Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery

Philip Jonsson
Student number: 2635502

Supervisor
Prof JA Morkel

A Mini-thesis submitted for partial fulfilment of the requirements of degree, Master of Dental Surgery, Maxillo-Facial and Oral Surgery, Faculty of Dentistry, University of the Western Cape

November 2020

Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery

Philip Jonsson

KEYWORDS

Quality of life

Fibula

Free flap

Mandible

Benign

Surgery

ABSTRACT

Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery

Philip Jonsson

MDS (MFOS) mini-thesis, Department of Maxillo-Facial and Oral Surgery, Tygerberg Oral Health Centre, Faculty of Dentistry, University of the Western Cape.

Introduction: Defects in the mandible and maxilla have various etiological factors. These include trauma, inflammatory diseases or pathology such as benign and malignant tumours. Patients that are exposed to these factors are often left with compromised function and aesthetics which could have a deleterious effects on the patients' quality of life if not adequately restored with reconstructive surgery (Goh *et al.* 2008*).*

Reconstruction should aim to allow rehabilitation of normal stomatognathic function, facial contour and aesthetics, obliteration of dead space left after ablation, and the need to examine the area for recurrence (Kim and Ghali 2011).

The fibula free flap has become the gold standard for maxillofacial reconstruction. This flap offers various advantages that makes it suitable, especially for reconstructing defects of the mandible (Anne-Gaelle *et al.* 2011).

The success of rehabilitation of these patients should however also take into consideration the patient's ability to use a dental prosthesis (conventional or implant retained) post-operatively. This remains challenging (Kramer and Dempf 2005). The effective placement of a dental prosthesis relies on the basic principles of retention, stability and support. With the altered anatomy caused by the graft, placement of dental implants is used to enhance retention and stability.

Quality of life (QoL) is a measure of a patient's satisfaction with their current

situation in regards to function and other factors compared to a perceived or expected ideal. The subjective component linked to quality of life means that it could vary from one locality to another, and therefore gathering data that will establish a baseline for these patients that have undergone tumour ablative surgeries. This could be invaluable to healthcare practitioners that operate in this specific field.

Aim: The aim of the study was to retrospectively evaluate the quality of life of patients after undergoing benign tumour ablative surgery of the mandible with fibula free flap reconstruction

Objectives: The objectives of the study were to compare the QoL of the different groups classified per mandibular defect and to assess the QoL of all the patients that have had fibula free flap reconstruction for benign tumours of the mandible. Furthermore, to compare the QoL of patients who have had implant supported prostheses with the group without implant supported prosthesis.

Methodology: The modified University of Washington Quality of life Questionnaire was used to make comparisons between the sizes of the defects (Brown's classification) before reconstruction and to assess the effect this had on their quality of life after reconstruction.

Results: The study consisted of fifteen patients that completed the questionnaire. The average age of participants in the study was 36.86 years (Age range: 26-47 years). There was almost equal number of eight females (53.3%) and seven males (46.7%). The majority of patients were Class I c (26.7%) and II c (26.7%) according to the Brown classification.

The study showed that patients were most concerned about pain, speech and chewing immediate post-operatively. Upon completing the questionnaires however these areas scored high meaning that patients were very satisfied in these domains. The majority of patients had no pain (53.3%), or very mild pain (26.7%) at follow-up. No patient had severe pain and the pain could be managed with the use of paracetamol. Speech and chewing was interestingly not negatively affected.

The majority of patients noted that they were satisfied with their appearance which also lead to better mood and less anxiety post-operatively.

There was no statistically significant difference (P=0.63) in overall quality of life scores between those who has implant supported restorations (N=3) versus those who did not receive implant-supported restorations (N=12). Furthermore, there was no statistically significant correlation (P=0.89) between the Brown's classification of the defect and overall quality of life.

The majority of patients (66.7%) reported their health-related quality of life had improved following surgery as compared to before they had the tumour resected. No patient reported worse quality of life after the surgery.

Conclusion: The fibula free flap is an excellent flap to use in the reconstruction of mandibular defects, and if performed well, it has minimal long-term effects on the overall quality of life for the patients treated for benign lesions of the mandible.

DECLARATION

I declare that ***Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery study at the University of the Western Cape Oral Health Care Centre*** is my own work, that it has not been submitted for any degree or examination in any other university, and that all sources I have used or quoted have been indicated and acknowledged by complete references.

Philip Jonsson November 2020

Signed 

ACKNOWLEDGEMENTS

This research project could not have been accomplished without the guidance and support of the following individuals:

- I would like to thank my wife for her continued support throughout my studies.

- Prof. Jean Morkel (Head of Department of Maxillo-Facial and Oral Surgery) for all his guidance and mentorship.

- My family and friends for their love and motivation to complete this course.

- Dr Fadi Titinchi (Fellow Registrar in Maxillo-Facial Surgery) for proof reading the mini-thesis and his valuable input.

DEDICATION

This mini-thesis is dedicated to my loving family who encouraged me throughout my studies.

CONTENTS

LIST OF TABLES AND FIGURES

List of Tables:

List of Figures:

Glossary:

The following terms will be clarified for purpose of this study:

- **Ablative**- surgical removal of tissue
- **Anastomoses**- surgical joining of blood vessels
- **Composite defects**- defect including hard and soft tissues
- **Deglutition**- process of swallowing
- **Intermaxillary fixation**- fixing the mandible and maxilla together in occlusion
- **Mastication**- function of chewing food
- **Non-odontogenic tumours**- tumours arises from non-tooth forming tissues
- **Obliteration**- destroy or eliminate
- **Odontogenic tumours**- tumours arising from tooth-forming tissues
- **Osseointegration**- functional connection between living bone and a implant
- **Osteosynthesis**- fixation of bone
- **Resection**- surgical removal of tissues
- **Stomatognathic**- anatomical unit including jaws, teeth and associated soft tissues

LIST OF ABBREVIATION

Abbreviations	Terms
ALT	Anterolateral Thigh
CNC	Computerized numerically controlled
CT	Computerized Tomography
FDA	Food and Drug Administration
FFF	Fibula Free Flap
EORTC QLQ-H&N	European Organization for Research and Treatment of Cancer Quality of life Questionnaire
OHIP-14	Oral Health Impact Profile
PSMP	Patient specific mandibular plates
QoL	Quality of life
UW-QoL	University of Washington Quality of life Questionnaire

Chapter 1
INTRODUCTION

Defects in the mandible and maxilla have various etiological factors. These include trauma, inflammatory diseases or pathology such as benign and malignant tumours. Patients that are exposed to these factors are often left with compromised function and aesthetics which could have a deleterious effects on the patients' quality of life if not adequately restored with reconstructive surgery (Goh *et al.* 2008*).*

Reconstruction should aim to allow rehabilitation of normal stomatognathic function, facial contour and aesthetics, obliteration of dead space left after ablation, and the need to examine the area in future for recurrence (Kim and Ghali 2011).

Reconstruction of defects after ablative surgery with regards to head and neck pathology is challenging. Defects caused by these surgeries are normally anatomically complex and have various other factors that may influence the outcome e.g. infection, inflammation and scarring. When rehabilitating these defects of the maxilla and mandible, it is important to look at the amount of bone and the soft tissue available or left, before deciding on the type of reconstruction (Chana *et al.* 2004; Chang *et al.* 2004). Reconstructing these defects with autogenous bone is considered the best method to date. Various graft and flap options exist which include both vascularized and non-vascularized (Pogrel *et al.* 1997). The type of graft depends on the size of the defect that needs to be reconstructed and also whether there is a soft tissue defect. Most techniques used today for reconstruction of composite defects involves some form of free tissue transfer via microvascular techniques (Ferrari *et al.* 2013).

Different donor sites can be used to obtain the grafting material (bone) needed to reconstruct the mandible, these include iliac graft and flap, radial forearm flap, the scapula and the fibula free flap.

These vascularized free flaps have revolutionized oral cavity rehabilitation, as it is

effective for the reconstruction of a multitude of defects (Turk *et al.* 1994). The fibula free flap has become the gold standard for maxillofacial reconstruction. This flap offers various advantages that makes it suitable, especially, for reconstructing defects of the mandible (Anne-Gaelle *et al.* 2011). These advantages include its straight form and resistance to high mechanical forces (pressure and torsion), its rapid incorporation and healing due to it being well perfused, composition of bone (high percentage of cortical bone), length (large defects can be bridged) and good osteotomising potential (allows shaping and adaptation to defect). Furthermore the flap includes skin and muscle (osteomyocutaneous flap) and is a relatively simple flap to harvest. It has adequate vessels for anastomoses and a low morbidity associated with the donor site. Adequate fixation with screws can be achieved due to good bone quality with good osseointegration of dental implants into the bicortical bone. The overlying skin is thin and pliable and matches the skin of head and neck area adequately. Resective surgery and grafting can be done as one procedure due to the harvesting site being at a distant location (Fagan and Van Zyl 2015).

The fibula free flap includes a vascularized skin pedicle and it can therefore be used as an osteomyocutaneous or osteomuscular flap. This enables reconstruction of not only the bony defect but can also be used to reconstruct soft tissue defects both intra- and extra-oral.

Ueba and Taylor are known to be the pioneers of this procedure. Ueba did the first vascularized fibula flap transfer in 1974 followed by Taylor in 1975. The technique for harvesting the fibula was described by Gilbert in 1979, thus making this procedure reproducible by other surgeons and increasing the flap's acceptance within the surgical community. The use of this flap for mandibular reconstruction was first reported by Hidalgo in 1989, which opened a new field in maxillofacial reconstruction with numerous articles being published on the topic in the early1900's.

The success of rehabilitation of these patients should however also take into consideration the patient's ability to use a dental prosthesis (conventional or implant retained) post-operatively. This remains challenging (Kramer and Dempf 2005). The effective placement of a dental prosthesis relies on the basic principles of retention, stability and support. With the altered anatomy, placement of dental implants is used

to enhance retention and stability. Huryn *et al.* (1993) and Sclaroff *et al.* (1994) highlighted the advantages of the use of implants as an adjunct to jaw reconstruction with free fibular flaps. There are only a few long-term reports on implants placed in vascularized fibula flaps. These studies are mostly limited to a follow-up of a few years only (Rohner *et al.* 2003).

Quality of life is a measure of a patient's satisfaction with their current situation in regards to function and other factors compared to a perceived or expected ideal.
The subjective component linked to quality of life means that it could vary from one locality to another, and therefore gathering data that will establish a baseline for these patients that have undergone tumour ablative surgeries. This could be invaluable to healthcare practitioners that operate in this specific field.

This study aimed to prospectively evaluate the quality of life of patients after undergoing benign tumour ablative surgery with fibula free flap reconstruction. Using the modified University of Washington Quality of life Questionnaire comparisons could be made between the size of the defects before reconstruction and the effect this has on their quality of life after reconstruction.

Chapter 2

LITERATURE REVIEW

2.1. Benign Tumours

Benign tumours of the head and neck are broadly classified into Non-odontogenic and Odontogenic tumours.

Non-odontogenic tumours

Non-odontogenic tumours can further be subdivided into:

- Tumours of connective tissue (Osteomas, Osteoblastomas and Chondromas)
- Neurogenic tumours
- Vascular and reactive lesions (Central Giant Cell Granulomas, Central Haemangiomas, Fibrous Dysplasias)

These lesions vary in their clinical and radiological presentation and treatment is based on the histopathological picture and aggressiveness of the lesion.

Odontogenic tumours

These tumours develop from structure involved with tooth development and formation. They also vary greatly in their clinical and radiological appearance and behaviour as well as their histological picture. Whilst some are truly benign in nature, others are very aggressive and cause massive local destruction. There are also some odontogenic tumours that can undergo malignant transformation. Odontogenic tumours are classified according to the tissue they develop from Wright and Vered (2017*)*. This includes:

- Odontogenic epithelium (Ameloblastoma, Calcifying Epithelial Odontogenic Tumour /Pindborg Tumour, Odontogenic Adenomatoid Tumours)
- Odontogenic ectomesenchyme (Odontogenic Myxomas, Cementoblastomas, Ossifying Fibromas/Cemento-Ossifying Fibroma)
- Mixed odontogenic epithelium and ectomesenchyme (Ameloblastic Fibromas, Odontomas)

2.2. Resection

According to Brown *et al.* (2016) the literature shows no universally accepted classification system for mandibular defects after resective surgery.

The decision to do a segmental mandibular resection is one of the most important decisions to make when it comes to curative treatment planning for benign tumours. The size of the resections is influenced by the size of the lesions and this plays a role when reconstruction options are planned. Pavlov published the first classification of mandibular defects following resective surgery in 1974. Subsequently six additional classifications were published. The HCL classification described by Jewer and colleagues in 1989 was commonly used according to the literature (Brown *et al*. 2016). Problems with classification systems like the one described by Urken *et al.* (1998) is that it is mostly descriptive, and cases cannot be grouped together according to their complexity in regard to reconstruction. There are also limited publications that comment on the results obtained when restoring complex defects after ablative surgery such as defects of the anterior mandible. Various flap options are available and discussed in the literature, but the there is little consensus to be found on specific flaps that are most suitable for specific sized defects. The flap choice is then often based on the surgeon's preference and experience in doing a particular flap instead of focusing on trying to restore the defect in such a way as to obtain optimum form, function and aesthetics. It was therefore proposed to create a classification of mandibular defects that could be used universally and will help surgeons to make use of the best available options for the reconstruction of these defects. Brown *et al.* (2016) looked at the classifications systems available in the literature (Table 1) and proposed a new revised classification system based on a combination of the pre-existing systems.

