1985:227; Hwang *et al.*, 2005:116; Rikhotso and Ferretti 2008:226; Feng *et al.*, 2009:46). According to Feng *et al.* (2009) and Trott (2011) patients who have not received an appropriate post-surgical exercise program experienced difficulty with mouth opening, fracture displacement and these patients demonstrated a reduction in gap size (Feng *et al.*,

2009:47; Trott 2011:5). A South African maxillo-facial research study specifically highlighted the need for physiotherapy intervention in the treatment of mandibular condyle fractures (Rikhotso and Ferretti 2008:226).

### **7.1.3. Problem statement**

No physiotherapy research has been done regarding the need for post-operative physiotherapy intervention for patients, in South Africa, who sustained mandibular condyle fractures.

No unifying criteria was found in the available literature regarding the type and dose of post-surgical functional exercises for patients who sustained mandibular condyle fractures (Bevilaqua-Grosso *et al.*, 2002:27; Yun and Kim 2005:1576; Feng *et al.*, 2009:46). Thus, no physiotherapeutic intervention program for the management of mandibular condyle fractures is available.

### **7.1.4. Research design**

Quantitative, non-experimental information, by means of a needs analysis questionnaire was collected from the needs analysis respondents.

The Delphi questionnaire, compiled from the needs analysis results as well as current literature, and personal communication between maxillo-facial surgeons and the researcher, was used to compile an effective and safe post-surgical functional exercise program for patients who sustained mandibular condyle fractures.

### **7.1.5. Methodology design**

An online electronic questionnaire was the chosen research design for both the needs analysis questionnaire and the Delphi questionnaire.

### **7.1.6. Study population and sampling**

The target population for the needs analysis was maxillo-facial surgeons and physiotherapists [who have completed their post-graduate certificate in Orthopedic Manipulative Physical Therapy (OMPT), with a special interest in cranio-mandibular disorders]. The needs analysis included 11 respondents, seven physiotherapists and four maxillo-facial surgeons. The maxillo-facial surgeons were representative from each of the four South African maxillo-

facial training institutions. Of the eight physiotherapy training institutions in South Africa, only seven institutions were represented in the needs analysis. One physiotherapy training institution failed to nominate a participant from their institution, or a suitable replacement, despite persistent electronic and telephonic requests by the researcher. Eight questionnaires were analysed.

The Delphi review panel included experts in the maxillo-facial, dentistry and cranio-mandibular physiotherapy fields in South Africa and abroad. The Delphi round one review panel consisted of eight physiotherapists, eight maxillo-facial surgeons and four dental surgeons. It was deemed optimal to include three international physiotherapists, three international maxillo-facial surgeons and one international dentist on the review panel. Unfortunately only two international physiotherapists and two international maxillo-facial surgeons complied with the time limit set for the return of the completed informed consent forms. After the completion of round three of the Delphi questionnaire, only one international physiotherapist, one international maxillo-facial surgeon and two international dental surgeons were still included in the study.

Maxillo-facial surgeons were included if they completed the specialisation degree in maxillo-facial surgery or a post-graduate qualification in maxillo-facial surgery. The dental surgeons, with no specialisation in maxillo-facial disorders, all obtained a Bachelor of Dental Surgery (B.Ch.D.) degree and at least five years work experience in the dental surgery field. Physiotherapists were included if they completed their post-graduate certificate in OMPT, has a special interest in cranio-mandibular disorders and had a minimum of two years work experience in the cranio-mandibular field.

There were 20 reviewers included in the review panel in round one of the questionnaire. Due to reviewer drop-out the second round included 16, and the third and final round 14.

#### **7.1.7. Reliability and validity**

To facilitate the face validity of the research study, a pilot study of both the needs analysis and all Delphi questionnaire rounds were performed. No study towards validity and reliability was done regarding the needs analysis and Delphi questionnaires.

## Chapter 7: Summary of the conducted research, discussion and recommendations

A decrease in the needs analysis questionnaire validity could have been present due to the specific inclusion and exclusion criteria set. Questions were worded for the adequately trained physiotherapist, but who did not necessarily have the clinical exposure regarding mandibular condyle fracture patients. A change in the inclusion and exclusion criteria or a change in question wording, could have prevented the possible decrease in validity.

When reviewing the Delphi questionnaire results, it should be kept in mind that due to the ratio of national:international reviewers not being optimally met, the validity and reliability of the study could have been decreased. Although everything in the researcher's power was done to obtain the aimed amount of international participants, some international maxillo-facial surgeons and physiotherapists did not respond.

The research was supervised by two, OMPT physiotherapists, which aimed to ensure the strength of the study. A thorough literature review, the researcher's own interest in the physiotherapeutic treatment of patients who sustained mandibular condyle fractures, the experience and training of the researcher and consultation of other physiotherapists in the field of OMPT for their input during the research study, also aimed to strengthen the validity and reliability of the study.

Personal communication between the researcher and maxillo-facial surgeons, regarding the formulation of needs analysis and Delphi questionnaire questions, also strengthened the study's validity and reliability.

The researcher made sure that the study's validity was not influenced by faulty measurement items or coding errors by the taking the necessary pre-cautions.

**7.2. Results of the needs analysis and Delphi questionnaire**

**7.2.1. Statements and questions, regarding demographical information and mandibular condyle fracture statistics, posed to participants and review panel members during the needs analysis and Delphi questionnaire**

Statements and questions posed to participants and review panel members	Needs analysis	Delphi questionnaire
Number of respondents	n = 8	<u>Round 1:</u> n = 16 <u>Round 2:</u> n = 14 <u>Round 3:</u> n = 12
Profession of respondents	Maxillo-facial surgeons = 22.2 %  Physiotherapists = 77.8 %	<u>Round 1:</u> Maxillo-facial surgeons = 37.4 % Dental surgeons = 18.8 % Physiotherapists = 43.8 %  <u>Round 2:</u> Maxillo-facial surgeons = 35.7 % Dental surgeons = 14.3 % Physiotherapists = 50 %  <u>Round 3:</u> Maxillo-facial surgeons = 25 % Dental surgeons = 16.7 % Physiotherapists = 58.3 %
Respondents currently treating in-hospital patients who sustained mandibular condyle fractures	Yes = 25 %  No = 75 %	Maxillo-facial surgeons = 31 %  Dental surgeons = 0 % Physiotherapists = 0 %  No = 50 %
Respondents currently treating out-patients who sustained mandibular condyle fractures	Yes = 13 %  No = 87 %	Maxillo-facial surgeons = 31 %  Dental surgeons = 6 % Physiotherapists = 13 %  No = 69 %

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<b>Statements and questions posed to participants and review panel members</b>	<b>Needs analysis</b>		<b>Delphi questionnaire</b>	
Treatment modalities currently utilised by respondents	n = 3  Maxillo-facial surgeons = ORIF; Closed reduction  Physiotherapists = ice / heat; Ultrasound / laser; Soft tissue mobilisation		n = 8  Maxillo-facial surgeons = ORIF, Arch bars with elastics, Closed reduction, Condylectomies, Wire fixation  Physiotherapists = Soft tissue mobilisation, Joint mobilisation, Electrotherapy, Postural advice, Strengthening exercises, Taping	
Reported in-hospital functional loss following ORIF surgery or closed reduction	ORIF	Closed reduction	ORIF	Closed reduction
	0 - 10 % = 66.3 %	0 - 10 % = 33.3 %	0 - 10 % = 41.3 %	0 - 10 % = 8.3 %
	11 - 49 % = 33.3 %	11 - 49 % = 66.3 %	11 - 49 % = 8.3 %	11 - 49 % = 41.7 %
			50 - 79 % = 41.3 %	50 - 79 % = 25 %
			80 - 100 % = 8.3 %	80 - 100 % = 25 %

Statements and questions posed to participants and review panel members	Needs analysis		Delphi questionnaire	
Reported functional loss at follow-up following ORIF surgery or closed reduction	ORIF	Closed reduction	ORIF	Closed reduction
	0 – 10 % = 66.7 %	0 – 10 % = 33.3 %	0 – 10 % = 35.7 %	0 – 10 % = 23.1 %
	11 – 49 % = 33.3 %	11 – 49 % = 33.3 %	11 – 49 % = 35.7 %	11 – 49 % = 53.8 %
		50 – 79 % = 33.3 %	50 – 79 % = 21.4 %	50 – 79 % = 15.4 %
			80 -100 % = 7.2 %	80 – 100 % = 7.7 %
The need for all mandibular condyle fracture patients to receive physiotherapy intervention as a pre-cautionary measure	Agree = 85.7 % Disagree = 14.3 %		Agree = 100 %	
Professional responsible for administration and evaluating progression of post-surgical exercise regimes and advice (n = 15)	NA		Maxillo-facial surgeons = 13.3 % Physiotherapists = 86.7 %	

**Table 7.1. Results of the needs analysis and Delphi questionnaire.**

**7.2.2. Questions, regarding the need for physiotherapy intervention for mandibular condyle fracture patients, only appearing in the needs analysis**

The following questions only appeared in the needs analysis, and not in the Delphi questionnaire (Table 7.2):

<b>Statements and questions posed to participants</b>	<b>Results</b>
All mandibular condyle fractures, regardless of anatomical area of the fracture, require physiotherapy (n = 7)	Yes = 100 %
Mandibular condyle fracture patients should only receive physiotherapy intervention when complaining of functional impairment and pain (n = 7)	Agree = 28.6 % Disagree = 71.4 %
The need for physiotherapy for mandibular condyle fracture patients treated by ORIF (n = 7)	0 – 10 % = 14.3 % 50 – 79 % = 28.6 % 80 – 100 % = 57.1 %
The need for physiotherapy for mandibular condyle fracture patients treated by closed reduction (n = 6)	50 – 79 % = 33.3 % 80 – 100 % = 67.7 %

**Table 7.2. Questions only appearing in needs analysis.**

The results of both the needs analysis and Delphi questionnaire, suggest that there is a proposed need for post-operative physiotherapy intervention in the treatment of patients, treated by either ORIF surgery or closed reduction, after sustaining mandibular condyle fractures (Tables 7.1 and 7.2). The proposed need for post-operative physiotherapy intervention may be subject to reviewer bias, due to the predominant profession of reviewers being that of physiotherapy. Rikhotso and Ferretti (2008:226) also emphasised in their research the need for appropriate physiotherapy treatment in mandibular condyle fracture patients.

The response rate for the needs analysis, 73 %, was well within the acceptable parameters set by previous questionnaire based studies (Miles-Tapping, Dyck, Bunham, Simpson and Barber 1990:450; Deutskens, De Ruyter, Wetzels, Oosterveld. 2004:23; Keeny, Hasson and

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McKenna 2006:207, 209; Hung *et al.*, 2008:194). Unfortunately only 27 % of the participants currently treat patients who sustained mandibular condyle fractures, posing questions regarding physiotherapeutic treatment techniques, pre-cautionary measures to be considered and the incidence of reported functional loss by mandibular condyle fracture patients to remain unanswered by a large number of participants.

**7.2.3. Pre-cautionary measures**

<b>Pre-cautionary measure</b>	<b>Response count for post-ORIF surgery (n = 6)</b>	<b>Response count for patients treated by closed reduction (n = 5)</b>
Soft diet	2	0
No ultrasound directly over the surgical area	1	1
No resisted exercises	1	1
No forced movements stressing the joint	1	1
No interferential current therapy over the surgical area	1	1
No dry needling over the surgical area	1	1
Will contact surgeon regarding specific precautionary measures	1	1
Prevent bleeding and infection	1	1
Mandibular and TMJ problems are not taught in our undergraduate curriculum. We do however give handouts to the students and refer to it as a self study topic	1	1

**Table 7.3. Pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient, following ORIF surgery or closed reduction: as listed by needs analysis participants.**

<b>Pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient</b>	<b>ORIF surgery</b>		<b>Closed reduction</b>	
	<b>Response %</b>	<b>Consensus/ Stability/ None</b>	<b>Response %</b>	<b>Consensus/ Stability/ None</b>
Ultrasound directly over the surgery area	Questions combined 18.2 %	Stability	Questions combined 50 %	Stability
Interferential current treatment directly over surgery area				
No resisted exercises	36.4 %	Stability	41.7 %	Stability
Active movements within limits of pain	Questions combined 45.5 %	Stability	Questions combined 50 %	Stability
No end range joint movements				
Dry needling in the facial area	0 %	Consensus	NA	Consensus
Maintaining a soft diet	63.6 %	Stability	50 %	Stability
All of the above	36.4 %	Stability	8.3 %	Stability

**Table 7.4. Round three of the Delphi questionnaire: Pre-cautionary measures to be considered when treating an in-hospital mandibular condyle fracture patient, following ORIF surgery or closed reduction.**

<b>Duration of pre-cautionary measures</b>	<b>Response count for ORIF surgery patients (n = 5)</b>	<b>Response count for closed reduction patients (n = 5)</b>
Two weeks	1	2
Three weeks	-	1
Six weeks	1	-
Not currently treating this patient population, and do not feel comfortable giving an answer	2	2

**Table 7.5. Duration of pre-cautionary measures for mandibular condyle fractures treated with ORIF surgery or closed reduction: as listed by needs analysis participants.**

<b>Duration of pre-cautionary measures</b>	<b>ORIF surgery</b>		<b>Closed reduction</b>	
	<b>Response %</b>	<b>Consensus/ Stability/ None</b>	<b>Response %</b>	<b>Consensus/ Stability/ None</b>
Two weeks	16.7 %	Stability	16.7 %	Stability
Three weeks	8.3 %	Stability	33.3 %	Stability
Four weeks	16.7 %	Stability	NA	NA
Five weeks	NA	NA	NA	NA
Six weeks	58.3 %	Stability	50 %	Stability

**Table 7.6. Round three of the Delphi questionnaire: Duration of pre-cautionary measures for mandibular condyle fractures treated with ORIF surgery or closed reduction.**

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The lack of responses to certain needs analysis and Delphi questionnaire questions may be due to the fact that many participants, and some reviewers, are not currently treating patients who sustained mandibular condyle fractures. Participants and reviewers demonstrated uncertainty when providing answers regarding possible treatment techniques and pre-cautionary measures, as they were not familiar with the clinical presentation of mandibular condyle fracture patients (Tables 7.3 and 7.4). Participants had the option to refrain from answering certain questions with which they felt uncomfortable with, for fear of giving the “wrong answer”, as commented by one review panel member. However, due to the specific inclusion criteria, all respondents had adequate training and knowledge to provide opinions regarding the treatment, pre-cautionary measures, and duration of listed pre-cautionary measures to be considered, when treating mandibular condyle fracture patients (Tables 7.3, 7.4, 7.5 and 7.6). It was of the reviewers’ own accord if they chose not to reply to a question. As highlighted by one needs analysis participant, the uncertainty regarding questionnaire completion could have been due to the fact that every mandibular condyle fracture patient presents and is treated differently, and some participants might have felt uncomfortable to generalise when providing questionnaire answers.