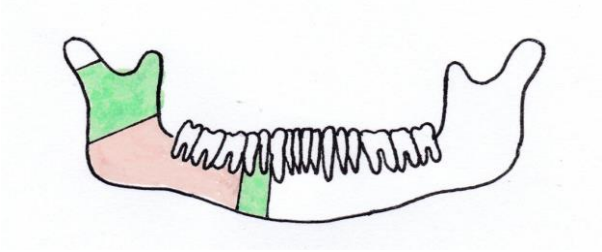
Table 1: Existing classifications of mandibular defects post ablative surgery:

Pavlov 1974	By the number of remaining bone fragments: class I-one bone fragment, class II- two bone fragments, class III- three bone fragments
David *et al.* 1988	A-lateral, B-unilateral angle to symphysis, C-angle and body of the other side, D-angle to angle, E-symphysis, F-hemimandible plus condyle
Jewer *et al.* 1989	H-unilateral condyle but can cross midline, L-unilateral no condyle but can cross midline, C-both canines, HC-lateral and condyle including both canines, LC-lateral and both canines, LCL-bilateral lateral defects including canines but not condyles, HCL- condyle lateral, central and contralateral lateral, HCH-entire mandible
Urken *et al.* 1991	C-condyle, R-ramus, B-body, S-symphysis, Sh- stops at the midline
Iizuka *et al.* 2005	Class I-IV based on the number of osteotomies of the fibula
Hashikawa *et al.* 2008	C- loss of condylar head, A- loss of angle, T- loss of mental tubercle, CAT- hemimandible
Baumann *et al.* 2011	Type I- segment not including condyle, Type II- segment including condyle

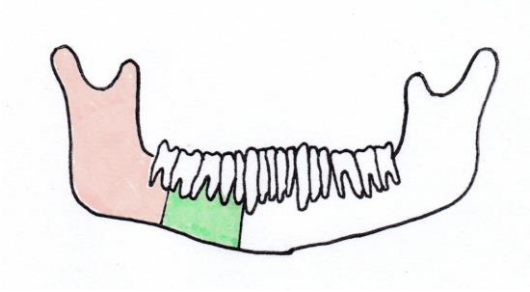
Existing classifications as noted in Table 1 was based on the concept that the mandible is made up of four parts: two vertical parts (the angles of the mandibles) and then two horizontal parts (centred at the canines). These parts show the change in form that occurs with resection and emphasizes the need to shape the graft in order to obtain adequate function and aesthetics.

The new panel proposed classification of mandibular defects by Brown *et al.* (2016).

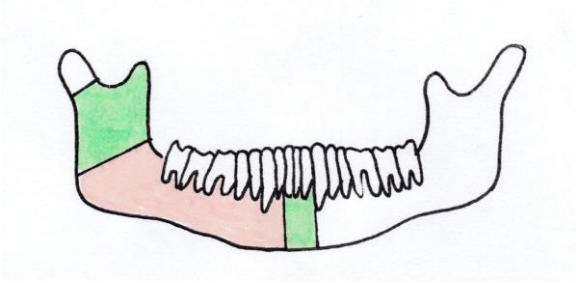
- Class I (angle)- lateral defect not including ipsilateral canine or condyle



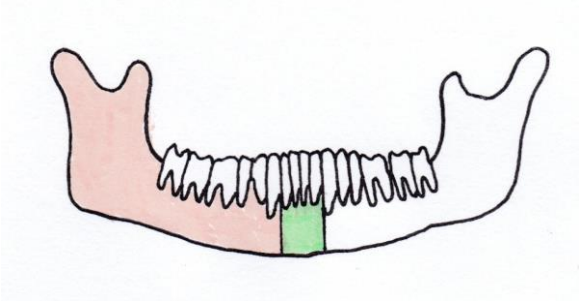
- Class Ic (angle and condyle)- lateral defect including condyle



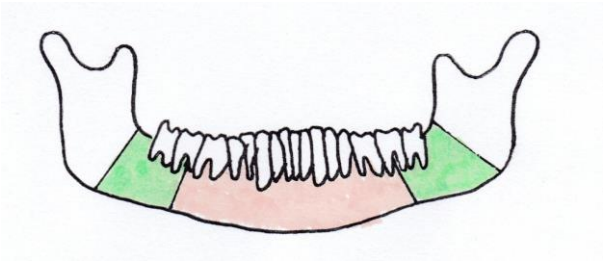
- Class II (angle and canine)- hemimandibulectomy including ipsilateral but not contralateral canine or condyle



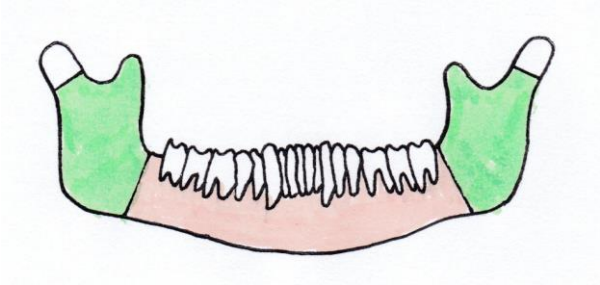
- Class IIc (angle, canine and condyle)- hemimandibulectomy including condyle



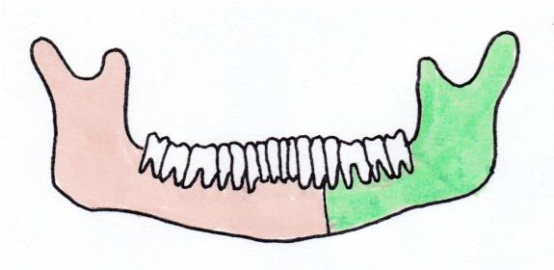
- Class III (both canines)- anterior mandibulectomy includes both canines but neither angles



- Class IV (both canines and at least one angle)- extensive anterior mandibulectomy including both canines and one or both angles



- Class IVc (both canines and at least one condyle)- extensive anterior mandibulectmy including both canines and one or both condyles

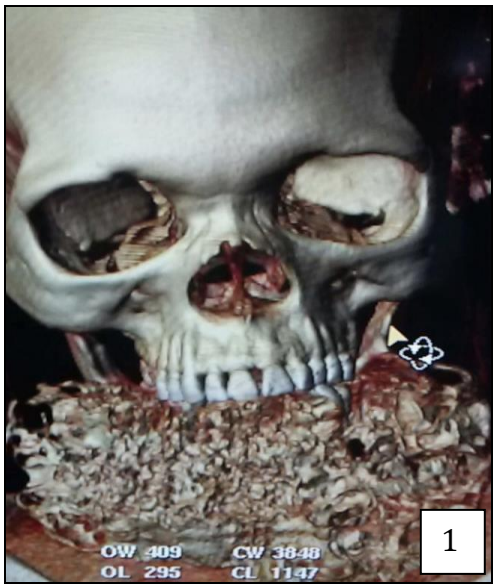


Using this new proposed classification, Brown *et al.* (2016) looked at 49 publications on reconstruction of mandibular defects with composite free tissue transfers. In these publications, 1766 mandibles were reconstructed using the four most common types of grafts namely fibula, iliac crest, radial forearm and scapula. They then classified all these defects and looked at the flap/graft used for each defect. As expected the fibula was the flap that was most often used (Table 2).

Table 2: Frequency of flap options used to reconstruct mandibular defects according to proposed classification Brown *et al.* (2016):

	Fibula n=831	Iliac n=156	Radial n=84	Scapula n=194	Total classified n=1265	Total not classified n=501	Total n=1766
All proposed mandibular defect classes							
Class I	261 (31%)	47 (30%)	42 (50%)	105 (54%)	455	198	653 (37%)
Class Ic	27 (3%)	7 (4%)	1 (1%)	1 (1%)	36	28	64 (4%)
Class II	85 (10%)	50 (32%)	15 (18%)	43 (22%)	193	139	332 (19%)
Class IIc	15 (2%)	5 (3%)	0	1 (1%)	21	10	31 (2%)
Class III	378 (45%)	41 (26%)	20 (24%)	31 (16%)	470	113	583 (33%)
Class IV	56 (7%)	4 (3%)	6 (7%)	12 (6%)	78	13	91 (5%)
Class IVc	9 (1%)	2 (1%)	0	1 (1%)	12	0	12 (1%)
Condylar resections combined mandibular defect classes							
Class I/Ic	288 (35%)	54 (35%)	43 (51%)	106 (55%)	-	-	-
Class II/IIc	100 (12%)	55 (35%)	15 (18%)	44 (23%)	-	-	-
Class III	378 (45%)	41 (26%)	20 (24%)	31 (16%)	-	-	-
Class IV/IVc	65 (6%)	6 (4%)	6 (7%)	13 (7%)	-	-	-

Example of Fibula Free Flap reconstruction:
A patient presented to the maxillofacial and oral surgery clinic with an ameloblastoma in the mandible. Figures 1 and 2 shows the radiographic images of the lesion.



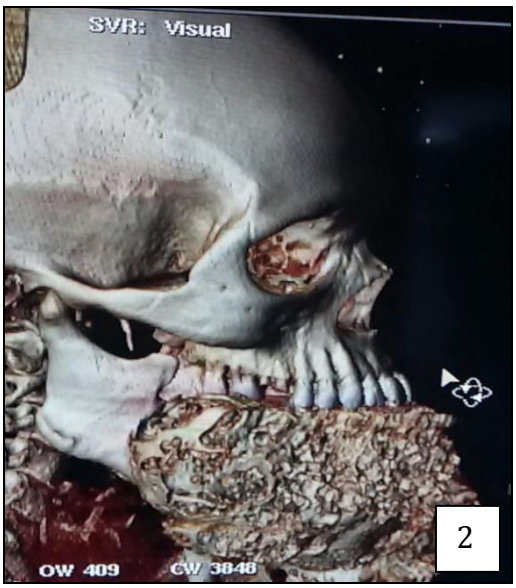
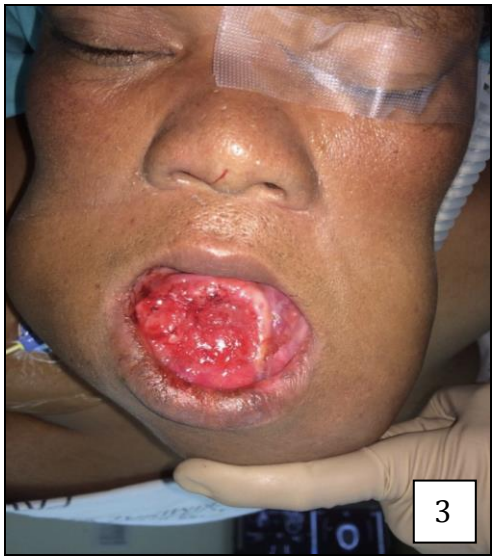


Figure 3: Clinical presentation of the patient preoperatively. Figure 4: Intra-operatively after resection of the lesion was done.



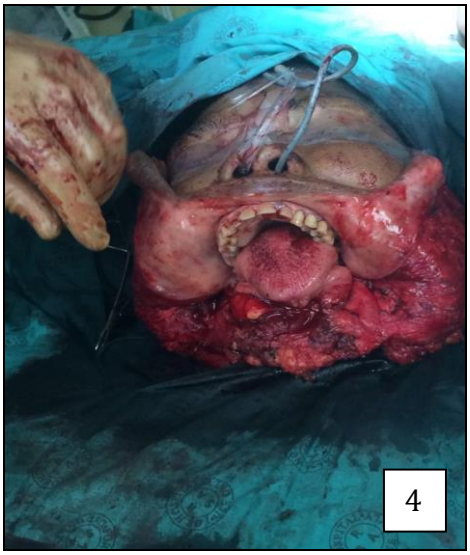
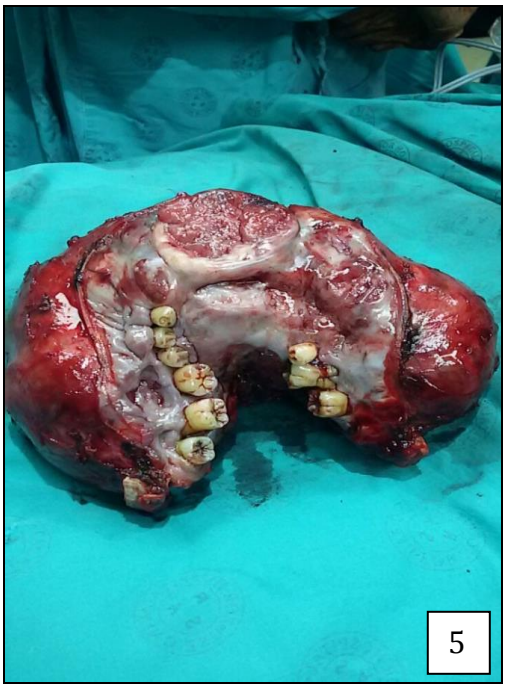
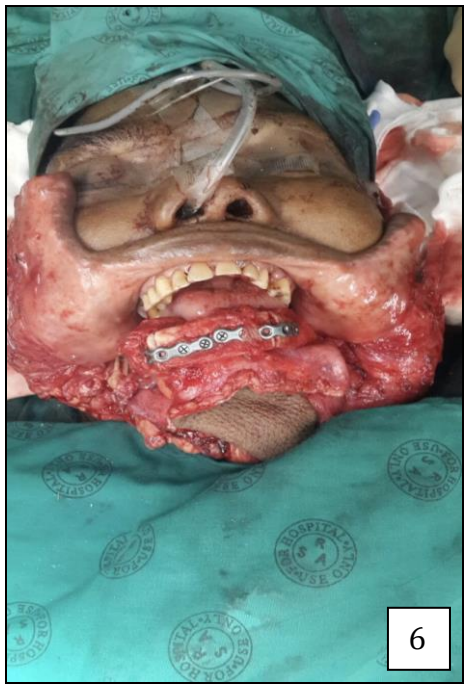


Figure 5: Resected specimen and Figure 6: Fibula free flap reconstruction of the defect.