Pre-cautionary measures to be considered, and the duration of these pre-cautionary measures, varied considerably between Delphi questionnaire rounds and consensus could not be reached between reviewers (Tables 7.3, 7.4, 7.5 and 7.6). The lack of inter-reviewer agreement may again be due to the loss of review panel interest in the questionnaire as the rounds progressed, or could be due to declining reviewer responses. When analysing the results, it was observed that six weeks demonstrated a relatively constant high response rate regarding the adherence to pre-cautionary measures for both patients treated by ORIF surgery or closed reduction (Table 7.6). When analysing the responses in Delphi questionnaire round one, for both ORIF and closed reduction treatments, results showed that a number of members of the review panel considered electrotherapy, active movements within pain limits and no end range exercises to be of high importance. It would then seem apparent that if the above-mentioned categories were grouped together, consensus should be reached regarding pre-cautionary measures. However, when grouped together, it seemed the responses varied even more (Table 7.4). This may be due to the decreased inter-round response rates, as well as a loss in interest in the study or topic as the questionnaire rounds progressed. The research aimed to minimise decreasing response rates by limiting the questionnaire rounds to a maximum of three (Keeney *et al.*, 2006:207; Skulmoski and Hartman 2007:11).

**7.2.3. Statements regarding physiotherapy intervention achieving consensus during the Delphi questionnaire**

All mandibular condyle fracture patients should receive physiotherapy as preventative measure
In-hospital visits should consist of post-surgical advice for ORIF surgery patients
In-hospital visits should consist of advice for closed reduction patients
In-hospital visits should consist of active jaw exercises
In-hospital visits should consist of isometric jaw muscle exercises
In-hospital visits should consist of jaw muscle stretches
In-hospital visits should consist of massage of the facial muscles
In-hospital visits should consist of cervical postural advice
Active jaw opening exercise comprises of the patient gently opening and closing the mouth
An active lateral mandibular exercise comprises of the patient protruding the mandible then slightly moving it to the side
An active mandibular protrusion exercise comprises of the patient moving the mandible forward as far as pain allows
Stretching of the jaw muscles is done by progressively wedging tongue depressors in the incisal space, increasing the number of depressors as pain allows
Ice can be applied to the surgery area straight after surgery to decrease pain and swelling.
In hospital visits should not consist of passive accessory temporomandibular joint mobilisations (joint mobilisation done by the therapist)
Physiotherapy evaluation and treatment of mandibular condyle fractures, treated with closed reduction, can be commenced day one post-operative
Active jaw movements and isometric masticatory muscle contractions for an intracapsular mandibular condyle fracture patient, treated by closed reduction, can be started day one post-operative

**Table 7.7. Statements regarding physiotherapy intervention achieving consensus during the Delphi questionnaire.**

**7.2.4. Statements achieving stability by the third and final round of the Delphi questionnaire (no consensus reached)**

Statement	Highest percentage scored in the final Delphi questionnaire round
Physiotherapy evaluation and treatment of mandibular condyle fractures, treated with ORIF surgery, should be commenced day one post-operative	75 %
It was disagreed that posterior-anterior/anterior-posterior condyle movement may give rise to a dysfunction of the lower jaw compartment	66.6 %
The number of in-hospital physiotherapy visits deemed adequate for mandibular condyle fractures treated by ORIF surgery	Three visits = 50 % Until hospital discharge = 50 %
The number of in-hospital physiotherapy visits deemed adequate for mandibular condyle fractures treated with closed reduction	As many as deemed effective = 36.4 %
Jaw exercises to be done in front of a mirror to prevent incorrect mandibular deviation	Jaw opening = 58 % Lateral movement = 50 %
Jaw exercises to be done with light guided hand pressure to prevent incorrect mandibular deviation	All = 45.5 % Jaw opening = 45.5 %
Commencement of active jaw movements and isometric masticatory muscle contractions for an extracapsular mandibular condyle fracture patient, treated by closed reduction	After fixation removal = 40 %

**Table 7.8. Statements achieving stability by the third and final round of the Delphi questionnaire (no consensus reached).**

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The number of in-hospital physiotherapy treatments for mandibular condyle fracture patients, which was deemed adequate by review panel members, varied significantly between questionnaire rounds (Table 7.8). During round two of the questionnaire 64.3 % of the review panel members agreed that ORIF surgery patients should be treated by a physiotherapist until discharged from hospital. During round three this decreased to 50 % of the review panel members indicating that a mandibular condyle fracture patient, treated with ORIF surgery, should be seen until hospital discharge, and 50 % of the review panel members indicated that three visits should be adequate.

For patients treated with closed reduction a trend was noted during questionnaire rounds one and two towards the patient being treated by a physiotherapist until discharged from hospital (Table 7.8). However, during round three the highest response, 36.4 %, was received for the option that patients treated with closed reduction should receive as many treatments as deemed adequate for each individual patient. The variation in results could be due to a lack in review panel interest as the questionnaire rounds advanced, or due to the fact that all mandibular condyle fracture patients differ in their clinical presentation. An open channel of communication between the surgeon and physiotherapist is therefore of utmost importance to establish the most beneficial physiotherapy treatment program for each individual patient (Pruitt and Epping-Jordan 2005:638; Trott. 2011:5).

### **7.2.5. Physiotherapeutic interventions, commencement of interventions and exercise dosages included in a post-surgical exercise protocol**

Results indicated that consensus was achieved regarding the majority of physiotherapeutic interventions to be included in a post-surgical exercise protocol, indicating inter-reviewer agreement (Table 7.7). This was substantiated by literature stating that controlled micro-movements, achieved through pain-free active joint movements, accelerate bone repair after fractures (Andreasen *et al.*, 2008:17). The mandible has a rich blood supply, enabling accelerated fracture healing, resulting in most mandibular fractures being united and consolidated by three weeks post-fracture (Trott 2011:5). As noted by a participant, pain and swelling in the jaw area would be present after the surgical treatment of a mandibular condyle fracture, by either ORIF surgery or closed reduction, inevitably resulting in a decrease in joint range of motion and function. This is substantiated by the studies conducted by Gonzalez *et al.* (1992), Worsaae and Thirn (1994), Bevilaqua-Grosso *et al.* (2002) and Hwang *et al.* (2005).

Stability, but not consensus, was achieved regarding exercises to be performed in front of a mirror. During round two of the Delphi questionnaire 64.3 % of review panel members indicated that all exercises should be done in front of a mirror, but during round three there was a marked decline, of 22.6 %, to 41.7 % of reviewers agreeing that all jaw exercises should be done in front of a mirror. During the third and final questionnaire round the highest response recorded were 58.3 % of members of the review panel indicating only jaw opening exercises should be done in front of a mirror. This varied distribution of results could be due to the iterative process within Delphi studies, as the rounds progressed. As the number of questionnaire rounds increases, and thus also the effort required by Delphi reviewers, there tends to be a fall in the response rates (Keeney *et al.*, 2006:209, Skulmoski and Hartman 2007:11).

Studies conducted by Hwang *et al.* (2002); Hwang *et al.* (2005) and Rikhotso and Ferretti (2008) included exercises done in front of a mirror or with light guided hand pressure, in front of a mirror. Light guided hand pressure was done to decrease incorrect mandibular movement patterns (Hwang *et al.*, 2002:709; Hwang *et al.*, 2005:114-115; Rikhotso and Ferretti 2008:223). During this study only stability could be reached regarding which exercises should be done with light guided hand pressure and / or in front of a

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mirror (Table 7.8). In the Delphi questionnaire, jaw opening and lateral movement were the two exercises, together with the option “all of the above”, demonstrating the least fluctuation in responses between rounds, with response percentages remaining relatively stable between rounds. Mirror guided jaw opening exercise scored 62.5 % during round one, 43 % during round two and 58.3 % during round three. Mirror guided lateral mandibular movement scored 37.5 % during round one, 43 % during round two and 50 % during round three. The answers received from review panel members for the option “all of the above”, included as from round two, remained fairly consistent between 57.1 % during round two and 41.7 % during round three.

The option for “all of the above”, with regards to mirror guided jaw exercises being done with light guided hand pressure, also demonstrated an increase in reviewer response rate from 29 % (round two) to 45.5 % (round three), but could still not achieve consensus by the final questionnaire round. As the option, for all listed exercises to be done with light guided hand pressure, did not form part of the answers provided during round one and was only introduced to members of the review panel during round two of the questionnaire, no data was obtained regarding this answer option during round one.

Treatment	Commencement	Response %	Round	Consensus/ Stability/ None
Cervical and post-surgical advice	Day one post-surgery	66.7 %	3	Stability
Active jaw exercises	Day one post-surgery	72.7 %	3	Stability
Isometric jaw exercises	Day one post-surgery	66.7 %	3	Stability
Jaw muscle stretches	Out-patient follow-up/ after fixation removal	45.5 %	3	Stability
Massage of facial muscles	Day one post-surgery	50 %	3	Stability
Passive accessory TMJ movements by therapist	Out-patient follow-up	58.3 %	3	Stability

**Table 7.9. Commencement of different treatment modalities after mandibular condyle fractures, treated with either ORIF surgery or closed reduction.**

Conflicting results were observed during result analyses regarding the incorporation of a masticatory muscle stretch into a post-surgical exercise regime for mandibular condyle fracture patients (Table 7.9). Patients tend not to open their mouths with enough force due to pain, resulting in dysfunctional masticatory recovery (Feng *et al.*, 2009:47). Therefore, jaw muscle stretching should be incorporated in an exercise program as soon as the healing process allows. Members of the review panel reached consensus regarding the inclusion of a masticatory muscle stretch, as well as the dosage of the appropriate stretch. However, in a question posed later in the questionnaire, members of the review panel did not reach consensus regarding the commencement of a jaw muscle stretch. Some reviewers opted for stretching only being commenced at out-patient follow-up, or after fixation removal if applicable. Feng *et al.* (2009:48) reported that jaw muscle stretching has significant positive effects regarding promotion of healing of the fractured bone ends, and should be included in a post-surgical exercise regime as soon as the patient's condition allows.

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Consensus was reached with regards to the commencement of in-hospital physiotherapy treatment, day one after closed reduction treatment of a mandibular condyle fracture (Table 7.9). By the third and final questionnaire round, only stability was reached regarding the commencement of in-hospital physiotherapy treatment, day one after ORIF surgery. The results are supported by studies by Zachariades *et al.* (2006) and Trott (2011) stating that internal fixation provides adequate stabilisation, allowing early mobilisation (Zachariades *et al.*, 2006:433; Trott. 2011:5). The statement by Zachariades *et al.* (2006) and Trott (2011) is supported by Feng *et al.* (2009) reporting that rigid fixation allows exercises to commence immediately, preventing pain and dysfunction (Feng *et al.*, 2009:46).

Exercise	Repetitions at one time		Repetitions per day		Contraction / stretch held for		Exercise obtained from
		Consensus/ Stability/ None		Consensus/ Stability/ None		Consensus/ Stability/ None	
Isometric jaw muscle contractions	5 contractions per muscle (63.3 %)	Stability	3 (77 %)	Stability	5sec (66.7 %)	Stability	Needs analysis; Delphi round 2
Jaw opening	5 movements (70 %)	Stability	3 (83.3 %)	Consensus	NA	-	Needs analysis; Delphi round 2
Lateral jaw movement	5 movements (75 %)	Stability	3 (70 %)	Stability	NA	-	Needs analysis; Delphi round 2
Protrusion of jaw	3 movements (63.6 %)	Stability	3 (70 %)	Stability	NA	-	Needs analysis; Delphi round 2
Stretch	5 movements (100 %)	Consensus	3 (90 %)	Consensus	5sec (63.6 %)	Stability	Needs analysis; Delphi round 2

**Table 7.10. Delphi questionnaire round three: Exercises and dosages.**

Responses regarding active exercise dosages varied between Delphi questionnaire rounds (Table 7.10). The varying in dosage prescription regarding active exercise dosage could be due to the fact that the review panel consisted of three different professions. From round two, questions pertaining to exercise dosage were grouped. Grouping of exercise related questions enabled the researcher to separately analyse answers given by dental surgeons and maxillo-facial surgeons from those answers given by physiotherapists.

After the completion of round two of the Delphi questionnaire, a request from a member of the review panel resulted in the restructuring of the exercise dosage questions. The

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restructuring of these questions meant that all exercise dosage questions were again included in the third and final Delphi questionnaire round.

Data analyses indicated that the majority of exercise dosage related questions reached consensus between physiotherapists, with the maxillo-facial surgeons and dentists only achieving consensus on 50 % of questions regarding exercise dosages, possibly due to their lack of practical experience regarding the prescription of post-surgical exercises. Physiotherapists achieved consensus on nearly 70 % of exercise dosage questions, with the remaining 30 % of questions achieving between 70 % and 76 % inter-reviewer agreement (consensus regarded as 80 % inter-reviewer agreement), illustrating that it is well within the scope of practise of physiotherapists to execute and continue with post-surgical exercise prescriptions.

Results regarding the dosage of isometric masticatory muscle contractions from the final Delphi questionnaire round, demonstrated that the majority of reviewers indicated that five repetitions of an isometric contraction per masticatory muscle, repeated three times per day, was sufficient in the production of masticatory muscle contraction and slight accessory TMJ movements (Table 7.10). When compared to research done by Rocabado (1983) and Morrone and Makofsky (1991), isometric jaw muscle contraction repetitions and daily dosages differed only slightly. Rocabado (1983) prescribed each isometric jaw muscle contraction to be maintained for six seconds, six repetitions per masticatory muscle, and repeated six times per day. Morrone and Makofsky (1991) prescribed each isometric masticatory muscle contraction to be maintained for two seconds, five repetitions per masticatory muscle done, and repeated five times per day. The study results concluded that reviewers deemed it satisfactory for each masticatory muscles' isometric contraction to be maintained for five seconds, with five contractions done per masticatory muscle, repeated three times per day. Trott (2011) also prescribed isometric jaw exercises, but provided no detailed exercise dosage.

According to Rocabado's study (1983), six repetitions of active jaw opening should be done, repeated six times per day. However, Morrone and Makofsky's (1991) study suggested five repetitions of jaw opening, repeated five times per day. Active jaw opening exercises were also mentioned in Trott's (2011) study, but only prescribed to perform six repetitions at a time, with no mention of daily repetition dosage. As illustrated in Table 7.10, this study

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found that five repetitions of jaw opening, repeated three times per day is deemed satisfactory by review panel members.

The review panel members deemed it suitable for five repetitions of active lateral mandibular movement to be repeated three times per day. The studies conducted by Thiele and Marcoot (1985) and Trott (2011) both prescribed lateral mandibular jaw exercises, but provided no detailed exercise dosage.

According to review panel members, three repetitions of active mandibular protrusion should be repeated three times per day.