Photographs courtesy of MFOS, UWC with consent of the patient

2.3. Types of reconstruction

Fixation Methods

Various techniques can be employed to assist with the optimal placement of the fixation device. These techniques involve the following:

- **Preplating on the mandible before doing the resection.** This can be done if

the pathology does not distort the outer form/contour of the mandible or if the tumour can be lifted off the mandible to contour the plate. The plate is thus bent to fit the patient's own mandible. In cases where the tumour needs to be lifted and the plate then bent, the plate must be autoclaved again before placement to prevent seeding of tumour cells.

- **Preoperative computer generated model plate contouring.** This is done when the tumour obliterates or totally distorts the normal form of the affected mandible. Patient specific computer aided design and manufacturing is therefore used to manufacture a plate that closely follows the patient's mandible before being affected by the tumour. The mandible can be mirror imaged from the unaffected side.
- **IMF (intermaxillary fixation) and "blind" bending of the reconstruction plate by the surgeon.** This technique is operator sensitive and not very accurate.
- **Use of external fixation devices**. The technique is indicated when the patient is edentulous and other modalities not available.
- **Simple "blind" bending of the reconstruction plate.** This technique is not very accurate and may yield undesired aesthetic results in facial form and contour (Fagan and Van Zyl 2015*).*

Osteosynthesis of the fibula to the native mandible is done by the use of various plating systems depending on factors such as the size of the graft placed and operator preference. These systems include reconstruction and mini-plates. Both systems come in locking and non-locking options. Pre-bending of the reconstruction plate prior to surgery has been made possible by digital advances. The use of 3D stereolithographic models, generated from CT scans allows the operator to plan the surgery beforehand and radically reduces operating time. Cornelius *et al.* (2015) showed that the use of Patient-Specific Mandibular Reconstruction plates (PSMPs) is the future of reconstruction. They made use of an innovative computerized numerically controlled (CNC)-3D milled and drilled patient-specific mandibular plates. These seem to preclude the deficiencies seen with the use of current pre-bent reconstruction plates (Mazzoni *et al*. 2013). PSMPs are constructed digitally to create a perfect fit between the fibula and the native bone segment (Hallerman *et al*. 2006). It also allows for

fixation to the fibula free flap at the donor site before the graft is transferred. This reduces surgical time and means that ischaemic time is basically limited to the time in which the microvascular re-anastomosis is done. This advance in virtual surgical planning together with other tools has brought a new level of surgical accuracy. It has provided a platform that can be used to accurately reconstruct the patient's occlusion with the use of dental implants via surgical stents and drilling templates (Levine *et al*. 2013).

Rehabilitation options following mandibular resective surgery

Reconstruction and rehabilitation of mandibular defects following tumour ablative surgery has come a long way. Early head and neck surgery left the patient with a facial deformity that was left untreated. These patients had major problems with function and aesthetics. With the advent of vascularized free tissue transfer and other modalities a lot has been achieved to correct these deformities, and subsequently also addressing and restoring function.

Today the following options are available to the patient:

- **Resection of tumour with placement of reconstruction plate.** No further reconstruction done. Reconstruction plate might have to be replaced in future when it fails. This modality however is not seen as an adequate reconstructive effort.
- **Resection of tumour with placement of grafts and reconstruction plate.** This can be done as a one-stage or two-stage procedure. Grafts can be divided in non-vascularized and vascularized grafts. Non-vascularized grafts entail free bone grafts, whereas vascularized grafts include soft tissue or osseocutaneous grafts. Examples of the grafts are as follows:

  -Free bone grafts include e.g. costochondral grafts, iliac crest

  -Soft tissue grafts include anterolateral thigh (ALT), gracilis rectus, latissimus dorsi, radial forearm flaps

  -Osseocutaneous grafts include fibula free flap, iliac crest osteocutaneous flap, scapular free osteocutaneous flap, and radial forearm osteocutaneous flap.

Various techniques can adjunct be employed to achieve adequate bone height should

the fibula be too thin. This include the double-barrel fibula technique, vertical osteodistraction of the fibula and bone grafts. Fixed or non-fixed prosthodontics appliances can be constructed on the grafted site. These include full dentures, partial dentures (acrylic or chrome cobalt), and implant-supported dentures. Studies have shown that non-fixed prosthodontic appliances are not successful due to the lack of retention (Bodard *et al*. 2008).

- **Resection of tumour with placement of 3D printed prosthesis. No graft needed.**

  The surgical fraternity is using the aid of 3D-printing increasingly. Being able to provide a patient with a 3D-printed prosthesis manufactured to custom fit the defect post resective surgery is being researched, but no long-term follow up data is available at present. These prosthetic mandibles or maxillae will allow for full dental rehabilitation with the advantage that the patient would not have to undergo a free tissue transfer and the morbidities associated with it.

The aim of all these advances is to render patients free of disease and to restore optimal function and aesthetics with minimal morbidity. Technological advances have made these procedures more predictable and improved the prognosis of these reconstructive efforts, however due to the multifactorial influences it remains one of the most challenging surgical fields.

2.4. Fibula free flaps

The Fibula

The tibia and fibula are the two long bones of the lower leg. Of these two, the tibia is the main weight bearing bone. The fibula is a slender bone that is triangular in shape, but has four surfaces. These surfaces allow muscles, ligament and fascial septae to attach to the bone (muscles attached to fibula: extensor digitorum longus, extensor halluces longus, flexor halluces longus, tibialis posterior, peroneus tertius, peroneus brevis, peroneus longus and soleus muscle). The fibula further serves to stabilize the knee and ankle due to insertion of tendons and ligaments to it (biceps femoris tendon, lateral collateral ligament, anterior and posterior tibiofibular ligaments, anterior and posterior talofibular ligaments and the calcaneofibular ligament).

Blood supply to the fibula is both endosteal and periosteal. The endosteal and periosteal supply are fed from branches of the peroneal vessels (and perforators to the skin). The anterior recurrent and posterior tibial vessels together with the lateral inferior genicular recurrent branches supply the head and up to a third of the proximal part of the fibula (Fagan and Van Zyl 2015).

When harvesting a fibula the common and superficial peroneal nerves together with the sural nerve is at risk, so care must be taken to avoid injuring them.
It is important to leave at least 6cm of the distal fibula when harvesting this bone. This will maintain stability of the ankle by not disturbing the integrity of the intraosseous membrane and ligaments attached (De Bree *et al.* 2008).

Advantages of fibula free flaps:

- Large vessels for anastomosis
- Long vascular pedicle
- Well vascularized bone
- Good length of donor bone (up to 25cm)
- Bone strength permits adequate fixation
- Length provide options for osteotomies to shape graft
- Dental implants has shown good osseousintegration into the fibula
- Usually little soft tissue bulk, so minimal debulking procedures necessary
- Skin paddle is usually large enough for most defects to be reconstructed
- Due to distant donor site, resection and harvesting can be done simultaneously

Disadvantages of the fibula free flap:

- Morbidity of the donor site- delayed wound-healing, loss of the skin graft, peroneal tendon exposure, compartment syndrome, ankle instability, nerve injury with functional and sensory impairment (claw toe and weakness in dorsiflexion of the great toe, reduced muscle strength, limited range of ankle motion, gait abnormality) and chronic pain.
- Preoperative vascular problems including peripheral vascular diseases, deep vein thrombosis, venous insufficiency and congenital absence of lower leg vessels could affect the donor-site negatively.

- Bone height of donor bone may be limited in certain patients.

Donor site (which leg to use)

When planning a fibula free flap there are various factors to consider when deciding on the donor site to be used.

As a general rule the contralateral side is used, but according to Fagan and Van Zyl (2015) it is a more complex decision and the following questions should be asked:

- What side is the defect?
- Is a skin pedicle required?
- Will the skin pedicle be used for intra-oral or extra-oral reconstruction?
- Was there previous surgery to the neck, and if so what side of the neck is available to use for anastomoses of the vascular flap?

Taking into account these variables and the anatomy of the fibula (orientation of the pedicle to be used, vessels to be used for anastomoses etc.), Fagan and Van Zyl (2015) compiled the following table to suggest which leg to use as donor site (Table 3).

Table 3: Site of defect, neck vessels and which leg to use

Defect	**Neck vessels**	**Donor leg**
Intraoral	Ipsilateral	Contralateral
Extraoral	Ipsilateral	Ipsilateral
Intraoral	Contralateral	Ipsilateral
Extraoral	Contralateral	Contralateral

The procedure (Fagan and Van Zyl 2015*).*

Surgery is done simultaneously in a two-team approach. One team will carry out the resection of the tumour, whilst the other will be harvesting the fibula. Harvesting the fibula includes the following steps:

- Skin marking: Marking the distal osteotomy site at least 5-7cm above the lateral malleolus to ensure ankle stability. Mark the dimensions of the skin flap taking into account the location of the superficial peroneal and sural nerves.
- Raising and freeing the flap and the fascia from the lateral surface of the peroneus muscle up to the posterior crural intermuscular septum.

- Perforator vessels will be encountered whilst doing this, take care not to damage them (at the posterior margin of the crural septum). Also take care to not damage the sural nerve and the lesser saphenous vein.
- Now the deep fascia is elevated from the soleus muscle all the way to the posterior aspect of the crural septum until the perforators come into view again.
- Small vessels supplying the soleus and flexor halluces longus should then be ligated and divided.
- After the flexor halluces longus have been identified the intermuscular septum should be divided.
- The posterior crural septum should also be divided, but allowing enough septum to protect the feeder (perforator) vessels.
- Now the peroneus muscle should be released whilst leaving a cuff of this muscle still on the bone
- The anterior crural intermuscular septum is then incised.
- The anterior part of the crural intermuscular septum and the proximal part of the peroneus muscle should gently be stripped off the fibula using a finger.
- If the peroneus muscle is now retracted anteriorly it will expose the extensor digitorum longus muscle.
- The fibres of extensor digitorum longus is divided with a scissor.
- Next the interosseous membrane is divided and that will expose the tibialis posterior and distal peroneal vessels.
- The dissection scissor is now advanced in an avascular plane between the intermuscular septum and the peroneal vessels.
- The interosseous membrane is now divided and the peroneal vessels are properly exposed.
- The flap can now be detached from flexor halluces longus whilst a finger protects the perforator vessels.
- The skin paddle, the fibula and the vascular pedicle is now ready to be removed.
- The reconstruction plate should be adapted to the defect and angles of osteotomies should be marked out on a template.
- Osteotomy cuts can now be made on the fibula.
- The flap can be removed and microvascular anastomosis done to one of the neck vessels.
- The flap is secured into place with the reconstruction plate.

2.5. Implant supported prostheses

Implants:
In 1952, Swedish orthopedic surgeon, Per-Ingvar Brånemark, the father of modern day implantology, inadvertently discovered osseointegration—"the formation of a direct interface between an implant and bone, without intervening soft tissue"—while studying blood flow in rabbit bone using vital microscopy (Brånemark *et al.* 1985). Recognizing the value of osseointegration, Brånemark and his colleagues spent the next three decades researching its application. Brånemark presented his data on osseointegration at the Toronto Conference in 1982. Shortly after this, the Food and Drug administration (FDA) approved the use of titanium dental implants in the United States.

Dental implants are metal structures that are placed into bone to support prosthesis. This prosthesis can be either fixed or removable. The placement of dental implants and a prosthesis as part of the oral rehabilitation of patients that have had resective surgery has led to a great improvement in the quality of life of these patients. The implant supported and retained prosthesis has drastically helped to improve function and aesthetics. This has also contributed to the psychological well-being of these patients following these major resective surgeries.

Studies in the 1990's reported the survival rate of implants to be between 81-99% with an average of 87% (Weischer *et al*. 1999). A recent systemic review by Laverty *et al.* (2018) showed that sixteen out of the twenty studies reviewed, reported implant survival rate in FFFs to be above 80%. Eleven of the sixteen studies had a survival rate of above 90%.