Trott (2011) prescribed jaw muscle stretches, to be commenced as soon as fixation and the maxillo-facial surgeon allow it, but mentioned no dosage. She suggested only for the exercise to be continued until the maximum tolerated range of movement is achieved. Five jaw muscle stretches, each stretch held for five seconds, were deemed satisfactory by the review panel members. Consensus was reached between reviewers that the jaw muscle stretches should be repeated three times per day.

Studies conducted by Bevilaqua-Grosso *et al.* (2002); Hwang *et al.* (2002); Hwang *et al.* (2005); Zachariades *et al.* (2006) and Feng *et al.* (2009) all suggested post-surgical exercises for mandibular condyle fracture patients, but mentioned no exercise dosage. Nicolakis, Erdogmus, Kopf, Nicolakis and Piehslinger (2002) provided similar TMJ exercises as the above mentioned studies, for patients diagnosed with cranio-mandibular disorders, but also mentioned no exercise dosage.

When compared to the general principals regarding exercise prescription, the exercise dosage suggested by the Delphi review panel correlated slightly with the general exercise prescription guidelines proposed by literature. Isometric exercises are usually the first form of strengthening after injury, especially if severe pain or immobility is present. Isometric exercises have also been proven to increase muscle endurance (Kisner and Colby 2007:163). Brukner and Kahn (2002:145) proposed isometric exercises to be held for five seconds, with a ten second rest period, repeated ten times. Isometric exercise sets should then be repeated frequently throughout the day. No mention was made of daily dosage (Brukner and Kahn

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2002:145). Kisner and Colby (2007:169) proposed that isometric exercises be held for six to ten seconds at a time, with no mention of the number of daily repetitions to be done.

Active exercises aimed at muscle strengthening should be started as soon as possible, and done within the patient's pain limits (Brukner and Kahn 2002:172). Literature suggests dosages ranging from one set of eight to twelve repetitions of each exercise (Gormely and Hussey 2005:111) to two to three sets of six to twelve repetitions of each exercise to be performed by the patient (Kisner and Colby 2007:163). To enhance muscle endurance Kisner and Colby (2007:163) suggests three sets of 40 to 50 repetitions of each exercise. Post-surgical exercise prescription guidelines advocate a low number of repetitions (only one set), performed at low intensity, to be repeated several times per day. As the healing process progresses, the number of sets of repetitions are increased gradually (Kisner and Colby 2007:163).

Musculotendinous flexibility is improved by maintaining a pain-free muscle stretch for a minimum of 15 seconds, progressing to a maximum of 60 seconds as healing occurs (Brukner and Kahn 2002:172-172).

In 1920, exercise was formally recognised as part of the physiotherapy profession by the Chartered Society of Physiotherapy (Gromley and Hussey 2005:3). According to the South African Physiotherapy Society, a physiotherapist is regarded as an expert in the field of exercise therapy (<http://www.physiosa.org.za>), supporting the fact that a physiotherapist is the most likely choice of healthcare professional that should execute and evaluate progression of a post-surgical exercise regime for mandibular condyle fracture patients. After intermaxillary fixation release, the physiotherapist will be the healthcare professional consulting with patients more frequently than the maxillo-facial surgeons and therefore the physiotherapist should supervise and progress the functional exercise program (Trott 2011:5). This view corresponds with results obtained from members of the review panel during the execution of this study.

**7.2.6. Symptoms warranting physiotherapeutic intervention, if mandibular condyle fracture patients are not routinely to be seen by a physiotherapist: Needs analysis questionnaire**

<b>Symptom</b>	<b>Results</b>
TMJ joint stiffness	100 %
TMJ pain	85.7 %
Facial muscle pain	85.7 %
A loss of function regarding speech and chewing	85.7 %
Incorrect jaw movements	71.4 %

**n = 8**

**Table 7.11. Symptoms warranting physiotherapeutic intervention, if mandibular condyle fracture patients are not routinely to be seen by a physiotherapist: Needs analysis questionnaire.**

The need for physiotherapy intervention in the treatment of mandibular condyle fractures has been highlighted in a South African conducted study (Rikhotso and Ferretti 2008:226), and is substantiated by the results of this study.

### **7.3 Response rates: Delphi questionnaire**

During the Delphi questionnaire the inter-round response rates were as follows: a 20 % drop in response rate during round one, a 12 % drop during round two, and a 14 % response rate drop during the final questionnaire round. The drop in response rates were in accordance to those reported in previous Delphi studies: 24 % response rate drop per round (Hassan in Keeny *et al.*, 2006:209) and an average response rate drop of 14 % (Hung *et al.*, 2008:194). As mentioned by Keeny *et al.* (2006:207) a downfall of questionnaire based research is the low response rates. During the Delphi questionnaire a decline of 20 % in responses between round one of the questionnaire (16 / 20 = 80 % responses) and round three (12 / 20 = 60 %) were noticed. This decline in response rates between round one and three of the Delphi questionnaire could result in a response bias if the attrition rate is substantial (Keeny *et al.*, 2006:209), but by the end of the final questionnaire round the attrition rate was only eight review panel members. Observing the inter-round responses from members of the review panel the drop-out remained low. Drop-out during round one was four review panel members, whilst during both round two and round three, only two review panel members dropped out. An inter-round response rate of over 80 % was maintained throughout all three rounds. The high response rate between rounds was satisfactory when compared to similar Delphi studies, and yielded an adequate number of data to obtain consensus and stability regarding all questions posed to the review panel (Miles-Tapping *et al.*, 1990:450; Keeny *et al.*, 2006:209; Hung *et al.*, 2008:194).

As physiotherapists are increasingly considering research an important part of their professional role, it was expected for physiotherapists to be more compliant with their responses during the Delphi questionnaire (Kamwendo. 2002:23). The research study was predominantly physiotherapy based, which could contribute to the fact that no physiotherapists dropped out during the Delphi study, as the study might be of more interest to physiotherapists. The nature of a Delphi questionnaire may also contribute to declining response rates, as the same questionnaire is repeatedly sent out until consensus is reached between members of the review panel (Keeny *et al.*, 2006:209; Hung *et al.*, 2008:194). This may result in members of the review panel losing interest in the study during subsequent rounds.

Kelley *et al.* (2003:264) and Keeney *et al.* (2006:207) stated that participants who are recruited personally by the researcher tend to have a higher response rate, and thus the researcher attempted to minimise the drop-out by encouraging interest, ownership and active participation of review panel members as well as following up non-responders with tenacity and persistence. Reviewer drop-out was minimised by contacting participants personally via e-mail, sending reports after each round stating which questions reached consensus and by sending weekly reminders to non-responders.

#### **7.4 Implementation of findings and recommendations**

As indicated by literature, studies have been conducted utilising various post-surgical exercise protocols, but until now no unifying criteria exist on the type and dose of functional exercises for patients presenting with mandibular condyle fractures (Bevilaqua-Grosso *et al.*, 2002:271; Yun and Kim 2005:1576; Feng *et al.*, 2009:46). Previous studies' exercise regimes varied in dosage, exercise types and was provided by the surgeons themselves with no physiotherapy interventions included. This highlighted the need for a specific physiotherapy exercise protocol to prevent any possible loss of function acquired by patients who sustained mandibular condyle fractures. Physiotherapists have an advanced understanding of how the human body moves and what prevents it from moving optimally, and are therefore proposed as experts in the field of pain relief, joint mobilisation, exercise therapy and correcting faulty movement patterns (<http://www.physiosa.org.za>). Therefore, physiotherapists should be able to provide an expert rehabilitative service to patients who sustained mandibular condyle fractures, aiding quicker recovery, slowing joint degeneration after trauma, reduce in-hospital stay and reduce the time demands placed on the surgeon's busy surgical schedule to also provide home advice and exercise prescription.

The results of the study will be made available to the physiotherapy departments of all the South African universities involved with physiotherapy training, as well as to the South African Orthopedic Manipulative Physical Therapy Group, for possible further implementation in the curriculum and OMPT course. The study results will also be presented to the maxillo-facial departments of all South African universities concerned with maxillo-facial training, for possible implementation in the curriculum.

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Participants and review panel members who partook in both the needs analysis and Delphi questionnaires, would have access to the final results, without compromising anonymity. The study results will be submitted as an article which could possibly be published in an accredited journal to create awareness amongst maxillofacial surgeons, as well as physiotherapists, regarding the role physiotherapy could play in the treatment of mandibular condyle fracture patients, and to open a new field to physiotherapists. The study provided a platform for expanding the evidence-base for physiotherapy in maxillo-facial conditions.

The needs analysis gathered evidence regarding the need for a post-operative intervention program for patients who sustained mandibular condyle fractures. The study results of the Delphi questionnaire finally provided a proposed post-operative physiotherapy intervention protocol for mandibular condyle fracture patients, by utilising opinions provided by known experts in the field, for possible use in further research studies and ultimately implementation. Further research should comprise of a control and experimental group in order to investigate the efficacy of the proposed post-operative intervention protocol before implementation.

### **7.5 Limitations**

As the study investigated an area where very few South African physiotherapists are currently actively practicing in, reviewers showed a certain number of unwillingness to participate in the research study. The unwillingness towards study participation resulted in the researcher not being able to increase the original sample size. Some participants and reviewers also demonstrated hesitance when answering questions regarding physiotherapy treatment for mandibular condyle fractures, as they do not necessarily have practical experience in the physiotherapy treatment of mandibular condyle fracture patients. This resulted in some needs analysis questions not being answered by all participants.

To prevent a decrease in the needs analysis questionnaire validity, the inclusion and exclusion criteria for the needs analysis questionnaire could be adjusted according to the participants' clinical experience. Questions were worded for the adequately trained physiotherapist, but who did not necessarily have the clinical exposure regarding mandibular condyle fracture patients. A recommendation for further research could be to separate the questions: the same question (1.1) to be answered by the participant who has the necessary clinical exposure, and (1.2) to be answered by the adequately trained participant with no clinical exposure.

The small needs analysis sample size could have posed a threat due to misrepresentation of results therefore care was taken when interpreting needs analysis results. However, as the needs analysis enquired regarding the need for physiotherapy in a currently unexplored area in South African physiotherapy, the results were still applicable and of value.

There is a strong possibility that recall bias may have been present in the questions relating to patient reported functional loss in-hospital and at follow-up after ORIF surgery or closed reduction for mandibular condyle fractures.

As the majority of respondents were physiotherapists which could introduce bias, in that physiotherapists will feel that physiotherapy is invaluable to mandibular condyle fracture patients.

The responses of certain questions were grouped together: “strongly agree” and “agree” were grouped together; “disagree” and “strongly disagree” were grouped together. This grouping

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could be viewed as a study limitation, as it requires extra time for the researcher to group and verify the results obtained. A recommendation for further research would be to have three options available (agree, disagree or undecided) to require participants to provide clear answers.

Inter-reviewer consensus could not be reached on all questions posed to reviewers, possibly due to the differing nature of reviewers' specialisation fields.

The Delphi questionnaire was not re-distributed to reviewers until consensus on all questions were achieved, a maximum of three rounds were sent to reviewers. Keeney *et al.* (2008:207) found in their discussion of the Delphi technique, that the number of questionnaire rounds may be decreased to minimise drop-out due to respondent fatigue. Studies cited in Keeney *et al.* (2008:207) found that response exhaustion starts to occur after two questionnaire rounds, especially with busy and timestrapped clinicians. This was reflected in literature where the number of Delphi questionnaire rounds varied between two and four (Keeney *et al.*, 2008:207).

## **7.6 Conclusion**

Dimitroulis (1998) described the aim of physiotherapy, with regards to the TMJ and mandible, to be the restoration of normal mandibular function by relieving musculoskeletal pain and to promote healing of injured tissue (Dimitroulis 1998:193).

The aim of the study was to perform a needs analysis amongst maxillo-facial surgeons and physiotherapists in South Africa, regarding the need for a post-operative physiotherapy intervention program for patients who sustained mandibular condyle fractures. The study also aimed to determine the content of a proposed post-operative physiotherapeutic intervention program for patients who have sustained mandibular condyle fractures, using the Delphi technique.

The study results were obtained by conducting a needs analysis (amongst physiotherapists and maxillo-facial surgeons) and a Delphi questionnaire (amongst physiotherapists, maxillo-facial surgeons, and dental surgeons) by means of electronic questionnaires.

The study results confirmed that, according to expert opinion, post-operative physiotherapeutic intervention for patients who sustained mandibular condyle fractures is of utmost importance. Even though questions pertaining to exercise dosages only achieved stability, the results regarding exercises to be included in a post-operative physiotherapeutic intervention provides information to be able to compile a comprehensive exercise program, together with proposed exercise dosages. The results of the study was used to compile a proposed post-operative intervention protocol for mandibular condyle fracture patients, by the researcher, which can be implemented as part of further research studies to assess the proposed intervention protocol's viability and efficacy (Addendum O).

As discussed in the studies conducted by Bevilaqua-Grosso *et al.* (2002), Yun and Kim (2005) and Feng *et al.* (2009) there are currently no unifying criteria regarding the physiotherapeutic management of mandibular condyle fractures. However, the need for adequate and prompt physiotherapy treatment in mandibular condyle fracture patients was emphasised by a South African study conducted by Rikhotso and Ferretti (2008), and also proposed by the results of the needs analysis and the Delphi questionnaire of this study.

Due to the fact that facial trauma is a major cause of TMJ cartilage degeneration, and intra-articular pathology, it is necessary to recognise the impact of trauma to the TMJ and provide

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adequate treatment for this patient population (Yun and Kim 2005:1576). As discussed in chapter 7, the Delphi questionnaire proposed various interventions to be included in the post-operative rehabilitation of mandibular condyle fractures.

It is advised that patient specific pre-cautionary measures, and the duration of these pre-cautionary measures, should be discussed with the maxillo-facial surgeon as each patient's clinical presentation differs.

The results of this current study provided a platform for expanding the evidence-base for physiotherapy in maxillo-facial conditions. The study provides a baseline for further clinical studies regarding a post-operative physiotherapy intervention for mandibular condyle fracture patients, and the implementation of the proposed post-operative physiotherapeutic intervention program. The post-operative physiotherapy intervention program developed in this current study was developed in an evidence-based way, which does not guarantee its efficacy in the prevention of complications amongst patients who underwent maxillo-facial surgery following a mandibular condyle fracture.

# CHAPTER 8

## References

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# CHAPTER 9

## Summaries

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### A SUMMARY OF THE RESEARCH CONDUCTED

**Research title:** The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.

The aim of the study was to perform a needs analysis amongst maxillo-facial surgeons and physiotherapists in South Africa, regarding the need for a physiotherapy intervention program for patients who sustained mandibular condyle fractures. Furthermore, the study also aimed to compile a proposed physiotherapeutic intervention program for the management of mandibular condyle fractures, by utilising the Delphi method.

The study consisted of two sets of internet questionnaires, sent out to experts in the fields of physiotherapy, maxillo-facial surgery and dental surgeons. The first part of the research comprised of a needs analysis questionnaire, aimed to determine the need for physiotherapy intervention for mandibular condyle fracture patients. The needs analysis questionnaire was sent out to qualified experts in the specific field: one physiotherapist and one maxillo-facial surgeon from each of the training institutions in South Africa.

The returned results were analysed by the researcher and a biostatistician, and a definite need for physiotherapy intervention for mandibular condyle fracture patients was identified. From the needs analysis questionnaire an online questionnaire, with statements regarding the type and dosage of a suitable physiotherapeutic treatment protocol, was sent out to a further 20 experts in the fields of physiotherapy, maxillo-facial surgery and dental surgery. Experts for the Delphi questionnaire included national and international physiotherapists, maxillo-facial surgeons and dental surgeons. After receiving reviewer responses after each questionnaire round, the questionnaire was adjusted according to reviewer comments, with the aim of achieving consensus on all questions / statements posed to reviewers. Any questions not achieving consensus between reviewers and any new statements made by the reviewers were included in the second and third rounds of this questionnaire. There were only three rounds of the Delphi questionnaire. For each round a two week period for completion was allowed.

This research study was not conducted on patients or in a hospital or university setting. As no treatment was administered, there was no risk or side-effects for study participants.

Physiotherapists are regarded as experts in the field of pain relief, joint mobilisation, exercise therapy and correcting faulty movement patterns. They can provide an expert rehabilitative service to patients who sustained mandibular condyle fractures, aiding quicker recovery, decreasing joint dysfunction after trauma, preventing and treating jaw joint dysfunctions and pain, reduce in-hospital stay and reduce time demands placed on the maxillo-surgeon regarding home advice and exercise prescription.

Value of the study:

- A proposed suitable physiotherapy intervention program for mandibular condyle fracture patients was developed.
- The current study provides a baseline for implementation of the proposed intervention program in further research studies.
- By focusing on physiotherapy-based treatment and research, a new avenue for physiotherapy was explored and the advantages of referring mandibular condyle fracture patients to physiotherapy, was presented.

**Key terms:** *mandibular condyle fractures; physiotherapy for mandibular condyle fractures; exercise; rehabilitation for mandibular condyle fractures; closed reduction for mandibular condyle fractures; open reduction and internal fixation for mandibular condyle fractures; temporomandibular joint; trismus treatment; needs analysis; Delphi questionnaire.*

## ‘N OPSOMMING VAN NAVORSING UITGEVOER

**Navorsings titel:** The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.

Die studie wat uitgevoer is het gepoog om ‘n behoeftebepaling te doen onder kaak-, gesig- en mondchirurgen asook fisioterapeute in Suid-Afrika, rakende die behoefte aan ‘n fisioterapeutiese intervensieprogram vir pasiënte wat mandibulêre kondiel frakture opgedoen het. Die navorsingstudie het ook gepoog om ‘n voorgestelde fisioterapeutiese intervensieprogram te ontwikkel vir pasiënte met mandibulêre kondiel frakture.

Die studie bestaan uit twee stappe: internet vraelys, uitgestuur aan kenners in die areas van fisioterapie, kaak-, gesig- en mondchirurgie en tandheelkunde. Die eerste gedeelte van die navorsing het uit ‘n behoeftebepalings vraelys bestaan, om die behoefte vir fisioterapeutiese intervensie vir mandibulêre kondiel frakture vir pasiënte te bepaal. Die behoeftebepalings vraelys is uitgestuur aan gekwalifiseerde kenners in die spesifieke veld: een fisioterapeut en een kaak-, gesig-, en mondchirurg van elk van die opleidingsentrums in Suid-Afrika. Die terugbesorgde resultate is geanaliseer deur die navorser en ‘n biostatikus, en ‘n definitiewe behoefte aan fisioterapie intervensie vir pasiënte met mandibulêre kondiel frakture is geïdentifiseer. Vanuit die behoeftebepalings vraelys is ‘n internet vraelys met stellings rakende die tipe en dosering van ‘n geskikte fisioterapeutiese behandelingsprotokol ontwikkel en uitgestuur aan ‘n verdere 20 kenners in die areas van fisioterapie, kaak-, gesig- en mondchirurgie en tandheelkunde. Die Delphi vraelys het nasionale en internasionale fisioterapeute, kaak-, gesig- en mondchirurgen en tandartse ingesluit. Na elke vraelys rondte is deelnemer terugvoer verwerk en is die vraelys aangepas na gelang van deelnemer opmerkings, met die doel om konsensus te bereik vir alle vrae / stellings. Alle vrae wat nie konsensus onder deelnemers bereik het nie, en enige nuwe stellings deur deelnemers gemaak, was verwerk om deel te word van die tweede en derde rondtes van die vraelys. Daar was slegs drie rondtes van die Delphi vraelys, met ‘n voltooiingsperiode van twee weke toegelaat vir elke rondte se vraelys.

Die navorsingstudie is nie uitgevoer op pasiënte, in 'n hospital of universiteit opset nie. Aangesien daar geen behandeling toegedien was nie, was daar geen risiko of newe-effekte vir deelnemers aan die studie nie.

Fisioterapeute word geag as kenners in die area van pynverligting, gewrigsmobilisasie, oefeningsterapie en die korrigerende van foutiewe bewegingspatrone. Fisioterapeute kan 'n gespesialiseerde rehabilitatiewe diens bied aan pasiënte wat mandibulêre kondiel frakture opgedoen het. Die intervensie program sal herstel versnel, gewrigsdisfunksie na trauma verminder, temporomandibulêre gewrigsdisfunksie en -pyn voorkom en behandel, hospitaalverblyf verminder, asook die eise gestel aan die kaak-, gesig-, en mondchirurg rakende tuisadvies en oefeningsvoorskrif, verminder.

Waarde van die studie:

- 'n Voorgestelde gepaste fisioterapeutiese intervensie program vir pasiënte met mandibulêre kondiel frakture is ontwikkel.
- Die huidige studie bied 'n grondslag vir die implementasie van die voorgestelde intervensie program in verdere navorsingstudies.
- Deur te fokus op fisioterapeutiese behandelings en navorsing, is 'n nuwe area vir fisioterapie verken, asook die voordele van die verwysing van mandibulêre kondiel frakture pasiënte na 'n fisioterapeut aangebied.

**Key terms:** *mandibular condyle fractures; physiotherapy for mandibular condyle fractures; exercise; rehabilitation for mandibular condyle fractures; closed reduction for mandibular condyle fractures; open reduction and internal fixation for mandibular condyle fractures; temporomandibular joint; trismus treatment; needs analysis; Delphi questionnaire.*

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**Addendum A: Ethical approval of study (pre-Delphi questionnaire formulation)**

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Ms H Strauss

2012-03-09

MS A VAN DER MERWE  
PO BOX 43567  
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9332

REC Reference nr 230408-011  
IRB nr 00006240

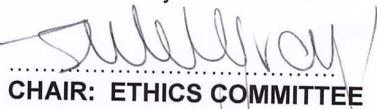
Dear Ms van der Merwe

**ECUFS NR 05/2012**

**PROJECT TITLE: THE DEVELOPMENT OF A PHYSIOTHERAPY INTERVENTION PROGRAM FOR CLOSED OR OPEN REDUCTION AND/OR INTERNAL FIXATION OF MANDIBULAR CONDYLE FRACTURES.**

- You are hereby kindly informed that the Ethics Committee approved the above project at the meeting held on 6 March 2012 after the first round of the Delphi questionnaire had been developed and submitted to the Ethics Committee.
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

  
.....  
**CHAIR: ETHICS COMMITTEE**

Cc Ms RY Barnes

**Addendum B: Ethical approval following amendments made to study**

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Ms H Strauss

2012-09-25

REC Reference nr 230408-011  
IRB nr 00006240

MS A VAN DER MERWE  
PO BOX 43567  
HEUWELSIG  
BLOEMFONTEIN  
9332

Dear Ms van der Merwe

**ECUFS NR 05/2012**

**PROJECT TITLE: THE DEVELOPMENT OF A PHYSIOTHERAPY INTERVENTION PROGRAM FOR CLOSED OR OPEN REDUCTION AND/OR INTERNAL FIXATION OF MANDIBULAR CONDYLE FRACTURES.**

- You are hereby kindly informed that the Ethics Committee approved the following at the meeting held on 18 September 2012:
  - ***Amendment to study population***
  - ***In the approved protocol it was stated that there were seven (7) physiotherapy training institutes in South Africa. Due to a typing error, it should have been eight (8) physiotherapy training institutes instead of seven (7).***
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.

- Kindly refer to the ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully



.....  
**PROF WH KRUGER**  
**CHAIR: ETHICS COMMITTEE**

**Addendum C: Recruitment letter (Needs Analysis)**

Dear Participant

**INFORMATION REGARDING THE NEEDS ANALYSIS QUESTIONNAIRE TO BE CONDUCTED**

**The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.**

I am currently a M.Sc. student (Physiotherapy) at the University of the Free State (UFS). Part of my postgraduate degree involves the execution of a research study. Research is the process to learn the answer to a question. In this study I want to learn what physiotherapists can do to help patients who sustained fractures of the mandibular condyle (top part of the jaw joint) recover quicker and with fewer complications.

I am inviting you to participate in this research study.

The mandible is most affected by trauma to the facial area, in approximately 80 % to 81.3 % of cases, and has a potentially serious impact on mouth function and facial features (DeFabianis 2002:268; Feng *et al.*, 2009:46; Singh 2009:18). A South African study conducted by Rikhotso and Ferretti (2008:222) stated that condyle fractures accounted for 27% to 57% of all mandibular fractures. Fractures of the condyle are the most controversial type of fracture when diagnosing or treating the jaw area (Zachariadis *et al.* 2006:421).

Working closely with dentists as well as maxillofacial surgeons, the researcher has seen many mandibular condyle fracture patients who struggle to regain their mandibular function, as well as struggle with persistent pain and lack of mouth opening, after the intermaxillary fixation was removed. One of the main complaints of surgeons is their lack of time to teach the patients post-surgical exercises and to ensure they are doing them correctly. As surgeons are on a tight surgical schedule, they do not always have the time to explain the much needed post-surgical exercise regime as well as the home advice to these patients. Physiotherapists are proposed as experts in the field of pain relief, joint mobilisation, exercise therapy and correcting faulty movement patterns. They should be able to provide an expert rehabilitative

service to patient's who sustained mandibular condyle fractures, aiding quicker recovery, decreasing joint destruction after trauma, reduced in-hospital stay and reduced time demands by the surgeon regarding home advice and exercise prescription.

The study aims to perform a needs analysis amongst maxillo-facial surgeons and physiotherapists in South Africa, regarding the perceived need for a post-operative physiotherapy intervention for patients who sustained mandibular condyle fractures.

What is involved in the study: This questionnaire is sent out to experts in this specific study field. Experts include one physiotherapist and one maxillo-facial surgeon from each of the training institutions in South Africa.

You are invited to complete the attached questionnaire and submit it to the researcher by clicking on the "submit" button after completion. You will not be asked to complete another needs analysis questionnaire.

This questionnaire should take no more than 20 minutes to complete.

Your participation in the study is purely voluntary. Please note that by completing and returning the questionnaire to the researcher you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. You may withdraw from this study at any given moment during the completion of the questionnaire.

As there are no treatments administered, there are no risks to participants.

No remuneration will be provided for study participation. No costs will be incurred by participants.

Permission has been obtained from the Ethics Committee at the Faculty of Health Sciences of the University of the Free State. You may contact the Ethical committee at the Medical Faculty of the University of the Free State if you have any queries regarding your rights as research participant. Contact number: +2751-405 2812.

The study protocol is available on request. Results may be published.

Please contact the researcher if more clarity is needed

Phone: +2782 446 4923

E-mail: [anke@gonzales.co.za](mailto:anke@gonzales.co.za)

Fax: 086 653 3538

Yours truly

Anke van der Merwe

(Researcher) (Physiotherapist)

**Addendum D: Needs Analysis questionnaire**

# Needs analyses.

You have been asked to participate in a research study. Please note that by completing this questionnaire you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from the study at any given moment during the completion of the questionnaire. The results may be published.

## 1. In which field is your current profession?

Maxillo-facial surgery field

Physiotherapy

Comments

## 2. How long have you been practising in this field?

## 3. Please mark your gender below

Male

Female

Comment

## 4. In which working environment are you currently practising?

Public sector

Private practise

University lecturer

Clinical supervisor

Public and private sector

Other (please specify)

Other (please specify)

## Needs analyses.

### 5. Do you currently treat patients, in-hospital, who sustained mandibular condyle fractures?

Yes

No

Comment

### 6. Do you currently treat patients, out of hospital, who sustained mandibular condyle fractures?

Yes

No

Comments

### 7. Which treatment modalities do you, or would you, administer for mandibular condyle fractures? List all used modalities.

### 8. How many, in-hospital, mandibular condyle fracture patients complain of functional loss after ORIF (open reduction and internal fixation) surgery?

0- 10%

11- 49%

50- 79%

80- 100%

### 9. How many, in-hospital, mandibular condyle fracture patients complain of functional loss after closed reduction and internal fixation?

0- 10%

11- 49%

50- 79%

80- 100%

## Needs analyses.

**10. How many mandibular condyle fracture patients complain of functional loss at follow-up, after ORIF (open reduction and internal fixation) surgery?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

**11. How many mandibular condyle fracture patients complain of functional loss at follow-up, after closed reduction and internal fixation?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**12. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient, day one after ORIF (open reduction and internal fixation) surgery?**

**13. How long should these pre-cautionary measures for mandibular condyle fractures treated by open reduction and internal fixation (ORIF) surgery be adhered to, if any?**

**14. Which physiotherapeutic treatment modalities are contra-indicated when treating a mandibular condyle fracture patient after ORIF (open reduction and internal fixation) surgery?**

**15. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient, day one after closed reduction and internal fixation?**

## Needs analyses.

**16. How long should these pre-cautionary measures for mandibular condyle fractures treated by closed reduction and internal fixation be adhered to, if any?**

**17. Which physiotherapeutic treatment modalities are contra-indicated when treating a mandibular condyle fracture patient after closed reduction and internal fixation?**

**18. There is a need for physiotherapy intervention in post-surgical patients treated for mandibular condyle fractures.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**19. How big is the need for physiotherapy intervention for mandibular condyle fracture patients?**

- Big
- Small
- Moderate

Comments

**20. How many patients treated by open reduction and internal fixation (ORIF) surgery require physiotherapy?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**21. How many patients treated by closed reduction and internal fixation require physiotherapy?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**22. Is there a need for physiotherapy intervention for surgically treated condylar head fractures?**

- Yes
- No

Comments

**23. Is there a need for physiotherapy intervention for condylar head fractures treated by closed reduction and internal fixation?**

- Yes
- No

Comments

## Needs analyses.

**24. Is there a need for physiotherapy intervention for surgically treated condylar neck fractures?**

Yes

No

Comments

**25. Is there a need for physiotherapy intervention for condylar neck fractures treated with closed reduction and internal fixation?**

Yes

No

Comments

**26. Mandibular condyle fracture patients should all receive physiotherapy intervention as a preventative measure.**

Strongly agree

Agree

Disagree

Strongly disagree

Comments

**27. Mandibular condyle fracture patients should only receive physiotherapy intervention when complaining of functional impairment and pain.**

Strongly agree

Agree

Disagree

Strongly disagree

Comments

## Needs analyses.

**28. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated with ORIF surgery, when should they be seen for the first time?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- Day three post-surgery
- After their out-patient follow-up

Comments

**29. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated with closed reduction and internal fixation, when should they be seen for the first time?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- Day three post-surgery
- After their out-patient follow-up

Comments

**30. How many in-hospital physiotherapy visits would be deemed adequate for mandibular condyle fractures treated by open reduction and internal fixation?**

**31. How many in-hospital physiotherapy visits would be deemed adequate for mandibular condyle fractures treated by closed reduction and internal fixation?**

## Needs analyses.

### 32. What type of physiotherapy intervention would be required by patients, day one after ORIF surgery? You may mark more than one option.