When planning the type of implant to be used, various factors play a role and should be considered before doing the procedure. These include: the general health of the patient, previous surgeries, type of pathology and resective surgery to be done, defect size and graft to be placed and type of prosthesis to be used (Teoh *et al.* 2005).
Tumour resection and the placement of a graft causes anatomic variations such as differences in bony height, soft tissue changes (thickness of flap), changes in the

muscular action in and around the area, loss of proprioception, and altered vestibular sulcus. These reasons contribute to the fact that removable dentures are mostly unsuccessful. Furthermore various factors reduce the prognosis of patients wearing a removable denture as it will lead to mucosal atrophy in the area, can cause irritation, ulceration and may lead to subsequent bone exposure (Weischer *et al*. 1999).

Various classifications are used to classify implants. These include: Implant design, attachment mechanism of implant, body design of the implant, surface of the implant and the material the implant is made from.
Implant design is classified into:

- Endosteal- ramus frame, root form and plate form
- Subperiosteal
- Transosteal

The root form implant is the most commonly used one in dentistry today.

Timing of implants

Implants can be placed before reconstruction, at the time of primary reconstruction or as a secondary (delayed) procedure following flap healing and completion of adjunctive therapies. Each technique offers advantages and disadvantages.

With immediate placement the treatment period is short and the patient is not exposed to a second procedure for placement of the implants. Urken *et al.* (1998) suggested that there was a higher probability for the successful integration of dental implants if it's placed immediately at the time of reconstruction. Fenlon *et al.* (2009) who compared immediate versus delayed implant placement did however not support this hypothesis. They found a significant loss of one-third of implants placed immediately.

Early studies recommended the placement of implants into the fibula before positioning of the flap into its final position. This was said to make placement of the implants easier and decrease ischemic time, but it was found that implants often ended up in unusable positions (either too far lingual or buccal). Therefore placement of implants after the flap in its final position is advocated due to more accurate orientation of the implants.

Hirsch *et al.* in 2009 described new techniques using stereolithography and virtual surgical planning. These techniques use prefabricated surgical guides that are used intraoperatively for the shaping and contouring of the bone (fibula) and also provide exceptional accuracy for the placement of the implants. This aids in decreasing surgical time and assists in accurate configuration of the neomandible for further prosthodontic reconstruction.

Delayed implant placement also provides its own set of advantages, although it does substantially lengthen treatment time. Postponing the implants provides the reconstructive team time to evaluate the exact needs of the patient and planning can be done based on post-surgical assessment. Immediate placement of implants has the disadvantage that it complicates the primary reconstructive surgery and increases the risk of infection. Studies by Holmes and Aponte-Wesson (2010) reported that the advantages (and predictability) of delayed implant placement superseded that of immediate placement.

The question that remains unanswered is how much time should be allowed before implant placement. At present there is no definitive answer, and estimations are made based on various investigator's experience. Jacobson *et al.* (1988) suggested a waiting period of at least one year, which allowed ample time for optimal healing and also for the patient to be optimized from a general health point of view. In general a period of twelve months is accepted as the norm before placing implants, although cases should be evaluated individually due to a multitude of factors that need to be taken into consideration for each patient.

The prognosis of the patient plays an important role in deciding whether implants should be placed immediately or if it should be delayed. If there is a high risk of recurrence, implant placement should be delayed. Garret *et al.* (2006) found a significant loss in patients receiving implants after resective surgery (oncology cases) and questioned the reasoning behind immediate implant placement in these cases. Delaying implant placement in these patients provides surgeons the opportunity to be able to easily examine the surgical field for any signs of recurrence.

Rohner *et al*. (2003) described a two-stage surgical approach for the reconstruction of mandibular defects with FFFs. This included placing dental implants into the fibula before reconstruction of the mandible had been done. This allowed for osseointegration of the implants into the fibula and the implants could then be loaded at the time of the reconstructive surgery. It is described as a two stage technique. The first phase is called the Prefabrication of the fibula. This entails pre-operative planning by means of CT scan and angiograms of the facial skeleton and lower limb. 3D reconstruction of the mandibular defect is done virtually. This planning is then sent to a laboratory where implant guides are made to locate the exact site where implants should be placed into the fibula. The fibula is then exposed surgically in the first procedure and implants placed in the positions planned. The leg is then closed.

After a waiting period of at least five weeks the second phase takes place. This phase is called Mandibular reconstruction. Access to the leg is gained through the previous incision. The fibula is exposed and prefabricated cutting guides (made during virtual planning) are used to make appropriate osteotomies. The fibula with or without a musculocutaneous flap is then harvested and the mandibular defect is reconstructed. The recipient site is also prepared with custom made surgical guides prior to placement of the fibula free flap. The fibula is then fixated to the remaining mandible with prefabricated plates. Immediate dental prostheses can then be placed at the end of the operation or after healing.

In an article by Pauchet *et al.* (2017), they advised that this technology should be reserved for complex secondary mandibular reconstructions. Secondary reconstruction is reserved to patients with problems of mandibular malposition, limited mouth opening and soft tissue contractures or retractions.

2.6. Quality of life

Quality of life assessment post tumour resective surgery is an important outcome parameter for the success of the treatment. The patient's quality of life is not only linked to the patient being rendered free of disease, but the patients' overall (physical and psychological) well-being after these surgeries. The concept or term "Quality of

life" has been defined and described by various groups.

These definitions include:

- The 1947 World Health Organization description: "a complete physical, mental and social welfare state and not only the absence of disease".

  This was updated by the WHO to: "an individual's perception of their own position in life, in the context of the culture and value system in their life and in relation to their goals, expectations, standards and concerns".
- Boscolo-Rizzo *et al.* (2009) and Kim *et al.* (2010) described Health-related Quality of life as "an individual's perception of overall well-being with regard to disease and treatment-related symptoms".
- Montazeri (2009) defined quality of life as "a multidimensional construct that includes, at a minimum, physical, functional, psychological and social well-being. Other dimensions include spirituality, sexuality, occupational functioning and treatment satisfaction".
- Revicki *et al.* (1997), and Sayed *et al.* (2009) said that quality of life is "a broad range of human experiences related to one's overall well-being that minimally includes the broadly-defined assessment of the physical, psychological and social domains of functioning".

Tumour resective surgeries cause disruption in one or more aspects of the patient's quality of life. Therefore assessing quality of life is essential to determine the effectiveness of these surgeries and the morbidity it holds, thus helping surgeons and patients to make the correct decisions when it comes to treatment planning. There are often different opinions regarding the success of surgery. The clinician will find the surgery to be successful when the patient has been rendered disease free and when no recurrence is seen, whereas the patient will be looking at the surgery as a success if they are able to reach a point where their function and aesthetics are more or less at a predisease state. Doing quality of life studies therefore helps to achieve a middle ground between surgeon and patient expectations/indicators.

The literature shows numerous studies on the quality of life after surgical resection of head and neck tumours. These studies indicate that the more advanced the tumour, the more extensive the resection, and the subsequent need for flap

reconstruction is associated with a low quality of life post-operatively (Bozec *et al*. 2008; Hammerlid and Taft 2001; Pierre *et al*. 2014; Rana *et al.* 2015).

The data relating to quality of life after reconstructive surgery by means of fibula free flaps in the literature however seems to be limited. These studies have various limitations that include factors such as small sample size, method of assessing quality of life, varying follow-up periods and conflicting results (Hikosaka *et al*. 2011; Momeni *et al*. 2013; Rana *et al.* 2015). Most of the studies on fibula free flap reconstruction focuses on malignant lesions, and very few studies look at the outcome and quality of life in cases post reconstruction of resections done for benign lesions.

2.7. Measuring quality of life

Means to evaluate and measure quality of life have been available and used since the early 1990's. Quality of life questionnaires are easily available tools to collect data from patients that have undergone specific procedures.

Quality of life questionnaires can be classified as generic or specific according to Fitzpatrick *et al.* (1992); Hays *et al.* (1993) and Rogers (2016). Whilst generic questionnaires are adequate to make comparisons between different diagnoses and therapeutic procedures in large populations, they are not accurate in evaluating the effect of specific surgical interventions or specific pathologies on the quality of life of these patients. Therefore specific questionnaires are more suitable to determine and identify problems pertaining to certain pathologies, their anatomic region and surgery required or performed to resect the pathology. These problems include impact on functions such as breathing, swallowing and speech, physical appearance etc. Generic questionnaires do not measure the effects on these functions (Bozec *et al*. 2008; Momeni *et al.* 2013).

The ideal quality of life questionnaire characteristics are:

- Short, usually take less than ten minutes to complete
- Easy to understand, and to be completed by patients themselves with minimal assistance from a surgeon/healthcare professional if absolutely necessary
- Address pertinent quality of life issues

- Responsive to change
- Reliable for data capture

The most commonly used questionnaires used for head and neck cancer is the University of Washington Quality of life Questionnaire (UW-QoL), the Oral Health Impact Profile (OHIP-14) questionnaire and the European Organization For Research And Treatment Of Cancer Quality of life Questionnaires (EORTC QLQ-H&N OR H&N35.7) (Xiangru *et al.* 2014). These questionnaires have been proven to be reliable and provide a good reflection of the changes that take place over time.

The UW-QOL questionnaire is a self-administered questionnaire that is completed by the patient and provides adequate practical and reliable data pertaining to the post-operative state of the patient. The original questionnaire has 15 domains, but for the purposes of benign tumour studies the questionnaire has been modified to exclude sections that were not relevant. The modified version contains 12 domains that assess specific areas such as pain, appearance, activity etc. Scoring of the domains work on a scale ranging from zero (worst) to 100 (best). Therefore the higher the patients score, the better their quality of life. Mean scores are calculated by finding the average of the domains. The domain scores are added and divided by the number of domains to obtain the composite score.

The OHIP-14 questionnaire provides insight into specific condition of the oral environment post-operatively. This questionnaire gives measures of aspects such as disability, discomfort and dysfunction post-operatively. OHIP-14 is made up of 14 domains that include physical disability, functional limitation, pain etc. These domains are also scored on a scale ranging from 0-100 but inversely correlate to the patient's quality of life status. Thus, a higher score indicates a worse state of overall health (0-best, 100-worst) Xiangru *et al.* (2014).

The EORTC H&N35 AND EORTC QLQ-H&N uses similar scales to assess the symptoms and side effects (12 domains) associated with tumour resective surgery. The scoring is also graded on a scale of 0-100 with a higher score representing a worse outcome.

Chapter 3

AIMS AND OBJECTIVES

3.1. Aim

The aim of the study was to evaluate the quality of life using the Modified University of Washington Quality of Life Questionnaire in patients who have had fibula free flap reconstruction for benign tumours of the mandible.

3.2. Objectives

- To describe the demographics of patients that have had fibula free flap reconstruction for benign tumours of the mandible.
- To compare the QoL of the different groups classified per mandibular defect.
- To assess the QoL of all the patients that have had fibula free flap reconstruction for benign tumours of the mandible.
- To compare the QoL of patients who have had implant supported prostheses with the group without implant supported prosthesis.

3.3. Rationale for the study

To assess the patients post reconstruction regarding their quality of life and have a better understanding of these patients' needs especially for implant supported rehabilitation.

Chapter 4

MATERIALS AND METHODS

4.1. Study design

The study was a descriptive cross-sectional study of patients who have had fibula free flap reconstruction for benign tumours of the mandible in the Department of Maxillo-Facial and Oral Surgery, Tygerberg Oral Health Centre of the University of the Western Cape from January 2000 until June 2019.

Patients were classified according to the mandibular defect that was restored after resection. The defects were classified according to the classification system proposed by Brown *et al.* in 2016. The patients were evaluated for functional and aesthetic satisfaction by means of a quality of life questionnaire that was completed by the patient. The quality of life questionnaire compiled by the University Of Washington for Head and Neck Cancer patients was modified to accommodate benign lesions. Scoring of the questionnaire was based on the 12 domains where each domain's options were scored out of 100 points.

4.2. Study site

Patients that were included in the study presented to the Department of Maxillo-Facial and Oral Surgery, University of the Western Cape, Tygerberg Oral Health Centre after fibula free flap reconstruction for benign tumours of the mandible.

4.3. Study population

A retrospective cohort of patients ($n = 15$) operated at a single centre during the period January 2000 to June 2019 were included if they met the inclusion criteria.

4.4. Inclusion criteria

- Patients who have had fibula free flap reconstruction for benign tumours of the mandible.

- Patients 18 years and older.
- More than three months post reconstructive surgery.
- All patients available for follow-up and who have completed the questionnaire either personally or telephonically.

4.5. Exclusion criteria

- Patients with malignant pathology of the mandible.
- Patient with local infection.
- Patients with uncontrolled systemic diseases i.e. uncontrolled diabetes, human immunodeficiency virus with a CD4 count of below 400, active pulmonary tuberculosis, recurrent or metastatic disease.
- Patients who have had fibula free flap reconstruction for benign tumours of the maxilla.
- Psychiatric patients.
- Mentally challenged patients.

4.6. Data capture

Data capturing was done in the form of clinical evaluation by the surgeon involved using the score sheets and classifications as described by Brown *et al.* (2016) and Iizuka *et al.* (2005). Patients completed the modified University of Washington Quality of Life questionnaire which consisted of 12 domains and general questions. The 12 domains assessed were pain, appearance, activity, recreation, swallowing, chewing, speech, taste, saliva, mood, anxiety and lastly which one of these parameters were considered the most important issue by each individual. (Appendix 3).