- Massage of facial muscles
- Passive temporomandibular joint mobilisations (movement of a mobile segment, produced by any means other than the particular muscles relating to that segment's movement.)
- Facial muscle stretches
- Active jaw exercises for movement pattern correction
- Isometric jaw muscle exercises (muscle contraction without jaw movement)
- Cervical postural advice
- Ultrasound therapy
- Transcutaneous Electrical Nerve Stimulation (TENS)
- Ice therapy

Comments

### 33. What type of physiotherapy intervention would be required day one after closed reduction and internal fixation? You may mark more than one option.

- Massage of facial muscles
- Passive temporomandibular joint mobilisations (movement of a mobile segment, produced by any means other than the particular muscles relating to that segment's movement.)
- Facial muscle stretches
- Active jaw exercises for movement pattern correction
- Isometric jaw muscle exercises (muscle contraction without jaw movement)
- Cervical postural advice
- Ultrasound therapy
- Transcutaneous Electrical Nerve Stimulation (TENS)
- Ice therapy

Comments

## Needs analyses.

**34. If patients are not routinely seen by a physiotherapist, which of these symptoms warrant physiotherapy intervention? You may mark more than one option.**

- Decreased function with regards to speech and chewing
- Facial muscle pain
- Temporomandibular joint stiffness
- Temporomandibular joint pain
- Incorrect jaw movement patterns

Comments



A large, empty white rectangular area with a thin black border, intended for writing or drawing.

## Needs analyses.

Thank you for your time in completing this questionnaire.

Regards

Anke van der Merwe  
(Researcher)

**Addendum E: Ethical approval of study (post-Delphi questionnaire formulation)**

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Ms H Strauss

2012-01-26

REC Reference nr 230408-011  
IRB nr 00006240

MS A VAN DER MERWE  
PO BOX 43567  
HEUWELSIG  
BLOEMFONTEIN  
9332

Dear Ms van der Merwe

**ECUFS NR 05/2012**

**PROJECT TITLE: THE DEVELOPMENT OF A PHYSIOTHERAPY INTERVENTION PROGRAM FOR CLOSED OR OPEN REDUCTION AND/OR INTERNAL FIXATION OF MANDIBULAR CONDYLE FRACTURES.**

- You are hereby kindly informed that the Ethics Committee approved the above project at the meeting held on 24 January 2012 on condition that once the first round of the Delphi questionnaire has been developed, it must be submitted to the Ethics Committee.
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

.....  
**CHAIR: ETHICS COMMITTEE**

Cc Ms RY Barnes

**Addendum F: Recruitment letter (Delphi questionnaire)**

Dear Participant

**INFORMATION REGARDING THE DELPHI QUESTIONNAIRE TO BE CONDUCTED**

**The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.**

I am currently a M.Sc. student (Physiotherapy) at the University of the Free State (UFS). Part of my postgraduate degree involves the execution of a research study. Research is the process to learn the answer to a question. In this study I want to learn what physiotherapists can do to help patients who sustained fractures of the mandibular condyle (top part of the jaw joint) recover quicker and with less complications.

I am inviting you to participate in this research study. The Delphi review panel will consist of 15 experts in this specific study field: physiotherapists, maxillo-facial surgeons and dentists.

The mandible is most affected by trauma to the facial area, in approximately 80% to 81.3% of cases, and has a potentially serious impact on mouth function and facial features (DeFabianis 2002:268; Feng, Chen, Zhang, Yang, Lin, Tian and Liu 2009:46; Singh 2009:18). A South African study conducted by Rikhotso and Ferretti (2008:222) stated that condyle fractures accounted for 27% to 57% of all mandibular fractures. Fractures of the condyle are the most controversial type of fracture when diagnosing or treating the jaw area (Zachariadis *et al.* 2006:421).

Working closely with dentists as well as maxillofacial surgeons, the researcher has seen many mandibular condyle fracture patients who struggle to regain their mandibular function, as well as struggle with persistent pain and lack of mouth opening, after the intermaxillary fixation was removed. One of the main complaints of surgeons is their lack of time to teach the patients post-surgical exercises and to ensure they are doing them correctly. As surgeons

are on a tight surgical schedule, they do not always have the time to explain the much needed post-surgical exercise regime as well as the home advice to these patients. Physiotherapists are proposed to be experts in the field of pain relief, joint mobilisation, exercise therapy and correcting faulty movement patterns. They should be able to provide an expert rehabilitative service to patient's who sustained mandibular condyle fractures, aiding quicker recovery, decreasing joint destruction after trauma, reduced in-hospital stay and reduced time demands by the surgeon regarding home advice and exercise prescription.

The study aims to provide a proposed post-operative physiotherapeutic intervention program for the management of mandibular condyle fractures, by formulating opinions and professional expertise of specialists in the field. This study will provide the baseline for further clinical studies into the implementation of the proposed physiotherapeutic intervention program.

What is involved in the study: If you agree to participate in the study, you will be asked to complete an online questionnaire. You will receive an e-mail with a link to the questionnaire, which you answer on your computer and then just click "submit" to send the completed questionnaire. All reviewers' answers will be analysed by the researcher and only statements not achieving consensus between reviewers, or new statements by reviewers, will be included in the second round questionnaire. This process will be repeated until the third round of the questionnaire. You will have two weeks to complete each round of the questionnaire. Each new round of the questionnaire will be sent out after two weeks of the previous questionnaire deadline.

Each questionnaire should take no more than 20 minutes to complete.

Your participation in the study is purely voluntary and you will not need to complete any further questionnaires if you decide to withdraw from the study.

As there are no treatments applied, there are no risks to participants.

No remuneration will be provided for study participation. No costs will be incurred by participants.

You will remain anonymous and your data will be treated confidentially at all times. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law.

If you agree to participate in the study please complete the attached consent form and return it to the researcher within 14 days of receiving this letter. Once informed consent has been obtained you will receive an information document regarding the Delphi questionnaire procedure, together with an online link to the questionnaire.

Permission has been obtained from the Ethics Committee at the Faculty of Health Sciences of the University of the Free State. You may contact the Ethical committee at the Medical Faculty of the University of the Free State if you have any queries regarding your rights as research participant. Contact number: +2751-405 2812.

The study protocol is available on request. The results may be published.

Please contact the researcher if more clarity is needed

Phone: +2782 446 4923

E-mail: [anke@gonzales.co.za](mailto:anke@gonzales.co.za)

Fax: 086 653 3538

Yours truly

Anke van der Merwe

(Researcher) (Physiotherapist)

**Addendum G: Informed consent form (Delphi questionnaire)**

Dear Participant

You were approached to take part in a research study.

You were informed regarding the study by the researcher, Anke van der Merwe, of the Department of Physiotherapy of the University of the Free State.

You may contact the researcher at any time at +2782 446 4923/ [anke@gonzales.co.za](mailto:anke@gonzales.co.za) if you have any queries regarding the study being conducted.

You may contact the Ethical committee at the Medical Faculty of the University of the Free State if you have any queries regarding your rights as research participant. Contact number: +2751-405 2812.

Your participation in the study is purely voluntary and you will not need to complete further questionnaires if you decide to withdraw from the study. Participation is voluntary and participants will receive no remuneration. No costs will be incurred by participants.

As there are no clinical tests or treatments applied, there exists no harm or risk for any participants.

The study will be published in an accredited journal and every care will be taken for the need analyses participants and Delphi reviewers to remain anonymous.

If you agree to participate in the study you will receive an information brochure regarding the study procedure as well as a copy of this form. Each rounds' questionnaire is estimated to take no more than 20 minutes.

It is foreseen that there will possibly be three to four rounds during the Delphi questionnaire in order to obtain the most accurate and safe functional exercises and dosages for a sufficient intervention protocol.

.....

...../...../.....

Signature

Date

I, the undersigned, understand the aim of this study. It has been explained to me in written format. I understand that my participation is voluntary and that I will not be penalized if I wish to discontinue my participation at any stage in the study. I give voluntary consent to participate in the study.

**Title: The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures. (ECUFS no. 05/2012)**

Hereby I, the undersigned, consent to participate in the Delphi survey, which is scheduled to take place from March 2012 –June 2012. My full particulars are as follows:

Title:

.....

Surname:

.....

Fullnames:

.....

Contact nr:

.....

Fax nr:

.....

E-mail address:

.....

.....

**Signature**

**Date**

Please return this form on or before 19 March 2012 by fax or e-mail. My full contact details are as follows:

Contact nr: +2782 4464923

Fax nr: 086 653 3538

E-mail: [anke@gonzales.co.za](mailto:anke@gonzales.co.za)

I wish to assure you that the information will be treated in a highly confidential manner and that there will be no reference to any names. Thank you in advance for your kind co-operation. Please take note that the results coming from this master's study will be published.

Sincerely yours,

Anke van der Merwe

**Addendum H: Instruction leaflet (Delphi questionnaire)**

Dear Participant

## **INSTRUCTIONS FOR THE DELPHI QUESTIONNAIRE**

**(Online survey)**

### **Information session:**

All participants have received a letter of information as well as a consent form.

All information will be handled as confidential and comments of the participants will only be known to the researcher.

### **Please take note:**

Participants have a choice of working **online** and submit their opinions directly by entering the submit button or print out the online questionnaire and fax the completed copy to the researcher. Both options will be available during the first round, thereafter participants will continue with the option that they have chosen for the first round. Each questionnaire is estimated to take no more than 20 minutes.

It is foreseen that there will possibly be three rounds during the Delphi questionnaire in order to obtain the most accurate and safe functional exercises and dosages for a sufficient intervention protocol.

### **First round**

- Statements with possible options, regarding physiotherapy involvement and a proposed intervention program for post-surgical mandibular condyle fracture patients are included in the questionnaire.
- Participants have to indicate which option describes their opinion the best.
- Participants may comment on the given options in the allocated block beneath each statement.

After each round a summary of the questions where 80% consensus was reached, will be drafted, for notice. These options will be excluded from the questionnaire for the following round. Any new options noted under “comments” will be added to the questionnaire for the following round.

### **Following rounds**

Comments made on each of the statements will be included in the questionnaire for the next round. This process will be followed until 80% consensus is reached on the statements.

Please contact me if more clarity is needed

Phone: +2782 446 4923

E-mail: [anke@gonzales.co.za](mailto:anke@gonzales.co.za)

Fax: 086 653 3538

Thank you for your willingness to participate.

Regards

Anke van der Merwe (Researcher)

**Addendum I: Delphi questionnaire: Round one**

You have been asked to participate in a research study. Please note that by completing the previously sent consent form you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from the study at any given moment during the completion of the questionnaire. The results may be published.

**1. In which field is your current profession?**

- Maxillo-facial surgery field
- Physiotherapy
- Dentistry
- Dentistry with a postgraduate diploma regarding aspects of maxillo-facial surgery

Comments

**2. How long have you been practising in this field?**

**3. Please mark your gender below**

- Male
- Female

**4. In which working environment are you currently practising?**

- Public sector
- Private practise
- University lecturer
- Clinical supervisor
- Private and public sector
- Other ( please specify)

Other

**5. Do you currently treat patients, in-hospital, who sustained mandibular condyle fractures?**

- Yes
- No

Comments

**6. Do you currently treat patients, out of hospital, who sustained mandibular condyle fractures?**

- Yes
- No

Comments

**7. If you answered yes to question 6, which treatment modalities do you administer for mandibular condyle fractures? List all used modalities.**

**8. If you answered no to question 6, which treatment modalities would you consider using when treating a patient who sustained a mandibular condyle fracture? List all modalities.**

**9. How many, in-hospital, mandibular condyle fracture patients complain of functional loss after ORIF (open reduction and internal fixation) surgery?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**10. How many, in-hospital, mandibular condyle fracture patients complain of functional loss after closed reduction and internal fixation?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**11. How many mandibular condyle fracture patients complain of functional loss at follow-up, after ORIF (open reduction and internal fixation) surgery?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**12. How many mandibular condyle fracture patients complain of functional loss at follow-up, after closed reduction and internal fixation?**

- 0- 10%
- 11- 49%
- 50- 79%
- 80- 100%

Comments

**13. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient, after ORIF (open reduction and internal fixation) surgery? This question should be answered whether you are currently treating these patients, or not. You may select more than one option.**

- Ultrasound over the surgery area
- Interferential current therapy over the surgery area
- Active movements within limits of pain
- No exercises against resistance
- No end range joint movements
- Dry needling in the facial area
- Maintaining a soft diet

Other (please specify)

**14. How long should these pre-cautionary measures for mandibular condyle fractures treated by ORIF (open reduction and internal fixation) surgery be adhered to, if any?**

- 1 week
- 2 weeks
- 3 weeks
- 4 weeks
- 5 weeks
- 6 weeks

Other (please specify)

**15. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient, after closed reduction and internal fixation? This question should be answered whether you are currently treating these patients, or not. You may mark more than one option.**

- Ultrasound over the fracture area
- Interferential current therapy over the fracture area
- Active movements within limits of pain
- No exercises against resistance
- No end range joint movements
- Dry needling in the facial area
- Maintaining a soft diet

Other (please specify)

**16. How long should these pre-cautionary measures for mandibular condyle fractures treated by closed reduction and internal fixation be adhered to, if any?**

- 1 week
- 2 weeks
- 3 weeks

Other (please specify)

**17. Mandibular condyle fracture patients should all receive physiotherapy intervention as a preventative measure.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**18. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated with ORIF (open reduction and internal fixation) surgery, when should they be seen for the first time?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- Day three post-surgery
- After their out-patient follow-up

Comments

**19. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated with closed reduction and internal fixation, when should they be seen for the first time?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- Day three post-surgery
- After their out-patient follow-up

Comments

**20. How many in-hospital physiotherapy visits would be deemed adequate for mandibular condyle fractures treated by ORIF (open reduction and internal fixation) surgery?**

- One
- Two
- Three
- Until discharge from hospital

Comments

**21. How many in-hospital physiotherapy visits would be deemed adequate for mandibular condyle fractures treated by closed reduction and internal fixation?**