Microsoft Excel was used to capture the data on spreadsheets. Statistical analysis of the data was done using SPSS Software for Windows version 16. The paired t-test was used to determine the significance in differences between Quality of life mean scores. A *P*-value <0.05 was considered to be statistically significant.

4.7. Ethical considerations

The study protocol was submitted for ethics clearance to the biomedical research ethics committee (BMREC) and senate research (SR) committee at the University of the Western Cape. The ethics reference number was BM19/10/17 (Appendix 4).

Permission to perform research in the faculty was obtained from the Dean of Dentistry (Appendix 1). Permission from the patient was obtained via informed consent (Appendix 2). The research purpose and objectives of the study were explained to each patient by using an information sheet (Appendix 2). Confidentiality was maintained and participants had the right to withdraw from the study at any time without deprivation of their rights and future treatment. Procedures for confidentiality of data was adopted. All the data collection forms were stored securely and will be shredded after five years. Electronic data was stored on password-protected computer. Serial numbers were used instead of names for data interpretation and analysis.

Chapter 5

Results

The average age of participants in the study was 36.86 years (Age range: 26-47 years). Of the 15 patients included in the study, there were eight females (53.3%) and seven males (46.7%). The majority of patients were Class I c (26.7%) and II c (26.7%) according to Brown's classification (Table 4).

Table 4: Defects according to Brown's classification

Brown classification	Number of patient	Percentage
Class I	2	13.3
Class I c	4	26.7
Class II	3	20.0
Class II c	4	26.7
Class IV c	2	13.3

Table 5 depicts that most ratings reported by the patients were high. This indicated that the majority of the patients were satisfied with the domains after the surgery.

Table 5: Response occurrences of ratings per domain

	25	30	50	70	75	100	N	Mean	SE
Pain	0	0	3	0	4	8	15	83.33	5.27
Appearance	1	0	2	0	8	4	15	75.00	5.46
Activity	1	0	1	0	6	7	15	81.67	5.70
Recreation	0	0	1	0	4	10	15	90.00	4.08
Swallowing	0	0	0	2	0	13	15	96.00	2.73
Chewing	0	0	8	0	0	7	15	73.33	6.67
Speech	0	0	0	4	0	11	15	92.00	3.55
Taste	0	0	0	1	0	14	15	98.00	2.00
Saliva	0	0	0	2	0	13	15	96.00	2.73
Mood	1	0	1	0	5	8	15	83.33	5.81
Anxiety	0	1	0	4	0	10	15	87.33	5.39

Table 6 depicts the scores obtained for the various categories which were reported to be of concern by the patients.

Table 6: Summary of mean and SD score of QOL survey following FFF reconstruction.

Category	Mean	Standard Deviation	Importance of domains (%)	Ranking order
Pain	83.3	20.4	31.1	1
Appearance	75	21.1	22.2	2
Activity	81.7	22.1	15.6	4
Recreation	90	15.8	0	
Swallowing	96	10.6	2.2	6
Chewing	73.3	25.8	11.1	5
Speech	92	13.7	17.8	3
Taste	98	7.7	0	
Saliva	96	10.5	0	
Mood	83.3	22.5	0	
Anxiety	87.3	20.8	0	

The majority of participants reported minor changes in appearance (53.3%) or no changes (26.7%). Only one patient reported significant changes in their appearance which they felt limited their activities.

Only one patient reported minimal physical activity following FFF reconstruction (6.7%). Most patients reported normal physical activity as before (46.7%) or slightly reduced physical activity (40%).Two-thirds (66.7%) of patients reported no limitation on their recreational activities or few limitations on their enjoyment of life (26.7%). No severe limitations were reported by any patients.

Only two patients (13.3%) report inability to swallow certain solid foods. The rest of patients reported that they were able to swallow as well as before the FFF reconstruction.

Most patients (53.3%) reported that they were able to eat soft solids but struggled to chew some foods. The rest of the patients (46.7%) reported no change in their ability to chew.

Three quarters of patients (73.3%) reported their speech was unchanged after FFF reconstruction while only four patients (26.7%) reported difficulty saying some words but they could be understood over the phone.

Almost all patients reported being able to taste food normally as before without any alteration. Only one patient (6.7%) reported not being able to taste most foods normally.
Two patients (13.3%) reported having less saliva than normal, but felt there was still enough saliva to function normally. The rest of the patients reported normal salivary production without any change.

One patient (6.7%) reported being somewhat depressed about his/her condition post surgery while another patient reported being neither in a good mood nor depressed about his/her post surgical condition. The majority of patients (53.3%) reported their mood to be excellent and unaffected after surgery. One patient reported suffering from anxiety after surgery while most (66.7%) did not feel any anxiety at all post-surgery.

Patients regarded pain as their biggest concern in the immediate (within seven days) following surgery followed by their appearance and speech (Table 7).

Table 7. Immediate post-op concerns as rated by patients

		Count	Percent
Immediate post-op concerns	pain, appearance, speech	3	20.0
	pain, appearance, activity	6	40.0
	swallowing, chewing, speech	1	6.7
	pain, appearance, chewing	1	6.7
	pain, chewing, speech	3	20.0
	pain, activity ,speech	1	6.7
	Total	15	100.0

Significant problem trigger criteria are defined as: -

- Pain, appearance, activity, recreation, mood: (scores of 0 or 25 or 50)
- Swallowing, speech, anxiety: (scores of 0 or 30)
- Taste, saliva: (scores or 0 or 30)
- Chewing: (score of 0)

The occurrences of domains defined by the trigger criteria are presented in Table 8: '0' means scores are higher than the criteria; '1' means scores fall in critical range. The count column depicts how many patients met the critical criteria.

Table 8: Occurrence of trigger domains

		Count
Trigger pain	0	12
	1	3
Trigger appearance	0	12
	1	3
Trigger activity	0	12
	1	3
Trigger recreation	0	12
	1	3
Trigger swallowing	0	15
Trigger chewing	0	15
Trigger speech	0	15
Trigger taste	0	15
Trigger saliva	0	15
Trigger mood	0	12
	1	3
Trigger anxiety	0	15

The responses to the general questions is depicted in Table 9.

Table 9: Quality of life post-operatively

		Count	Column N %
General Question 1	50	1	6.7%
	75	3	20.0%
	80	1	6.7%
	100	10	66.7%
	Total	15	100.0%
General question 2	40	3	20.0%
	60	1	6.7%
	80	5	33.3%
	100	6	40.0%
	Total	15	100.0%
General question 3	20	1	6.7%
	40	3	20.0%
	80	7	46.7%
	100	4	26.7%
	Total	15	100.0%

The majority of patients (66.7%) reported that their health-related quality of life had improved following respective surgery. No patient reported worse quality of life after the surgery. Patients rated their health-related quality of life after surgery as being either outstanding (40%) or very good (33.3%). No patient rated his or her health-related quality of life after surgery as poor or very poor.

Most patients reported their overall quality of life as being very good (46.7%) or outstanding (26.7%). One patient (6.7%) rated their quality of life as being poor.

There was no statistically significant correlation (*P*=0.89) between the Brown's classification of defect and overall quality of life.

There was no statistically significant difference (*P*=0.63) in overall quality of life scores between those who has implant supported restorations (N=3) versus those who did not receive implant-supported restorations (N=12). Although these finding should be interpreted with caution as the patient sample was very small.

The relation between the rating occurrences per domain and the Brown scale is presented in Table 10.

Table 10: Brown's classification related to domains

		Brown's class				
		1	1C	2	2C	4C
Pain	50	1	1	1	0	0
	75	0	2	0	1	1
	100	1	1	2	3	1
Appearance	25	1	0	0	0	0
	50	0	1	0	0	1
	75	0	3	1	3	1
	100	1	0	2	1	0
Activity	25	0	1	0	0	0
	50	0	0	1	0	0
	75	0	2	1	2	1
	100	2	1	1	2	1
Recreation	50	0	1	0	0	0
	75	1	1	1	1	0
	100	1	2	2	3	2
Swallowing	70	0	1	0	1	0
	100	2	3	3	3	2
Chewing	50	0	2	1	3	2
	100	2	2	2	1	0
Speech	70	1	2	0	1	0
	100	1	2	3	3	2
Taste	70	0	0	0	1	0
	100	2	4	3	3	2
Saliva	70	0	1	0	0	1
	100	2	3	3	4	1
Mood	25	0	1	0	0	0
	50	0	1	0	0	0
	75	0	1	0	3	1
	100	2	1	3	1	1
Anxiety	30	0	0	0	1	0
	70	1	2	0	0	1
	100	1	2	3	3	1

Figure 7 gives a schematic look at the Quality of life in relation to the Brown's classification of the defect.

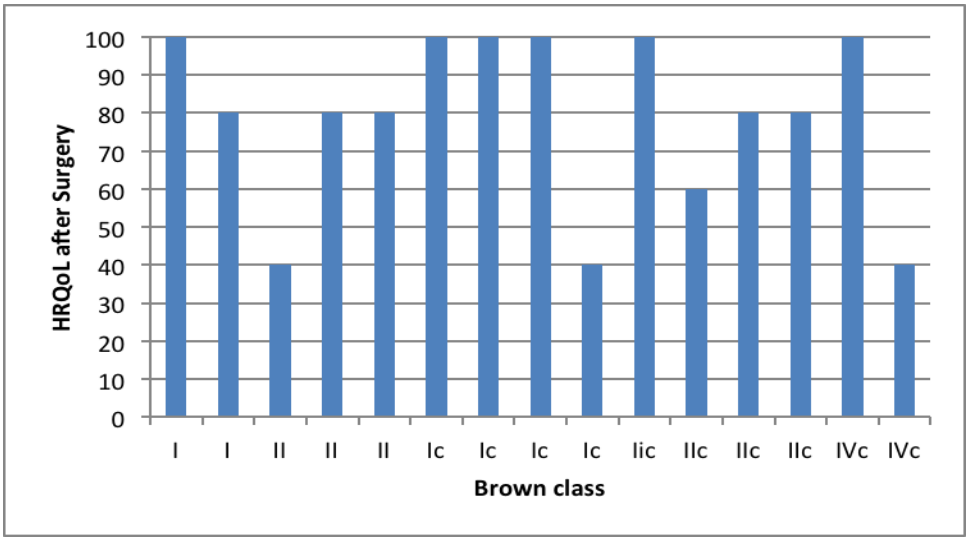


Figure 7: Health related quality of life after Surgery score in relation to Brown's classification of defects.

The relation between the rating occurrences per domain (as shown in Table 11) and gender is presented in Table 8.

Table 11: Gender relation to domains

		F	M
Pain	50	1	2
	75	4	0
	100	3	5
Appearance	25	0	1
	50	2	0
	75	3	5
	100	3	1
Activity	25	0	1
	50	1	0
	75	4	2
	100	3	4
Recreation	50	0	1
	75	4	0
	100	4	6
Swallowing	70	1	1
	100	7	6
Chewing	50	4	4
	100	4	3
Speech	70	2	2
	100	6	5
Taste	70	1	0
	100	7	7
Saliva	70	2	0
	100	6	7
Mood	25	0	1
	50	1	0
	75	4	1
	100	3	5
Anxiety	30	1	0
	70	2	2
	100	5	5

Chapter 6
Discussion

The state of someone's oral health plays an important part in their general health and therefore contributes greatly to their overall quality of life. Health related quality of life focuses on the health instead of disease, and takes into account that health is multi-facetted and complex. Oral health-related quality of life indicators can be the outcome of one episode of intervention or multiple interventions as well as no intervention performed and also a risk determinant of future episodes of care. The individual impact on each patient is therefore measurable according to the intervention they had if the defect left was classified. The vast amount of questionnaires available shows that there is no specific questionnaire that is seen as the "gold standard". Many of the questionnaires available cover overlapping themes in either more or less detail. In the current study the University of Washington questionnaire was adapted and used as it seemed to suit benign mandibular tumour cases well. The researchers in the current study found this adapted questionnaire to be appropriate and effective in assessing quality of life after resective surgery and FFF reconstruction for specifically benign tumours of the mandible.

The mandible plays an essential role in everyday functions. Reconstructing defects left by ablative tumor surgery remains a challenging field for reconstructive surgeons. Through the years the vascularized fibula free flap has shown to be the workhorse flap for these types of reconstructions. This flap helps to not only restore form and shape of the jaw, but also allows for functional rehabilitation so that the patient may in future have a workable occlusion once full rehabilitation with implants is done. It is however important to note the expectation of the clinical outcome of the ablative as well as reconstructive surgeries by the patient. Unrealistic expectations will always result in low scores when evaluating quality of life after these surgeries.

When comparing our results with similar studies it was found that the results mostly

corresponded in the areas of pain, appearance and returning to normal activity post-operatively, but there were some contradictory findings when it came to the areas such as speech, swallowing and chewing. Possible reasons for these differences will be discussed.

It was expected that areas such as taste and saliva would not really be affected when resecting benign lesions in a cautious manner. This was confirmed in the current study as both these areas scored high (taste scoring a mean of 98% and saliva 96%). Results obtained by Yang *et al.* (2014) showed lower scores for the abovementioned categories with saliva only scoring 33.13% and taste 55.6%. This difference can be attributed to their study series which involved malignant lesions where the resections may have included parts of the tongue and floor of the mouth.

Yang *et al.* (2014) treated 115 patients in their study. Their results showed that pain and appearance scored high (pain 67.38% and appearance 70.13%). The current study obtained a similar result with pain and appearance scoring high at 83% and 75% respectively. Nagy *et al.* (2011) also found pain post-operatively not to be a problem. Only one study by Al-Hayder *et al.* (2016), found that pain was a problem scoring low at 25%. It was hypothesized that the possible reason for this finding might be the fact that their study population had a higher mean age of 58 years compared to the other studies. The fact that most studies obtained high scores for pain shows that with adequate pain control post-operatively, these patients are relatively comfortable with minimal pain and discomfort.

In assessing appearance, most patients in the current study noted only minor changes to their appearance with only a few being concerned about their appearance post-operatively. In South Africa, patients present at a late stage and by then the tumours are often significant in size. Pre-operatively facial deformities are therefore present and post-operatively these patients have a more "normal" appearance. Most of them are actually very satisfied with their appearance post-operatively.

Speech and chewing are two of the fields that yielded some controversial results. Our study showed that speech was mostly unaffected, scoring high at 92%. Zavalishina *et al.* (2014) reported that 75% of their patients had unaffected speech, the rest had some

difficulty saying some words but generally could be understood. Contradictory, other studies found speech post-operatively to be a problem with most of them obtaining very low scores. Al-Hayder *et al.* (2016) found a speech score of only 27.2%, Biazevic *et al.* (2010) obtained a speech score of 44%; Yang *et al.* (2014) noted a score of 55.26%. Reasons for these contradictory results remain unclear.

Chewing scored high in the current study at 73.3%. Again these results were contradicted by results found by Yang *et al.* (2014) showing a score of only 33.13%. Studies by Rogers *et al.* (1999) and Kazi *et al.* (2010) also obtaining low scores for post-operative chewing with 45% and 60% respectively. In South Africa, many of the patients present with extensive tumours with compromised chewing capabilities. Patients are often edentulous with no prosthetic rehabilitation. Both these factors could explain why the patients in the current study reported that they could function well after free flap surgery without prosthetic rehabilitation.

Only two patients (13.3%) reported inability to swallow certain solid foods. The rest of patients reported that they were able to swallow as well as before the FFF reconstruction. Rogers *et al. (*1999) found that 33% of their patients could not swallow solid foods. This finding was attributed to the extensive resections that were done.

Other areas that scored high were mood and anxiety. The patients questioned related that they were more anxious about their tumours before the respective surgery. Their anxiety and mood improved post-operatively when they saw the results obtained after reconstructive surgery. In the current study a large proportion of the patients presented with significant deformities due to the size of their tumours, and therefore post-operatively they felt much better about their aesthetics.

In the current study only 20% of the patients had functional rehabilitation done with implant supported prostheses. It was found that there was no statistically significant difference (P=0.63) in overall quality of life scores between those who has implant supported restorations versus those who did not receive implant-supported restorations. It is important that the statistical significant deference should be considered in the context of the small sample (n=3). The only reason why all the

patients could not be rehabilitated with implant supported prostheses was due to financial constraints. If this functional rehabilitation had been done for all patients, higher scores in most categories would have been expected. Complete prosthodontic rehabilitation not only influences form, function and aesthetics but also the general well-being and overall quality of life for these patients.

Age, gender and location of the resection (Brown's classification) did not seem to play a major role statistically in the determination of quality of life in the current study. It was reported by Chim *et al. (*2010) that resections involving the angle seemed more difficult to produce adequate aesthetic results. The same was found with resections in the anterior area where no or minimal lip support adversely affected aesthetics.

In the current study, most patients reported their overall quality of life as being very good (46.7%) or outstanding (26.7%). One patient (6.7%) rated their quality of life as being poor. However, all the patients rated their overall quality of life post-operatively as better than before the procedure. This finding was reflected in a study by Zavalishina *et al.* (2014) that interviewed eleven patients. Eight of these patients rated their quality of life as outstanding, very good and good. Only two said that their quality of life was worse after the procedure.

Chapter 7
Limitations of this Study

The study was limited by the small sample size. A larger sample, especially in the implant supported prostheses group, would have added value to the study result.

Time elapsed between surgery and the research was not included. The latter would have added value to the study.

Monetary constraints played a role when it came to prosthetic rehabilitation of the patients, and therefore only a few received implant supported prostheses.

Researching the amount of time lapsed from surgery to assessment could have been a valuable measurement in the study. Patients who were operated recently vs. fully recovered could possibly report different qualities of life.

Recalling patients were difficult which negatively affected the sample size.

Chapter 8
Conclusion

Reconstruction of large mandibular defects remains challenging for both surgeons and patients. There will always be some form of interference with normal form and function, but correct surgical planning and full rehabilitation has shown that patients could be given a good functional and aesthetic result using flaps like the fibula free flap. The field of reconstruction is constantly evolving and by incorporating the latest technologies the surgeon is capable of reproducing facial form and aesthetics to such an extent that minimal negative effects is noted on the quality of life in these patients. In all surgery there is a multitude of variables that may alter the outcome and those factors differs for each patient, but if the correct techniques are used the outcome can be highly predictable. In conclusion, the fibula free flap is an excellent flap to use in the reconstruction of mandibular defects, and if performed well, it has minimal long-term effects on the overall quality of life of the patients treated for benign oral lesions.

Chapter 9

References

Al-Hayder S., Elberg JJ., Charabi B., 2016. Clinical outcome and health-related quality-of-life following microsurgical reconstruction in patients with oral and oropharyngeal cancer. *Acta Oto-Laryngologica,* 137(5):541-545. doi: 10.1080/00016489.2016.1249945. Epub 2016 Nov 4.

Anne-Gaëlle B., Samuel S., Julie B., Renaud L., Pierre B., 2011. Dental implant placement after mandibular reconstruction by microvascular free fibula flap: current knowledge and remaining questions. *Oral Oncol,* 47(12):1099 -104.

Baumann DP., Yu P., Hanasono MM., Skoracki RJ., 2011. Free flap reconstruction of osteoradionecrosis of mandible: a 10-year review and defect classification. *Head Neck,* 33(6):800-807.

Biazevic MGH., Antunes JLF., Togni J., De Andrade P., De Carvalho MB., Wünsch-Filho V., 2010. Survival and quality of life of patients with oral and oropharyngeal cancer at 1-year follow-up of tumor resection. *J Appl Oral Sci,* 18(3):279-284.

Bodard A-G., Bémer J., Gourmet R., Lucas R., Coroller J., Salino S., Breton P., 2008. Dental implants in microvascular free fibula flap: 23 patients. Rev *Stomatol Chir Maxillofac*, 109(6):363-6.

Boscolo-Rizzo P., Stellin M., Fuson R., Marchiori C., Gava A., Da Mosto M., 2009. Long-term quality of life after treatment for locally advanced oropharyngeal carcinoma: surgery and postoperative radiotherapy versus concurrent chemoradiation. *Oral Oncology*, 45(11):953-957.

Bozec A., Poissonnet G., Chamorey E., Casanova C., Vallicioni J., Demard F., Mahdyoun P., Peyrade F., Follana P., Bensadoun RJ., Benezery K., Thariat J., Marcy PY., Sudaka A., Dassonville O., 2008. Free-flap head and neck reconstruction and quality of life: a 2-year prospective study. *Laryngoscope*, 118(5):874-880.

Brånemark PI., Zarb, GA., Albrektsson T., 1985. Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry. Hanover Park, IL: Quintessence Publishing.

Brown JS., Barry C., Ho M., Shaw R., 2016. A new classification of mandibular defects after oncological resection. *Lancet Oncol*, 17(1): e23–30.

Cornelius CP., Smolka W., Giessler GA, Wilde F., Probst FA., 2015. Patient-specific reconstruction plates are the missing link in computer-assisted mandibular reconstruction: A showcase for technical description; *Journal of Craniomaxillofac Surg*, 43(5):624-9.

Chana JS., Chang YM., Wei FC., Shen YF., Chan CP., Lin HN., Tsai CY., Jeng SF., 2004. Segmental mandibulectomy and immediate free fibula osteoseptocutaneous flap reconstruction with endosteal implants: an ideal treatment method for mandibular ameloblastoma. *Plast Reconstr Surg*, 113(1):80–7.

Chang YM., Coskunfirat OK., Wei FC., Tsai CY., Lin HN., 2004. Maxillary reconstruction with a fibula osteoseptocutaneous free flap and simultaneous insertion of osseointegrated dental implants. *Plast Reconstr Surg*, 113(4):1140–5.

Chim H., Salgado CJ., Mardini S., Chen HC., 2010. Reconstruction of mandibular defects. *Advances in Head and Neck Reconstruction*, 24(2):188-197.

David DJ., Tan E., Katsoras J., Sheen R., 1988. Mandible reconstruction with vascularized iliac crest; a 10-year experience. *Plastic Reconstr Surg*, 82(5):792-803.

De Bree R., Rinaldo A., Genden E., Suárez, C., Rodrigo JP., Fagan, JJ., Kowalski LP., Ferlito A., Leemans CR., 2008. Modern reconstruction techniques for oral and pharyngeal defects after tumor resection. *Eur Arch of Otorhinolaryngol*, *265*(1):1-9.

Fagan JJ., Van Zyl O., 2015.Vascularized free fibular flaps in head and neck reconstruction; The open access atlas of otolaryngology, Head & Neck operative surgery; www.entdev.uct.ac.za

Fenlon MR., Lyons A., Farrell S., Bavisha K., Banerjee A., Palmer RM., 2012. Factors affecting survival and usefulness of implants placed in vascularized free composite grafts used in post-head and neck cancer reconstruction. *Clin Implant Dent Relat Res*., 14(2):266-72.

Ferrari S., Copelli C., Bianchi B., Ferri A., Poli T., Ferri T., Gallesi P, Sessenna E., Brevi BC., 2013. Rehabilitation with endosseous implants in fibula free-flap mandibular reconstruction: a case series of up to 10 years. *J Craniomaxillofac S*urg, 41(2):172-8.

Fitzpatrick R., Fletcher A., Gore S., Jones D., Spiegelhalter D., Cox D., 1992. Quality of life measures in health care. I: Applications and issues in assessment. *British Medical Journal,* 305(6861):1074-1077.

Garrett N., Roumanas ED., Blackwell K., Freymiller E., Abemayor E., Wong WK., Barratt B., Berke G., Beumer J., Kappur KK., 2006. Efficacy of conventional and implant-supported mandibular resection prostheses: study overview and treatment options. *J Prosthet Dent,* 96(1):13–24.

Gilbert A., 1979. Vascularized transfer of the fibular shaft. *Int J Micro*surg, 1:100-102.

Goh BT., Lee S., Tideman H., Stoelinga P., 2008. Mandibular reconstruction in adults: a review. *Int J Oral Maxillofac Surg,* 37(7):597–605.

HallermannW., Olsen S., Bardyn T., Taghizadeh F., Banic A., Iizuka T., 2006. A new method for computer-aided operation planning for extensive mandibular reconstruction. *Plast Reconstr Surg,* 117:2431e2437.

Hammerlid E., Taft C., 2001. Health-related quality of life in long-term head and neck cancer survivors: a comparison with general population norms. *Br J Cancer,* 84(2): 149-156.

Hashikawa K., Yakoo S., Tohara S., 2008. Novel classification system for oncologic mandibular defects: CAT classification. *Japanese Journal Head and Neck Cancer,* 34:412-418.

Hays RD., Sherbourne CD., Mazel RM., 1993. The RAND 36-Item Health Survey 1.0. *Health Econ,* 2(3):217-227.

Hidalgo DA., 1989. Fibula free flap: a new method of mandible reconstruction. *Plast Reconstr Surg,* 84(1):71-9.

Hirsch DL., Garfein ES., Christensen AM., Weimer KA., Saddeh PB., Levine JP., 2009. Use of computer aided design and computer-aided manufacturing to produce orthognathically ideal surgical outcomes: a paradigm shift in head and neck reconstruction. *J Oral Maxillofac Surg,* 67(10):2115–22.

Hikosaka M., Ochiai H., Fujii M., Habu N., Yajima Y., Sakurai T., Bito S., 2011. QOL after head and neck reconstruction: evaluation of Japanese patients using SF-36 and GOHAI. *Auris Nasus Larynx,* 38(6):730-734.
Holmes J., Aponte-Wesson R., 2010. Dental Implants After Reconstruction with Free Tissue Transfer. *Oral Maxillofac Surg Clin North Am,* 22(3):407–418.

Huryn JH., Zlotolow IM., Piro JD., Lenchewski E., 1993. Osseointegrated implants in microvascular free flap reconstructed mandibles. *J Prosthetic of Dentistry*, 70(5):443-446.