- One
- Two
- Three
- Until discharge from hospital

Comments

## Exercises and advice

### 22. Who should execute and evaluate progression of post-surgical exercise regimes and advice?

- Maxillo-facial surgeon
- Physiotherapist

Comments

### 23. In hospital visits should consist of post-surgical and postural advice for ORIF (open reduction and internal fixation)surgery patients

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

### 24. In hospital visits should consist of post-surgical and postural advice for mandibular fracture patients treated with closed reduction and internal fixation.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

### 25. When should this advice be given to the patient?

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- Day 3 post-surgery
- At out-patient follow-up

Comments

**26. In-hospital visits should consist of active jaw exercises.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**27. When should these active jaw exercises be commenced?**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- Day 3 post-surgery
- At out-patient follow-up

Comments

**28. In-hospital visits should consist of isometric jaw muscle exercises (muscle contraction without movement).**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**29. When should these isometric jaw muscle exercises (muscle contraction without movement) be commenced?**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- Day 3 post-surgery
- At out-patient follow-up

Comments

**30. In-hospital visits should consist of jaw muscle stretches.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**31. When should these stretches be commenced?**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- Day 3 post-surgery
- At out-patient follow-up

Comments

**32. Which jaw exercises should be done in front of a mirror to prevent incorrect mandibular deviation. You may mark more than one option.**

- Jaw opening
- Lateral mandibular movement
- Mandibular protrusion
- Isometric exercises
- Facial muscle stretches

Comments

**33. Which jaw exercises should be done with light guided hand pressure to prevent incorrect mandibular deviation.**

- Jaw opening
- Lateral mandibular movement
- Mandibular protrusion
- Isometric exercises
- Facial muscle stretches

Comments

**34. In-hospital visits should consist of massaging of the facial muscles.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**35. When should this massaging be commenced?**

- Day of surgery
- Day 1 post-op
- Day 2 post-op
- Day 3 post-op
- At out-patient follow-up

Comments

**36. In-hospital visits should consist of temporomandibular joint passive mobilisations (joint mobilisation done by the therapist)**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comment

**37. When should these passive mobilisations (joint mobilisation done by the therapist) be commenced?**

- Day of surgery
- Day 1 post-op
- Day 2 post-op
- Day 3 post-op
- At out-patient follow-up

Comments

**38. In-hospital visits should consist of cervical postural advice.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**39. When should this postural advice be commenced?**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- Day 3 post-surgery
- At out-patient follow-up

Comments

## Exercise sets and repetitions

**40. How long should each facial muscle isometric contraction (muscle contraction without movement) be held for?**

- 5 seconds
- 6 seconds
- 10 seconds
- 15 seconds
- 20 seconds
- 30 seconds

Comments

**41. How many repetitions of isometric contractions (muscle contraction without movement) should be done in one set?**

- One
- Two
- Three
- Four
- Five
- Six

Comments

**42. How many sets of repetitions should be done?**

- One
- Two
- Three
- Four
- Five

Comments

**43. How many times per day should the sets be repeated?**

- One
- Two
- Three
- Six

Comments

**44. Active jaw opening exercise comprises of the patient slightly protruding the mandible and then opening and closing the mouth.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**45. How many repetitions of the active jaw opening exercise should be done in one set?**

- Five
- Six
- Ten
- Fifteen

Comments

**46. How many sets of repetitions should be done?**

- One
- Two
- Three
- Four
- Five

Comments

**47. How many times per day should the sets be repeated?**

- One
- Two
- Three
- Four
- Five
- Six

Comments

**48. An active lateral mandibular exercise comprises of the patient protruding the mandible then slightly moving it to the side**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**49. How many repetitions of lateral mandibular exercise should be done in one set?**

- Five
- Six
- Ten
- Fifteen

Comments

**50. How many sets of repetitions should be done?**

- One
- Two
- Three
- Four
- Five

Comments

**51. How many times per day should the sets be repeated?**

- One
- Two
- Three
- Four
- Five
- Six

Comments

**52. An active mandibular protrusion exercise comprises of the patient moving the mandible forward as far as pain allows.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**53. How many repetitions of mandibular protrusion should be done in one set?**

- One
- Two
- Three
- Four
- Five
- Six

Comments

**54. How many sets of repetitions should be done?**

- Five
- Ten
- Fifteen

Comments

**55. How many times per day should the sets be repeated?**

- One
- Two
- Three
- Four
- Five
- Six

Comments

**56. Stretching of the jaw muscles is done by progressively wedging tongue depressors in the incisal space, increasing the amount of depressors as pain allows.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**57. Jaw muscle stretches should be held for how long at a time?**

- 5 seconds
- 6 seconds
- 10 seconds
- 15 seconds
- 20 seconds
- 30 seconds

Comments

**58. How many repetitions of the stretch should be done in one set?**

- Five
- Six
- Ten
- Fifteen

Comments

**59. How many sets of repetitions should be done?**

- One
- Two
- Three
- Four
- Five

Comments

**60. How many times per day should the sets be repeated?**

- One
- Two
- Three
- Four
- Five
- Six

Comments

**61. Ice can be applied to the surgery area straight after surgery to decrease pain and swelling.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**62. Now that you have completed the questionnaire, do you feel the questions asked are adequate for compiling a physiotherapy intervention program for patients sustaining a mandibular condyle fracture.**

- Yes
- No

Comments

Thank you for your time in completing this questionnaire.

Regards

Anke van der Merwe

Researcher)

**Addendum J: Report: Delphi questionnaire, round one**

**Report on questions achieving consensus during round one of the questionnaire:**

**The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.**

The reviewers consisted of five maxillo-facial surgeons, seven physiotherapists and three dentists, working predominantly in the private sector. Members of the review panel consisted of 11 South African and four international respondents.

It was established that 69,3% of ORIF patients, and 75% of closed reduction patients, has a 0 - 49% chance of complaining of functional difficulties at their out-patient follow-up.

All respondents agreed that mandibular condyle fracture patients, regardless of their treatment type, should receive physiotherapy intervention whilst in the hospital.

It was agreed that all patients should be seen by a physiotherapist day one after surgery/ fracture correction. This would consist of general advice, cryotherapy (ice therapy) and cervical postural advice given to the patient. After round two it should be clear if any other interventions should be added and exactly when they should be commenced.

Consensus was reached on what in-hospital visits should be comprised of: active, non-resistant jaw movements, light facial muscle massaging/ electro-massage (dependant on degree of soft tissue injury) and isometric contractions of the masticatory muscles. All exercises to be done within pain limits. The commencement of jaw muscle stretches (within surgery, fracture and pain limits) and passive temporomandibular joint mobilisations is still to be decided.

The definitions of active mandibular movements (protrusion and lateral excursion) as well as the execution of a jaw muscle stretch were all accepted by the majority of the reviewers. The definition regarding jaw opening movement did not reach consensus, and would be altered according to reviewer comments.

The exercise dosages for active, non-resistant jaw opening, lateral jaw movement, mandibular protrusion, isometric jaw exercises and jaw muscle stretches (within surgery, fracture and pain limits) still require inter-reviewer agreement.

No consensus could be reached regarding the pre-cautionary measures to be considered for patients who sustained mandibular condyle fractures, treated by either ORIF or closed reduction. The duration of consideration of pre-cautionary measures was also inconclusive. Reviewer comments were incorporated in round two of the Delphi questionnaire.

As no patient is alike, the questionnaire answers will only serve as a rough guideline for in-hospital physiotherapy intervention. It would still be advised to consult the referring surgeon regarding specific pre-cautionary measures for individual patients.

This protocol does not address the out-patient treatment regimes for this patient population. Each patient will present differently to a physiotherapist at their out-patient follow-up, and would therefore require a different treatment plan to suite their specific needs. It would serve no purpose to discuss physiotherapeutic passive temporomandibular joint mobilisations in detail in this questionnaire, as each patient would require a different approach (general joint stiffness/ anterior joint stiffness/ posterior joint stiffness / muscle weakness etc) and would therefore require different treatment techniques. The temporomandibular joint arthrokinematics, the effect of mandibular trauma on the joint, is discussed in detail in the literature study. Physiotherapeutic passive temporomandibular joint mobilisations and the indications for use are also covered extensively in the literature study.

Thank you again for your participation in this research study. Your opinion is greatly appreciated and valued.

Kind regards

Anke van der Merwe

(Researcher)

**Addendum K: Delphi questionnaire: Round two**

You have been asked to participate in a research study. Please note that by completing the previously sent consent form you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from the study at any given moment during the completion of the questionnaire. The results may be published.

PLEASE NOTE: Some questions have been duplicated, one set to be answered by the maxillo-facial surgeons and dentists and the other set to be answered by the physiotherapists. Please read carefully and answer the questions applicable to your profession. This is done to filter the responses regarding exercise prescription.

As each patient presents differently, the following will be assumed when answering the questionnaire:

Patients are awake and coherent

The patients are hospitalised for three days

There is limited soft tissue damage

There are no other complications or precautions

All exercises and movements are done within pain limitations

All exercise repetitions are to be increased as the fracture heals.

**1. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient after ORIF (open reduction and internal fixation) surgery? Day one until hospital discharge.**

**This question should be answered whether you are currently treating these patients, or not. You may select more than one option**

- Ultrasound directly over surgery area
- Electrotherapy treatment directly over surgery area
- Active movements within pain limits
- No resisted exercises
- No forced end range temporomandibular joint movements
- Dry needling over the surgical area
- Maintaining a soft diet
- All of the above

Comments

**2. Generally, how long should these pre-cautionary measures for mandibular condyle fractures, treated by ORIF surgery, be adhered to?**

- 2 weeks
- 3 weeks
- 4 weeks
- 5 weeks
- 6 weeks

Comments

**3. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient after closed reduction? Day one until hospital discharge. This question should be answered whether you are currently treating these patients, or not. You may mark more than one option.**

- Ultrasound directly over fracture area
- Electrotherapy treatment directly over fracture area
- Active movements within pain limits
- No resisted exercises
- No forced end range temporomandibular joint movements
- Dry needling over the surgical area
- Maintaining a soft diet
- All of the above

Comments

**4. How long should these pre-cautionary measures for mandibular condyle fractures treated by closed reduction, be adhered to?**

- 1 week
- 2 weeks
- 3 weeks
- 6 weeks

Comments

**5. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated with ORIF surgery, when should they be seen for the first time?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- Only at out patient follow-up

Comments

**6. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated with closed reduction, when should they be seen for the first time?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- At out-patient follow-up

Comments

**7. When should post-surgical and postural advice be given to mandibular condyle fracture patients, treated by either ORIF (open reduction and internal fixation) surgery or closed reduction?**

- Prior to surgery
- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- At out-patient follow-up

Comments

**8. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When is it safe for an intracapsular mandibular condyle fracture patient, treated by closed reduction, to start doing active jaw movements and isometric masticatory muscle contractions (slight, painless muscle contractions without movement of the jaw), within their pain limits?**

- Day one post-surgery
- Day two post-surgery
- Day three post-surgery
- Only at the out-patient follow-up

Comments

**9. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When is it safe for an extracapsular mandibular condyle fracture patient, treated by closed reduction, to start doing active jaw movements and isometric masticatory muscle contractions (slight, painless muscle contractions without movement of the jaw), within their pain limits?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- Day three post-surgery
- Only at out patient follow-up

Comments

**10. Approximately how many in-hospital physiotherapy visits should be adequate for patients with mandibular condyle fractures, treated by ORIF surgery? Assuming they are hospitalised for the standard three days and that electrotherapy is safe to administer in the facial area, but not directly over the surgery site.**

- One
- Two
- Three
- Until discharge from hospital

Comments

**11. Approximately how many in-hospital physiotherapy visits should be adequate for patients with mandibular condyle fractures, treated by closed reduction? Assuming they are hospitalised for the standard three days and that electrotherapy is safe to administer in the facial area, but not directly over the fracture site.**

- One
- Two
- Three
- Until discharge from hospital

Comments

**12. Active jaw opening exercise comprises of the patient gently opening and closing the mouth.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**13. When should non-resisted active jaw exercises, within pain limits, be commenced in hospital? Assuming there is limited soft tissue damage.**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- Until discharge from hospital
- Only at out-patient follow-up

Comments

**14. When should stretching of the jaw (mouth opening), within pain and surgical limitations, be commenced for post-ORIF surgery patients, as well as after intermaxillary fixation removal for patients treated with closed reduction?**

- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- At out-patient follow-up
- After intermandibular fixation has been removed

Comments

**15. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.  
A jaw muscle stretch, within pain and surgical limitations, should be held for how long each time?**

- 5 seconds
- 10 seconds
- 30 seconds

Comment

**16. Only to be answered by PHYSIOTHERAPISTS.**

**A jaw muscle stretch, within pain and surgical limitations, should be held for how long each time?**

- 5 seconds
- 10 seconds
- 30 seconds

Comments

**17. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many repetitions of a jaw muscle stretch should be done in one set?**

- Five
- Ten
- Fifteen

Comments

**18. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of a jaw muscle stretch should be done in one set?**

- Five
- Ten
- Fifteen

Comment

**19. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many sets of repetitions of the jaw muscle stretch (within pain and surgical limitations) should be done?**

- One
- Two
- Three
- Five

Comments

**20. Only to be answered by PHYSIOTHERAPISTS.**

**How many sets of repetitions of the jaw muscle stretch (within pain and surgical limitations) should be done?**

- One
- Two
- Three
- Five

Comments

**21. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many times per day should these repetitions of a jaw muscle stretch be repeated as part of an exercise program?**

- One
- Two
- Three

Comments

**22. Only to be answered by PHYSIOTHERAPISTS.**

**How many times per day should these repetitions of a jaw muscle stretch be repeated as part of an exercise program?**

- One
- Two
- Three

Comments

**23. When should isometric jaw muscle exercises (slight, painless masticatory muscle contraction without jaw movement) be commenced?**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- At discharge from hospital
- Only at out-patient follow-up

Comments

**24. Which of the following jaw exercises should be done in front of a mirror to prevent incorrect mandibular deviation. You may mark more than one option.**

- Jaw opening
- Lateral mandibular movement
- Mandibular protrusion
- Isometric exercises
- Facial muscle stretches
- All of the above

Comments

**25. Which jaw exercises should be done with light guided hand pressure to prevent incorrect mandibular deviation.**

- Jaw opening
- Lateral mandibular movement
- Mandibular protrusion
- Isometric exercises
- Facial muscle stretches
- All of the above

Comments

**26. When should light manual or electro-massaging be commenced for mandibular condyle fracture patients, assuming there is only slight soft tissue damage.**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- Only at out-patient follow-up

Comments

**27. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many repetitions of active mandibular protrusion should be done in one set?**

- One
- Two
- Three
- Five

Comments

**28. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of active mandibular protrusion should be done in one set?**

- One
- Two
- Three
- Five

Comments

**29. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many sets of repetitions of mandibular protrusion should be done?**