Iizuka T., Hãfliger J., Seto I., Rahal A., Mericske-Stern R., Smolka K., 2005. Oral rehabilitation after mandibular reconstruction using an osteocutaneous fibula free flap with endosseous implants. Factors affecting the functional outcome in patients with oral cancer. *Clin Oral Implants Res,* 16(1):69-79.

Jacobsson M., Tjellstroem AT., Thomsen P., Albrektsson T., Turesson I., 1988. Integration of titanium implants in irradiated bone. Histologic and clinical study. *Ann Otol Rhinol Lary*ngol, 97:337–40.

Jewer DD., Boyd JB., Monktelow RT., Zuker RM., Rosen IB., Gullane PJ., Rotstein LE., Freeman JE., 1989. Orofacial and mandibular reconstruction with iliac crest free flap: a review of 60 cases and new method of classification. *Plast Reconstr Surg*, 84(3):391-403; discussion 404-5.

Kim DD., Ghali GE., 2011. Dental implants in oral cancer reconstruction. *Oral Maxillofac Surg Clin North Am,* 23(2):337–345.

Kazi R., Sayed S., Dwivedi RC., 2010. Clinical importance of quality of life measures in head and neck cancer. *Indian J Cancer,* 47(3):237-238.

Kim TW., Youm HY., Byun H., Son YI., Baek CH., 2010. Treatment outcomes and quality of life in oropharyngeal cancer after surgery-based versus radiation-based treatment. *Clin Exp Otorhinolaryngol*, 3(3):153-160.

Kramer FJ., Dempf R., 2005. Efficacy of dental implants placed into Fibula free flaps for oro-facial reconstruction: *Clinical oral implant research*, 16(1):80-88.

Laverty DP., Kelly R., Addison O., 2018. Survival of dental implants placed in autogenous bone grafts and bone flaps in head and neck oncology patients: a systemic review. *Int J of Implant Dent,* 4:19.

Levine JP., Bae JS., Soares M., Brecht LE., Saadeh PB., Ceradini D., Hirsch DLH., 2013. Jaw in a day: total maxillofacial reconstruction using digital technology. *Plast Reconstr Surg,* 131(6): 1386-1391.

Mazzoni S., Marchetti C., Sgarzani R., Cipriani R., Scotti R., Ciocca L., 2013. Prosthetically guided maxillofacial surgery: evaluation of the accuracy of a surgical guide and custom-made bone plate in oncology patients after mandibular reconstruction. *Plast Reconstr S*urg, 131(6):1376-1385.

Momeni A., Kim RY., Kattan A., Lee GK., 2013. Microsurgical head and neck reconstruction after oncologic ablation: a study analyzing health-related quality of life. *Ann Plast Surg,* 70(4):462-469.

Montazeri A., 2009. Quality of life data as prognostic indicators of survival in cancer patients: an overview of the literature from 1982 to 2008. *Health Qual Life Outcomes,* 7:102.

Nagy J., Piffkó J., Nagy K. 2011. Quality of life of H&N cancer patients after prosthetic rehabilitation. *Dent Res,* 90(3):773.

Pauchet D., Pigot JL., Chabolle F., Bach CA., 2018. Prefabricated fibula free flap with dental implants for mandibular reconstruction. *Eur Ann Otorhinolaryngol Head Neck Dis,* 135(4):279-282.

Pavlov BL., 1974. Classification of mandibular defects. *Stomatologiia,* 53(5):43-46.

Pierre CS., Dassonville O., Chamorey E., Poissonnet G., Ettaiche M., Santini J., Peyrade F., Benezery K., Sudaka A., Bozec A., 2013. Long-term quality of life and its predictive factors after oncologic surgery and microvascular reconstruction in patients with oral or oropharyngeal cancer. *European Archives of Oto-rhino-laryngology* 271(4):801-807.

Pogrel MA., Podlesh S., Anthony J., Alexander J., 1997. A comparison of vascularized and nonvascularized bone grafts for reconstruction of mandibular continuity defects. J *Oral Maxillofac Surg,* 55(11):1200-6.

Rana M., Kanatas A., Herzberg PY., Khoschdell M., Kokemueller H., Gellrich NC., Rana M., 2015. Prospective study of the influence of psychological and medical factors on quality of life and severity of symptoms among patients with oral squamous cell carcinoma. *Br J Oral Maxillofac Surg,* 53(4):364-370.

Revicki DA., Cella DF., 1997. Health status assessment for the twenty-first century: item response theory, item banking and computer adaptive testing. *Qual Life Res,* 6(6): 595-600.

Rogers SN., Hannah L., Lowe D., Magennis P., 1999. Quality of life after 5-10 years after primary surgery for oral and oropharyngeal cancer. *J Craniomaxillofac Surg,* 27(3):187-191.

Rogers SN., 2016. Improving quality-of-life questionnaires in head and neck cancer. *Journal Expert Review of Quality of Life in Cancer Care,* 1(1):61-71.

Rohner D., Jaquiéry C., Kunz C., Bucher P., Maas H., Hammer B., 2003. Maxillofacial reconstruction with prefabricated osseous free flaps: a 3-year experience with 24 patients. *Plast Reconstr Surg*, 112(3):748–57.

Sayed SI., Elmiyeh B., Rhys-Evans P., Syrigos KN., Nutting CM., Harrington KJ., Kazi R., 2009. Quality of life and outcomes research in head and neck cancer: A review of the state of the discipline and likely future directions. *Cancer treat Rev,* 35(5):397-402.

Sclaroff A., Haughey B., Gay W., 1994. Immediate mandibular reconstruction and placement of dental implants at the time of ablative surgery. *Oral Surg Oral Med Oral Pathol,* 78:711.

Taylor GI., Miller GD., Ham FJ., 1975. The free vascularized bone graft. A clinical extension of microvascular techniques. *Plast Reconstr Surg*, 55(5):533-44.

Teoh KH., Huryn JM., Patel S., Halpern J., Tunick S., Wong HB., Zlotolow IM., 2005. Implant prosthodontics rehabilitation of fibula free-flap reconstructed mandible: a Memorial Sloan-Kettering Cancer Center review of prognostic factors and implant outcomes. *Int J Oral Maxillofac Implants,* 20(5):
738–46.

Turk JB., Vuillemin T., Raveh J., 1994. Revascularized bone grafts for cranial facial reconstruction. *Otolaryngol Clin North Am,* 27(5): 955-82.

Ueba Y., Fujikawa S., 1983. Nine year follow-up of a vascularized fibula graft in neurofibromatosis: A case report and literature review. Jpn J *Orthop Trauma Surg,* 26:595-600.

Urken ML., Buchbinder D., Costantino PD., Sinha U., Okay D., Lawson W., Biller HF., 1998. Oromandibular reconstruction using microvascular composite flaps: report of 210 cases. *Arch Otolaryngol Head Neck Surg,*124(1):46–55.

Weischer T., Mohr C., 1999. Ten-year experience in oral implant rehabilitation of cancer patients: treatment concept and proposed criteria for success. *Int J Oral Maxillofac Implants,* 14(4):521-528.

Wright JM., Vered M., 2017. Update from the 4th Edition of the World Health Organization Classification of Head and Neck Tumours: Odontogenic and Maxillofacial Bone Tumours, *Head and Neck Pathol,* 11(1):68-77.

Xiangru L., Kuicheng Z., Fei L., Hongwen L., 2014. Assessment of quality of life in giant ameloblastoma adolescent patients who have had mandible defects reconstructed with a free fibula flap. *World J Surg Oncol*, 12:201.

Yang W, Zhao S, Liu F, Sun M., 2014.Health-related quality of life after mandibular resection for oral cancer: reconstruction with free fibula flap. *Med Oral Patol Oral Cir Bucal,* 19(04):414–418.

Zavalishina L., Karra N., Zaid WS., El-Hakim M., 2014. Quality of life assessment in patients after mandibular resection and free flap reconstruction. *J Oral Maxillofac Surg,* 72(8): 1616-26.

APPENDIX 1

Letter to the Dean

DEPARTMENT OF MAXILLO-FACIAL AND ORAL SURGERY
Faculty of Dentistry & WHO Oral Health Collaborating Centre

Private Bag X1, Tygerberg 7505
South Africa
Telephone: +27 21 937 3151/50
Fax: +27 021 937 3182
Email: jamorkel@uwc.ac.za (Prof JA Morkel)
jdewet@uwc.ac.za (Ms J de Wet)

20 September 2019

For Attention: The Dean
Faculty of Dentistry
University of the Western Cape
Tygerberg
7505

Dear Prof Osman

RE: Application to conduct research study at the Tygerberg Dental Hospital (Oral Health Centre, UWC)

A Master's student, Dr P Jonsson, is conducting research under the supervision of Prof Jean Morkel of the Dept. of Maxillofacial and Oral Surgery. The title of the study is "**Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery**".

We will use our findings to compile our results and complete our research project which will be for a mini-thesis for the specialist degree in Maxillofacial and Oral Surgery. Ethical approval will be requested from the UWC Research Ethics Committee, for consideration for registration as an approved research project.

Please do not hesitate to contact me should you require anything further

Yours sincerely

Prof Jean Morkel
Supervisor

APPENDIX 2

Information and consent form

Consent form

UNIVERSITY *of the*
WESTERN CAPE

Department of Maxillofacial and Oral Surgery
Faculty of Dentistry and WHO Oral Health Collaborating Centre
University of the Western Cape
Cape Town

Title: Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way.

Participant's name.....

Participant' signature …….

Date.....

Patient Information

Department of Maxillofacial and Oral Surgery
Faculty of Dentistry and WHO Oral Health Collaborating Centre
University of the Western Cape
Cape Town

Study Title: **Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery**

What is this study about?

This is a research project being conducted by Dr Phillip Jonsson from the University of the Western Cape in South Africa. We are inviting you to participate in this research project because you meet the set criterion for the population of interest and your participation will help other people. The purpose of this research project is to evaluate the effect of tumour surgery and fibula free flap reconstruction on individual's oral health-related quality of life.

What will I be asked to do if I agree to participate?

You will be asked to sign a consent form agreeing to take part in the study and will be assigned a study participant number, which will keep you anonymous and you will be asked to fill in a questionnaire. Any enquiry regarding the questionnaire will be met immediately by the researcher and if you needed any help filling in the questionnaire it will be provided.

Would my participation in this study be kept confidential?

Your personal information will be kept confidential. To help protect your confidentiality you will be assigned a study participant number to identify your data. Only the researchers will have access to your personal data, which will only be used to make the initial group allocation. Your data and any results we obtain will be kept under password protection and in locked cabinets. Your results and opinions will be kept confidential and no personal data will be made public.

What are the risks of this research?

There are no risks from participating in this research study. There will be no costs involved.

What are the benefits of this research?

You will have the right to benefit from the researcher knowledge and skills.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or be discriminated against.

What if I have questions?

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact: Prof Jean Morkel (Supervisor) at jamorkel@uwc.ac.za; tel. 021 937 3087 or Research Ethics Committee at BMREC, UWC, Private Bag x17, Bellville, 7535, Tel: + 27 21 959 4111, Email: research-ethics@uwc.ac.za

Inligtings- en toestemmingsvorm
Departement Kaak- en Mondchirurgie
Fakulteit Tandheelkunde
Universiteit van Wes-Kaapland

Vrywaringsvorm

Title: Assessering van lewenskwaliteit na fibula vry flap rekonstruksie van defekte na verwydering van benigne tumore.

Die studie is aan my beskryf in taal wat ek verstaan, en ek stem vrywillig saam om deel te neem. My vrae oor die studie is beantwoord. Ek verstaan dat my identiteit nie bekend gemaak sal word nie en dat ek my kan onttrek aan die studie sonder enige rede, en dit sal my op geen manier beïnvloed nie.

Pasiënt naam.....
Pasiënt handtekening……
Datum.....

Departement Kaak- en Mondchirurgie
Fakulteit Tandheelkunde
Universiteit van Wes-Kaapland

Pasiëntinligting

UNIVERSITY *of the*
WESTERN CAPE

Studie Titel: Assessering van lewenskwaliteit na fibula vry flap rekonstruksie van defekte na verwydering van benigne tumore.

Dit is 'n navorsingsprojek wat deur r Philip Jonsson van die Universiteit van Wes-Kaapland in Suid-Afrika gedoen word. Ons nooi u uit om deel te neem aan hierdie navorsingsprojek, omdat u voldoen aan die vasgestelde kriterium vir die bevolking wat van belang is en u deelname ander mense sal help. Die doel van hierdie navorsingsprojek is om die lewenskwaliteit te meet na verwydering van benigne tumore en die rekonstruksie van die defekte deur middel van fibula vry flappe.

Wat sal ek gevra word om te doen as ek instem om deel te neem?
U sal gevra word om 'n toestemmingsvorm te onderteken wat instem om aan die studie deel te neem, en u sal 'n deelnemer-nommer van die studie ontvang wat u anoniem sal hou en u sal gevra word om 'n vraelys in te vul. Enige ondersoek rakende die vraelys word onmiddellik deur die navorser nagekom en indien u hulp nodig het om die vraelys in te vul, sal dit voorsien word.