- Five
- Ten

Comment

**30. Only to be answered by PHYSIOTHERAPISTS.**

**How many sets of repetitions of mandibular protrusion should be done?**

- Five
- Ten

Comments

**31. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**In hospital, how many times per day should these sets of mandibular protrusion be repeated?**

- One
- Two
- Three
- Four
- Five

Comments

**32. Only to be answered by PHYSIOTHERAPISTS.**

**In hospital, how many times per day should these sets of mandibular protrusion be repeated?**

- One
- Two
- Three
- Four
- Five

Comments

**33. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many repetitions of an active jaw opening exercise should be done in one set?**

- One
- Two
- Three
- Four
- Five

Comments

**34. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of an active jaw opening exercise should be done in one set?**

- One
- Two
- Three
- Four
- Five

Comments

**35. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many sets of repetitions of an active jaw opening exercise should be done?**

- One
- Two
- Three
- Five

Comments

**36. Only to be answered by PHYSIOTHERAPISTS.**

**How many sets of repetitions of an active jaw opening exercise should be done?**

- One
- Two
- Three
- Five

Comments

**37. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many times per day should these repetitions of an active jaw opening exercise be repeated as part of an exercise program?**

- One
- Two
- Three
- Four
- Five
- As much as possible within pain limits

Comments

**38. Only to be answered by PHYSIOTHERAPISTS.**

**How many times per day should these repetitions of an active jaw opening exercise be repeated as part of an exercise program?**

- One
- Two
- Three
- Four
- Five
- As much as possible within pain limits

Comments

**39. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many repetitions of an active lateral mandibular movement should be done in one set?**

- Five
- Ten
- Fifteen

Comments

**40. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of an active lateral mandibular movement should be done in one set?**

- Five
- Ten
- Fifteen

Comments

**41. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many sets of repetitions of an active lateral mandibular movement should be done?**

- One
- Two
- Three
- Five

Comment

**42. Only to be answered by PHYSIOTHERAPISTS.**

**How many sets of repetitions of an active lateral mandibular movement should be done?**

- One
- Two
- Three
- Five

Comments

**43. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many times per day should these repetitions of an active lateral mandibular movement be repeated as part of an exercise program?**

- One
- Two
- Three
- Four
- Five
- As much as possible within pain limits

Comments

**44. Only to be answered by PHYSIOTHERAPISTS.**

**How many times per day should these repetitions of an active lateral mandibular movement be repeated as part of an exercise program?**

- One
- Two
- Three
- Four
- Five
- As much as possible within pain limits

Comments

**45. In hospital physiotherapy visits should consist of passive temporomandibular joint mobilisations (passive joint mobilisation done by the therapist into joint resistance).**

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Comments

**46. When should these passive temporomandibular joint mobilisations (passive joint mobilisation done by the therapist into joint resistance) be commenced?**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- At out-patient follow-up

Comments

**47. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When doing an isometric masticatory muscle contraction (slight, painless muscle contraction without jaw movement), for how long should each contraction be held?**

- Five seconds
- Ten seconds
- Fifteen seconds
- Twenty seconds

Comments

**48. Only to be answered by PHYSIOTHERAPISTS.**

**When doing an isometric masticatory muscle contraction (slight, painless muscle contraction without jaw movement), for how long should each contraction be held?**

- Five seconds
- Ten seconds
- Fifteen seconds
- Twenty seconds

Comments

**49. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many repetitions of each isometric muscle contraction (slight, painless muscle contraction without jaw movement) should be done for each masticatory muscle?**

- One
- Two
- Three
- Five

Comments

**50. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of each isometric muscle contraction (slight, painless muscle contraction without jaw movement) should be done for each masticatory muscle?**

- One
- Two
- Three
- Five

Comments

**51. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many sets of repetitions of each isometric muscle contraction (slight, painless muscle contraction without jaw movement) should be done for each masticatory muscle?**

- One
- Two
- Three

Comments

**52. Only to be answered by PHYSIOTHERAPISTS.**

**How many sets of repetitions of each isometric muscle contraction (slight, painless muscle contraction without jaw movement) should be done for each masticatory muscle?**

- One
- Two
- Three

Comments

**53. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many times per day should these sets of isometric muscle contraction repetitions be repeated?**

- One
- Two
- Three

Comments

**54. Only to be answered by PHYSIOTHERAPISTS.**

**How many times per day should these sets of isometric muscle contraction repetitions be repeated?**

- One
- Two
- Three

Comments

**55. If you have any further comments or suggestions, please feel free to document them below.**

Thank you for completing the second round of this questionnaire. After analyses, there should only be one more round left.

Your participation is greatly appreciated.

Regards

Anke van der Merwe  
(Researcher)

**Addendum L: Report: Delphi questionnaire, round two**

**Report on questions achieving consensus during round two of the questionnaire:**

**The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.**

The second round of the questionnaire consisted of 14 members of the review panel, ten South African and four international review panel members. Two dentists, five maxillo-facial surgeons and seven physiotherapists were included in this round of the questionnaire.

It was agreed on between the surgeons and dentists that it is safe to start with active jaw movements, day one after closed reduction for an intracapsular mandibular condyle fracture.

Physiotherapists reached consensus regarding daily dosages for active jaw movements (repetitions done three times per day), sets of repetitions of isometric jaw muscle contraction (three sets), daily dosages for isometric jaw muscle contractions (repetitions done three times per day), repetitions of mandibular protrusion when deemed safe (three repetitions), daily dosages of mandibular protrusion (repetitions done three times per day), repetitions of a jaw muscle stretch (five repetitions done three times) as well as the daily dosage of jaw muscle stretch repetitions (five repetitions done three times per day).

Maxillo-facial surgeons and dentists reached consensus regarding the amount of isometric jaw muscle contraction sets which should be done per day (three sets), the repetitions of active mandibular protrusion movement to be done at one time (five) as well as on the repetitions of a jaw muscle stretch to be repeated at one time (five).

When combining the answers from all participants regarding the daily dosage of active lateral mandibular movement, consensus was reached (repetitions done three times per day).

The definition of active jaw opening, comprising of the patient gently opening and closing the mouth, was accepted by 90% of the participants.

One participant commented on the safety of a mandibular protrusion movement, which may give rise to a dysfunction of the lower jaw compartment. This was added as a question in the third round questionnaire.

Another participant suggested a wording change regarding exercise dosages. It was altered during the third questionnaire round. Questions regarding exercise dosage will now read for example: “How many repetitions of an active jaw opening movement should be done at one time?” And: “How many times per day should these repetitions of active jaw opening be repeated as part of an exercise program?” This will simplify exercise dosage related questions. As no patient is alike, these answers will only serve as a rough guideline for possible in-hospital physiotherapy intervention. It is still advised to consult with the referring surgeon regarding specific pre-cautionary measures for individual patients.

Thank you again for your participation in this research study. Your opinion is greatly appreciated and valued.

Kind regards

Anke van der Merwe

(Researcher)

**Addendum M: Delphi questionnaire: Round three**

You have been asked to participate in a research study. Please note that by completing the previously sent consent form you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from the study at any given moment during the completion of the questionnaire. The results may be published.

PLEASE NOTE: Some questions have been duplicated, one set to be answered by the maxillo-facial surgeons and dentists and the other set to be answered by physiotherapists. Please read carefully and answer the questions applicable to your profession. This is done to filter the responses regarding exercise prescription.

As each patient presents differently, the following will be assumed when answering the questionnaire:

Patients are awake and coherent

The patients are hospitalised for three days

There is limited soft tissue damage

There are no other complications or precautions

All exercises and movements are done within pain limitations

All exercise repetitions are to be increased as the fracture heals.

**1. Which PRE-CAUTIONARY measures should be considered when treating a mandibular condyle fracture patient after ORIF (open reduction and internal fixation) surgery? DAY ONE UNTIL HOSPITAL DISCHARGE.**

**This question should be answered whether you are currently treating these patients, or not. You may select more than one option.**

- Any electrotherapy modalities DIRECTLY over the surgical area
- Active movements within pain limits, with no forced end range temporomandibular joint movements
- Resisted exercises
- Maintaining a soft diet
- All of the above

Comments

**2. Generally, how long should pre-cautionary measures for mandibular condyle fractures, treated by ORIF (open reduction and internal fixation) surgery, be adhered to? Interventions are continued as long as it has a beneficial effect.**

- 2 weeks
- 3 weeks
- 4 weeks
- 6 weeks

Comments

**3. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient after closed reduction (intermaxillary wires still in situ)?**

**This question should be answered whether you are currently treating these patients, or not. You may mark more than one option.**

- Any electrotherapy modalities DIRECTLY over surgical area
- Active movements within pain limits, with no forced end range temporomandibular joint movements
- No resisted exercises
- Dry needling over the surgical area
- Maintaining a soft diet
- All of the above

Comments

**4. Which pre-cautionary measures should be considered when treating a mandibular condyle fracture patient after closed reduction (after removal of intermaxillary wires)? This question should be answered whether you are currently treating these patients, or not. You may mark more than one option.**

- Ultrasound directly over fracture area
- Electrotherapy treatment directly over fracture area
- Active movements within pain limits
- No resisted exercises
- No forced end range temporomandibular joint movements
- Maintaining a soft diet
- All of the above

Comments

**5. How long should these PRE-CAUTIONARY measures for mandibular condyle fractures treated by closed reduction, be adhered to?**

- 2 weeks
- 3 weeks
- 6 weeks

Comments

**6. If you feel a physiotherapist should evaluate and treat mandibular condyle fractures treated by closed reduction when should they be seen for the first time? Taking into account that surgery times may vary from day to day and that patients may be more receptive day 1 after anaesthesia/ surgery.**

- Day of surgery
- Day one post-surgery
- Day three post-surgery
- After their out-patient follow-up

Comments

**7. When should post-surgical and cervical postural advice be given to patients who sustained mandibular condyle fractures, treated by ORIF surgery or closed reduction? Taking into account that surgery times may vary from day to day and that patients may be more receptive day 1 after anaesthesia/ surgery.**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- At out-patient follow-up

Comment

**8. In general, when should physical physiotherapeutic treatment modalities commence for patients with mandibular condyle fracture patients, treated with ORIF surgery? Each modality (postural advice, active movements etc) chosen according to the surgeons preference as well as the pre-cautionary measures for each specific patient.**

- Day of surgery
- Day one post-surgery
- Day two post-surgery

Comments

**9. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When is it safe for an extracapsular mandibular condyle fracture patient, treated by closed reduction, to start doing active jaw movements and isometric masticatory muscle contractions (slight, painless muscle contractions without movement of the jaw), within their pain limits?**

- Day of surgery
- Day one post-surgery
- Day three post-surgery
- Only at out patient follow-up
- After removal of intermaxillary fixation

Comments

**10. Approximately how many in-hospital physiotherapy visits should be adequate for patients with mandibular condyle fractures, treated by ORIF surgery? Assuming patients are hospitalised for the standard three days and that electrotherapy is safe to administer in the facial area, but not directly over the surgery site.**

- One
- Two
- Three
- Until discharge from hospital
- As many as show to be effective

Comments

**11. Approximately how many in-hospital physiotherapy visits should be adequate for patients with mandibular condyle fractures, treated by closed reduction? Assuming patients are hospitalised for the standard three days, have intermaxillary fixation and that electrotherapy is safe to administer in the facial area, but not directly over the fracture site.**

- One
- Three
- Until discharge from hospital
- As many as shows to be effective

Comments

**12. When should non-resisted active jaw movements (normal jaw movements), within pain limits, be commenced in hospital? Assuming there is limited soft tissue damage. If the patient has intermaxillary fixation, this will be done within the movement limits dictated by the fixation.**

- Day of surgery
- Day one post-surgery
- Until discharge from hospital
- Only at out-patient follow-up

Comments

**13. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.  
How many repetitions of active jaw opening exercise should be done at one time?**

- Three
- Five

Comments

**14. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of active jaw opening exercise should be done at one time?**

- Three
- Five

Comments

**15. Only to be answered by PHYSIOTHERAPISTS.**

**How many times per day should these repetitions of active jaw opening exercise be repeated as part of an exercise program?**

- Three
- Five
- As much as possible within pain limits

Comments

**16. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many times per day should these repetitions of active jaw opening exercise be repeated as part of an exercise program?**

- Two
- Three
- Four

**17. When should stretching of the jaw (mouth opening) be commenced for post-ORIF surgery patients, as well as after intermaxillary fixation removal for patients treated with closed reduction?**

- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- Only at out-patient follow-up
- After intermandibular fixation has been removed

Comments

**18. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When applicable, a jaw muscle stretch within pre-cautionary measures and pain limits, should be held for how long each time?**

- 5 seconds
- 10 seconds
- 30 seconds

Comments

**19. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When applicable, how many times per day should the repetitions of a jaw muscle stretch (within precautionary measures and pain limits) be repeated as part of an exercise program?**

- Two
- Three

Comments

**20. Only to be answered by PHYSIOTHERAPISTS. How many repetitions of an active lateral mandibular movement should be done at one time?**

- Five
- Ten

**21. When should isometric jaw muscle exercises (slight, painless masticatory muscle contraction without jaw movement) be commenced?**

**As there is no physical jaw movement, the answer will include patients treated by ORIF surgery as well as closed reduction, with or without intermaxillary fixation.**

- Day of surgery
- Day 1 post-surgery
- Day 2 post-surgery
- At discharge from hospital
- Only at out-patient follow-up

Comments

**22. Which of the following jaw exercises should be done in front of a mirror. You may mark more than one option.**

- Jaw opening
- Lateral mandibular movement
- Mandibular protrusion
- Isometric exercises
- Facial muscle stretches
- All of the above

Comments

**23. Which jaw exercises should be done with light guided hand pressure to prevent incorrect mandibular deviation (Post-ORIF surgery and after intermaxillary fixation removal for patients treated by closed reduction).**

- Jaw opening
- Lateral mandibular movement
- Mandibular protrusion
- Isometric exercises
- Facial muscle stretches
- All of the above

Comments

**24. When could light massaging be commenced for mandibular condyle fracture patients, assuming there is only slight soft tissue damage.**

- Day of surgery
- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- Only at out-patient follow-up

Comments

**25. Posterior-Anterior/ Anterior-Posterior condyle movement (e.g. mandibular protrusion) may give rise to a dysfunction of the lower jaw compartment and should be avoided.**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**26. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**In hospital, how many repetitions of active mandibular protrusion should be done at one time?**

- One
- Three
- Five
- Not to be done

Comments

**27. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**In hospital, how many times per day should these repetitions of mandibular protrusion be repeated?**

- Two
- Three
- Five
- Not to be done

Comments

**28. In-hospital physiotherapist visits should consist of passive joint mobilisations (joint mobilisation done by the physiotherapist by moving the condyle head in relationship to the mandible)**

**(After ORIF surgery and closed reduction, while intermaxillary fixation is still in situ)**

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Comments

**29. When should these passive joint mobilisations (joint mobilisation done by the physiotherapist by moving the condyle head in relationship to the mandible) be commenced?**

- Day one post-surgery
- Day two post-surgery
- At discharge from hospital
- Only at out-patient follow-up

**30. Only to be answered by PHYSIOTHERAPISTS.**

**When doing an isometric muscle contraction (slight, painless muscle contraction without jaw movement), for how long should each contraction be held?**

**As there is no physical jaw movement, the answer will include patients treated by ORIF surgery as well as closed reduction, with or without intermaxillary fixation.**

- Five seconds
- Ten seconds

Comments

**31. Only to be answered by PHYSIOTHERAPISTS.**

**How many repetitions of each isometric muscle contraction (slight, painless muscle contraction without jaw movement) should be done for each masticatory muscle?**

- Three
- Five

Comments

**32. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**When doing an isometric masticatory muscle contraction (slight, painless muscle contraction without jaw movement), for how long should each contraction be held?**

**As there is no physical jaw movement, the answer will include patients treated by ORIF surgery as well as closed reduction, with or without intermaxillary fixation.**

- Five seconds
- Ten seconds

Comments

**33. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many repetitions of each isometric muscle contraction (slight, painless muscle contraction without jaw movement) should be done for each masticatory muscle?**

Three

Five

Comments

**34. Only to be answered by MAXILLO-FACIAL SURGEONS AND DENTISTS.**

**How many times per day should the repetitions of isometric muscle contractions be repeated?**

Two

Three

Comments

**35. Only to be answered by PHYSIOTHERAPISTS.**

**When applicable, a jaw muscle stretch within pre-cautionary measures and pain limits, should be held for how long each time?**

5 seconds

30 seconds

Comments

**36. If you have any further comments or suggestions, please feel free to document them below.**

Thank you for completing the third and final round of this questionnaire.

Your participation is greatly appreciated.

Regards

Anke van der Merwe  
(Researcher)

**Addendum N: Report: Delphi questionnaire, round three**

### **Report on the final round of the Delphi questionnaire:**

#### **The development of a physiotherapy intervention program for closed or open reduction and / or internal fixation of mandibular condyle fractures.**

The third and final round of the Delphi questionnaire consisted of 12 members of the review panel, eight South African and four international review panel members. Two dentists, three maxillo-facial surgeons and seven physiotherapists were included in this round of the questionnaire.

Consensus was reached regarding physiotherapy evaluation and treatment of a patient who sustained a mandibular condyle fracture, treated by closed reduction, commencing day one after closed reduction.

Only the daily repetitions of a jaw opening exercises, as well as a jaw muscle stretch (three times per day) in the exercise dosage and jaw muscle stretch category achieved consensus. The amount of five jaw stretches to be done at a time received inter-reviewer consensus.

After completion of the final Delphi questionnaire round, only stability could be reached between reviewers regarding pre-cautionary measures, and duration of listed pre-cautionary measures, to be considered when treating a mandibular condyle fracture patient. Stability was achieved concerning exercise dosages (excluding the dosages mentioned above), as well as the commencement of different physiotherapeutic treatment modalities.

Even though consensus could not be reached on all questions, inter-reviewer stability regarding all other questionnaire questions was achieved.

The results of all Delphi questionnaire rounds will be analysed by the researcher and reported to all members of the review panel when finalised.

As every patient differs in clinical presentation, the answers provided during the Delphi study will only serve as a rough guideline for physiotherapy intervention.

It is still advised to consult with the referring surgeon regarding specific pre-cautionary measures for individual patients.

Thank you again for your participation in this research study. Your expert opinion was greatly appreciated and valued.

Kind regards

Anke van der Merwe

(Researcher)

**Addendum O: A proposed physiotherapeutic intervention program for the management of mandibular condyle fracture patients**

## **A proposed physiotherapeutic intervention program for the management of mandibular condyle fracture patients: Patient copy.**

### **Post-surgical advice:**

Commence day one after surgery:

1. **Early jaw movement:** It is safe and very important to commence gentle jaw movements, within pain limits, as soon as your physiotherapist and maxillo-facial surgeon gives permission after the surgery.
2. **Specific dietary requirements:** The maxillo-facial surgeon might advise you to be on a liquid or soft diet for a while after the surgery. The diet type would depend on the type of surgery done as well as the maxillo-facial surgeon.
3. **Ice** can be applied to the surgical area after surgery. Ice applications are recommended as much as possible (repeated every 1-2 hours), for a minimum of 48 hours to decrease pain and swelling in the jaw area.

#### Instructions

The following may be repeated every 1 - 2 hours if needed for relief of pain and / or swelling.

1. Place ice gel pack in freezer for about two hours. (Crushed ice in a plastic bag may be used as a substitute)
2. Remove gel pack or plastic bag from freezer.
3. Place in a damp towel.
4. Place ice pack over the painful or swollen area. It may help to secure the pack with an elastic strap.
5. Keep ice pack in place for 15 minutes.
6. Remove ice pack if a severe burning or pain sensation is experienced.

## **Postural advice:**

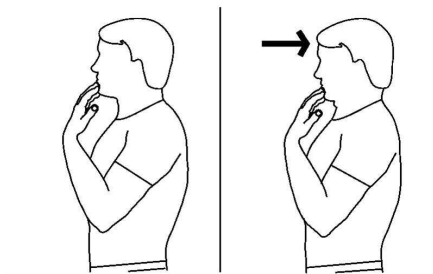
Commence day one after surgery.

### **1. Postural re-education:**

The basic rules of posture is as follows:

- The head should be directly over the neck, chin tucked in slightly and not poking forward.  
The ears should be over the shoulders.
- The shoulders should be level and "squared" back, not slumped or rounded forward.
- The middle of the back should be straight up and not slumped forward.

While maintaining the above mentioned principles perform the following neck movements:



- Sit or stand, looking forward. Imagine two strings: One string pulls the top and back of the head straight up towards the ceiling, the other string pulls the breastbone upwards.
- Keep above mentioned position and slightly tuck chin in.
- Return to start position.
- To progress, place finger on chin, apply backwards pressure.

**Perform five repetitions, three times a day.**

### **2. Relaxation techniques**

1. Relax: Stop what you are doing. Allow your body to relax.
2. Teeth apart: Let your jaw drop open slightly and remain in that position.
3. Tongue on roof of mouth: Keep your tongue just behind the top two front teeth ("clucking" position).
4. Maintain a good posture, as described above.
5. Breath: Place one hand on upper chest, the other on your stomach. When you breath in, the hand on your stomach should move more than the hand on your chest (diaphragmatic breathing). Imagine that a balloon is being inflated and deflated in your stomach.

## **Post-surgical exercises**

### **1. Active jaw exercises done within pain limits.**

#### **a) Jaw opening**



- Perform exercise in front of a mirror.
- Use light guided hand pressure to prevent incorrect side-wards jaw movement.
- Gently open and close the mouth, as far as pain allows.
- Repeat.

#### **Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

#### **b) Lateral jaw movement**



- Do exercise in front of a mirror.
- Use light guided hand pressure to prevent incorrect downwards jaw movement.
- Move jaw slightly forward and then to the left and then to the right.

#### **Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

**c) Protrusion of the jaw**



- Use light guided hand pressure to prevent incorrect downwards or side-ways jaw movement.
- Slightly move the lower part of the jaw forward and then slide jaw forward and backward to start position, as far as pain allows.

**Special Instructions:**

Commence day one after surgery.

Perform three repetitions, three times a day.

## **2. Isometric jaw exercises**

### **a) Isometric jaw opening**



Place thumb under the jaw.

- Open mouth slightly.
- Attempt to open your mouth further against the slight pressure of your thumb.
- No movement of the jaw should occur.

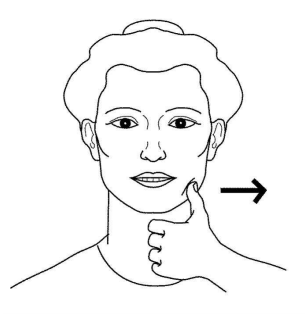
#### **Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

Hold muscle contraction for five seconds.

### **b) Isometric lateral jaw movement**



- Place thumb on side of jaw and open mouth slightly.
- Attempt to move the jaw sideways.
- Apply light resistance with thumb.
- No movement of the jaw should occur.
- Relax, use other thumb and repeat in other direction.

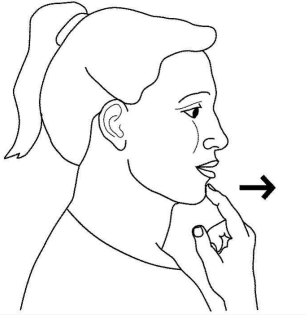
**Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day for the left and right side of the jaw.

Hold muscle contraction for five seconds.

**c) Isometric protrusion**



- Place index finger on chin and open mouth slightly.
- Attempt to move the jaw forward.
- Apply light resistance with index finger.
- No movement of the jaw should occur.

**Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

Hold muscle contraction for five seconds.

### **3. Jaw muscle stretch**



Done with permission from physiotherapist and maxillo-facial surgeon.

- Open mouth to point of stiffness.
- Place tongue blades on back teeth to open mouth.
- Do not open into pain.
- Slowly progress by adding more tongue depressors, as pain allows.

#### **Special instructions:**

Commence after fixation removal/ at out-patient follow-up.

Perform five repetitions, three times a day.

Hold stretch for five seconds.

Illustrations with permission from BioEX: Exercise Pro Version five.

## **A proposed physiotherapeutic intervention program for the management of mandibular condyle fracture patients: Guidelines for physiotherapy treatment.**

### **Pre-cautionary measures to be considered when treating a mandibular condyle fracture patient:**

#### **1. Following open reduction and internal fixation surgery**

- Follow a soft diet.
- Active jaw movements to be done within pain limits, and no end range joint movements done.
- No exercises done against resistance.

#### **2. Following closed reduction**

- Follow a soft diet.
- Active jaw movements to be done within pain limits, and no end range joint movements done.
- No exercises done against resistance.
- Ultrasound and interferential current therapy not to be done directly over fracture area.

#### **Other physiotherapeutic interventions which can be used:**

1. Massage of the facial muscles by the physiotherapist. Commence from day one after surgery.
2. Passive accessory temporomandibular joint movements performed by the physiotherapist. Commence at out-patient follow-up.
3. Ultrasound and Interferential Current therapy. Not to be done directly over surgical area.

## **A proposed physiotherapeutic intervention program for the management of mandibular condyle fracture patients: Physiotherapist copy.**

### **Postural advice:**

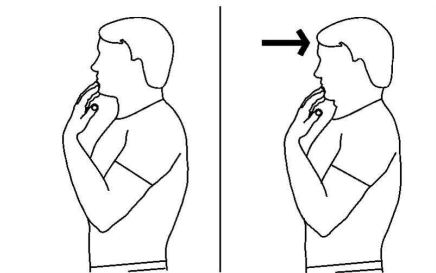
Commence day one after surgery.

### **3. Postural re-education:**

The basic rules of posture is as follows:

- The head should be directly over the neck, chin tucked in slightly and not poking forward. The ears should be over the shoulders.
- The shoulders should be level and "squared" back, not slumped or rounded forward.
- The middle of the back should be straight up and not slumped forward.

While maintaining the above mentioned principles perform the following neck movements:



- Sit or stand, looking forward. Imagine two strings: One string pulls the top and back of the head straight up towards the ceiling, the other string pulls the breastbone upwards.
- Keep above mentioned position and slightly tuck chin in.
- Return to start position.
- To progress, place finger on chin, apply backwards pressure.  
**Perform five repetitions, three times a day.**

### **4. Relaxation techniques**

1. Relax: Stop what you are doing. Allow your body to relax.
2. Teeth apart: Let your jaw drop open slightly and remain in that position.
3. Tongue on roof of mouth: Keep your tongue just behind the top two front teeth ("clucking" position).

4. Maintain a good posture, as described above.
5. Breath: Place one hand on upper chest, the other on your stomach. When you breath in, the hand on your stomach should move more than the hand on your chest (diaphragmatic breathing). Imagine that a balloon is being inflated and deflated in your stomach.

### **Post-surgical exercises**

#### **1. Active jaw exercises done within pain limits.**

##### **a) Jaw opening**



- Perform exercise in front of a mirror.
- Use light guided hand pressure to prevent incorrect side-wards jaw movement.
- Gently open and close the mouth, as far as pain allows.
- Repeat.

#### **Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

### **b) Lateral jaw movement**



- Do exercise in front of a mirror.
- Use light guided hand pressure to prevent incorrect downwards jaw movement.
- Move jaw slightly forward and then to the left and then to the right.

#### **Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

### **c) Protrusion of the jaw**



- Use light guided hand pressure to prevent incorrect downwards or side-ways jaw movement.
- Slightly move the lower part of the jaw forward and then slide jaw forward and backward to start position, as far as pain allows.

#### **Special Instructions:**

Commence day one after surgery.

Perform three repetitions, three times a day.

## **2. Isometric jaw exercises**

### **a) Isometric jaw opening**



Place thumb under the jaw.

- Open mouth slightly.
- Attempt to open your mouth further against the slight pressure of your thumb.
- No movement of the jaw should occur.

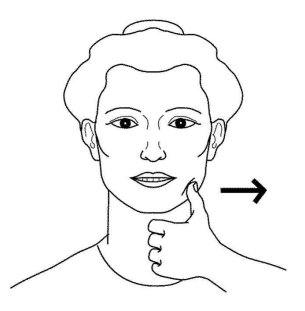
#### **Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

Hold muscle contraction for five seconds.

### **b) Isometric lateral jaw movement**



- Place thumb on side of jaw and open mouth slightly.
- Attempt to move the jaw sideways.
- Apply light resistance with thumb.
- No movement of the jaw should occur.
- Relax, use other thumb and repeat in other direction.

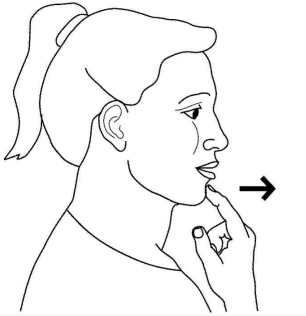
**Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day for the left and right side of the jaw.

Hold muscle contraction for five seconds.

**c) Isometric protrusion**



- Place index finger on chin and open mouth slightly.
- Attempt to move the jaw forward.
- Apply light resistance with index finger.
- No movement of the jaw should occur.

**Special Instructions:**

Commence day one after surgery.

Perform five repetitions, three times a day.

Hold muscle contraction for five seconds.

### **3. Jaw muscle stretch**



Done with permission from physiotherapist and maxillo-facial surgeon.

- Open mouth to point of stiffness.
- Place tongue blades on back teeth to open mouth.
- Do not open into pain.
- Slowly progress by adding more tongue depressors, as pain allows.

#### **Special instructions:**

Commence after fixation removal/ at out-patient follow-up.

Perform five repetitions, three times a day.

Hold stretch for five seconds.

Illustrations with permission from BioEX: Exercise Pro Version five.