Sou my deelname aan hierdie studie vertroulik gehou word?
U persoonlike inligting sal vertroulik gehou word. Om u vertroulikheid te beskerm, sal u 'n deelnemer-nommer kry om u data te identifiseer. Slegs die navorsers het toegang tot u persoonlike gegewens, wat slegs gebruik word om die aanvanklike groepstoekenning te maak. U data en enige resultate wat ons verkry, sal onder wagwoordbeskerming en in geslote kaste gehou word. U uitslae en menings sal vertroulik gehou word en geen persoonlike inligting sal openbaar gemaak word nie.

Wat is die risiko's van hierdie navorsing?
Deelname aan hierdie navorsingstudie het geen risiko’s nie. Daar is geen koste verbonde aan u nie.

Wat is die voordele van hierdie navorsing?
U het die reg om voordeel te trek uit die kennis en vaardighede van die navorser.

Moet ek aan hierdie navorsing deelneem en mag ek op enige tydstip ophou deelneem?
U deelname aan hierdie navorsing is vrywillig. U kan kies om glad nie deel te neem nie. As u besluit om aan hierdie navorsing deel te neem, kan u op enige tydstip ophou deelneem. As u besluit om nie aan hierdie studie deel te neem nie, of as u op enige tydstip ophou om deel te neem, sal u nie gepenaliseer word of teen u gediskrimineer word nie.

Wat as ek vrae het?
As u vrae het rakende hierdie studie en u regte as 'n navorsingsdeelnemer, of as u probleme wat u ondervind het rakende die studie wil rapporteer, kontak: Prof Jean Morkel (studieleier) by jamorkel@uwc.ac.za; tel. 021 937 3087 of Komitee vir Navorsingsetiek by BMREC, UWC, Privaatsak x17, Bellville, 7535, Tel: + 27 21 959 4111, E-pos: research-ethics@uwc.ac.za

ISebe leMaxillofacial kunye nonyango lomlomo
Icandelo le-Dentalistry kunye ne-WHO Oral Health Collaborating Centre
IYunivesithi yeNtshona Koloni
Ikapa

Isihloko: Umgangatho wovavanyo lobomi emva kokuvuselelwa ngokutsha kwefibula yasimahla ngenxa yesiphene esinyanzelekileyo

Isifundo sichaziwe kum ngolwimi endisiqondayo kwaye ndivuma ngokukhululekileyo nangokuzithandela ukuvuma ukuthatha inxaxheba. Imibuzo yam malunga nesifundo iphendulwe. Ndiyaqonda ukuba isazisi sam asizukuchazwa kwaye nokuba ndingarhoxa esifundweni ndinganiki sizathu nangaliphi na ixesha kwaye oku akuyi kundichaphazela kakubi nangayiphi na indlela.

Igama lomthathi-nxaxheba ……

Isiginitsha yabathathi-nxaxheba ……..…….

Ngomhla ……...

Ulwazi ngezigulana

UNIVERSITY of the
WESTERN CAPE

ISebe leMaxillofacial kunye nonyango lomlomo
Icandelo le-Dentalistry kunye ne-WHO Oral Health Collaborating Centre
IYunivesithi yeNtshona Koloni
Ikapa

Isihloko sokufunda: Umgangatho wokuvavanywa kobomi emva kokuvuselelwa ngokutsha kwefibula yasimahla ngenxa yesiphene esisinyanzelo sokuhlinzwa

Lufundelwa ntoni olu phando?
Le yiprojekthi yophando eqhutywa nguGqr. Jonsson ovela kwiDyunivesithi yaseNtshona Koloni eMzantsi Afrika. Siyakumema ukuba uthathe inxaxheba kule projekthi yophando kuba uhlangabezana nenqobo ebekiweyo yabantu abanomdla kwaye inxaxheba yakho iza kunceda abanye abantu. Injongo yale projekthi yophando kukuvavanya isiphumo sokuhlinzwa kwesibeleko kunye nokwakhiwa ngokutsha kweflat free kumgangatho wobomi bomlomo.

Yintoni endiza kucelwa ukuba ndiyenze ukuba ndiyavuma ukuthatha inxaxheba?
Uya kucelwa ukuba usayine ifomu yokuvuma ukuvuma ukuthatha inxaxheba kwisifundo kwaye uya kunikwa inombolo ethatha inxaxheba yokufunda, eya kukugcina ungaziwa kwaye uya kucelwa ukuba ugcwalise iphepha lemibuzo. Nawuphi na umbuzo ophathelele kwiphepha lemibuzo uza kudibana ngokukhawuleza umphandi kwaye ukuba ufuna uncedo olugcwalisiweyo kwiphepha lemibuzo uya kunikwa.

Ngaba ukuthatha inxaxheba kolu phando kuya kugcinwa kuyimfihlo?
Iinkcukacha zakho ziya kugcinwa ziyimfihlo. Ukukunceda ukukhusela ubumfihlo bakho uya kunikwa inombolo ethatha inxaxheba yokufunda uchonge idatha yakho. Kuphela ngabaphandi abaya kufikelela kwidatha yakho, eya kuthi isetyenziselwe ukwaba iqela lokuqala. Idatha yakho kunye naziphi na iziphumo esizifumanayo ziya kugcinwa phantsi kokhuseleko lwephasiwedi nakwiikhabhathi ezivalelekileyo. Iziphumo zakho kunye nezimvo ziya kugcinwa ziyimfihlo kwaye akukho datha yobuqu iya kwaziswa esidlangalaleni.

Buphi ubungozi bolu phando?
Akukho mngcipheko uthatha inxaxheba kolu phando. Akusayi kubakho zindleko zibandakanyekileyo kuwe.

Zithini izibonelelo zolu phando?
Uya kuba nelungelo lokuxhamla kulwazi kunye nezakhono zomphandi.

Ngaba kufuneka ndibekho kolu phando kwaye ndingayeka ukuthatha inxaxheba nangaliphi na ixesha?
Ukuthatha inxaxheba kolu phando kukuzithandela. Unokukhetha ukungathathi nxaxheba. Ukuba uthatha isigqibo sokuthatha inxaxheba kolu phando, unokuyeka ukuthatha inxaxheba ngalo naliphi na ixesha. Ukuba uthatha isigqibo sokungathathi nxaxheba kolu phononongo okanye ukuba uyekile ukuthabatha inxaxheba nangaliphi na ixesha, awusohlwaywa okanye ube nocalucalulo.

Kuthekani ukuba ndinemibuzo?
Ukuba unemibuzo malunga nolu phononongo kunye namalungelo akho njengomthathi-nxaxheba ophando okanye ukuba unqwenela ukunika ingxelo ngazo naziphi na iingxaki onazo ezinxulumene neso sifundo, nceda uqhagamshelane: no-Prof Jean Morkel (Supervisor) jamorkel@uwc.ac.za; itel. 021 937 3087 okanye kwiKomiti yeeNqobo zokuPhanda kwiBMREC, e-UWC, kwiNgxowa yabucala x17, eBellville, 7535, kule nombolo: + 27 21 959 4111, Email: research-ethics@uwc.ac.za

APPENDIX 3

Quality of Life Questionnaire

Data capturing sheet 1:

Modified University of Washington Quality of Life Questionnaire (UW-QOL v4)

This questionnaire asks about your health and quality of life after your surgery. Please answer all of the questions by ticking one box for each question.

1. Pain. (Tick one box: _)
- I have no pain. (100)
- There is mild pain not needing medication. (75)
- I have moderate pain - requires regular medication (e.g. paracetamol). (50)
- I have severe pain controlled only by prescription medicine (e.g. morphine). (25)
- I have severe pain, not controlled by medication. (0)

2. Appearance. (Tick one box: _)
- There is no change in my appearance. (100)
- The change in my appearance is minor. (75)
- My appearance bothers me but I remain active. (50)
- I feel significantly disfigured and limit my activities due to my appearance. (25)
- I cannot be with people due to my appearance. (0)

3. Activity. (Tick one box: _)
- I am as active as I have ever been. (100)
- There are times when I can't keep up my old pace, but not often. (75)
- I am often tired and have slowed down my activities although I still get out. (50)
- I don't go out because I don't have the strength. (25)
- I am usually in bed or chair and don't leave home. (0)

4. Recreation. (Tick one box: _)
- There are no limitations to recreation at home or away from home. (100)
- There are a few things I can't do but I still get out and enjoy life. (75)
- There are many times when I wish I could get out more, but I'm not up to it. (50)
- There are severe limitations to what I can do, mostly I stay at home and watch TV (25)
- I can't do anything enjoyable. (0)

5. Swallowing. (Tick one box: _)
- I can swallow as well as ever. (100)
- I cannot swallow certain solid foods. (70)
- I can only swallow liquid food. (30)
- I cannot swallow because it "goes down the wrong way" and chokes me. (0)

6. Chewing. (Tick one box: _)
- I can chew as well as ever. (100)
- I can eat soft solids but cannot chew some foods. (50)
- I cannot even chew soft solids. (0)

7. Speech. (Tick one box: _)
- My speech is the same as always. (100)
- I have difficulty saying some words but I can be understood over the phone. (70)
- Only my family and friends can understand me. (30)
- I cannot be understood. (0)

8. Taste. (Tick one box: _)
- I can taste food normally. (100)
- I can taste most foods normally. (70)
- I can taste some foods. (30)
- I cannot taste any foods. (0)

9. Saliva. (Tick one box: _)
- My saliva is of normal consistency. (100)
- I have less saliva than normal, but it is enough. (70)
- I have too little saliva. (30)
- I have no saliva. (0)

10. Mood. (Tick one box: _)
- My mood is excellent and unaffected by my cancer. (100)
- My mood is generally good and only occasionally affected by my cancer. (75)
- I am neither in a good mood nor depressed about my cancer. (50)
- I am somewhat depressed about my cancer. (25)
- I am extremely depressed about my cancer. (0)

11. Anxiety. (Tick one box: _)
- I am not anxious about my cancer. (100)
- I am a little anxious about my cancer. (70)
- I am anxious about my cancer. (30)
- I am very anxious about my cancer. (0)

12. Which issues have been the most important to you during the past days after surgery?
Tick _ up to 3 boxes.
- Pain • Swallowing • Taste
- Appearance • Chewing • Saliva
- Activity • Speech • Mood
- Recreation • Shoulder • Anxiety

General Questions:
1. Compared to before you developed the tumor, how would you rate your health-related quality of life? (Tick one box: _)
- Much better (100)
- Somewhat better (75)
- About the same (50)

- Somewhat worse (25)
- Much worse (0)

2. In general, how would you say your health-related quality of life after surgery has been: (Tick one box: _)

- Outstanding (100)
- Very good (80)
- Good (60)
- Fair (40)
- Poor (20)
- Very poor (0)

3. Overall quality of life includes not only physical and mental health, but also many other factors, such as family, friends, spirituality, or personal leisure activities that are important to your enjoyment of life. Considering everything in your life that contributes to your personal well-being, rate your overall quality of life. (Tick one box: _)

- Outstanding (100)
- Very good (80)
- Good (60)
- Fair (40)
- Poor (20)
- Very poor (0)

APPENDIX 4

Data Collection Sheet

1-12 = questionnaire scores
G1-G3 = scores to three general questions

Age	*Sex*	*Brown class*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*G1*	*G2*	*G3*	*Implants*
47	M	1	50	25	100	100	100	100	70	100	100	100	70	PAIN, APPEARANCE,SPEECH	100	100	80	N
42	F	1C	75	75	75	100	100	50	70	100	100	100	100	PAIN, APPEARANCE,ACTIVITY	100	100	100	N
32	F	2	50	100	50	75	100	100	100	100	100	100	100	PAIN,APPEARANCE,ACTIVITY	100	40	20	N
28	F	1C	75	50	75	75	100	100	100	100	70	50	70	PAIN,APPEARANCE,ACTIVITY	75	100	40	N
37	M	2C	100	75	100	100	100	100	100	100	100	100	100	PAIN, APPEARANCE,ACTIVITY	100	100	80	Y
33	F	1C	100	75	100	100	100	100	100	100	100	75	100	SWALLOWING,CHEWING,SPEECH	75	100	100	N
44	M	4C	100	75	100	100	100	50	100	100	100	100	100	PAIN, APPEARANCE,ACTIVITY	100	100	100	N
45	F	4C	75	50	75	100	100	50	100	100	70	75	70	PAIN,APPEARANCE,CHEWING	75	40	40	N
40	F	2C	75	75	75	75	70	50	70	70	100	75	30	PAIN,APPEARANCE,SPEECH	100	60	80	N
43	F	2C	100	100	100	100	100	50	100	100	100	75	100	PAIN, APPEARANCE,SPEECH	100	80	80	N
35	M	2	100	100	75	100	100	100	100	100	100	100	100	PAIN,CHEWING,SPEECH	100	80	100	N
44	M	1C	50	75	25	50	70	50	70	100	100	25	70	PAIN, APPEARANCE,ACTIVITY	50	40	40	N
27	F	1	100	100	100	75	100	100	100	100	100	100	100	PAIN,ACTIVITY,SPEECH	100	80	80	Y
30	M	2C	100	75	75	100	100	50	100	100	100	75	100	PAIN,CHEWING,SPEECH	80	80	80	Y
26	M	2	100	75	100	100	100	50	100	100	100	100	100	PAIN,CHEWING,SPEECH	100	80	80	N

APPENDIX 5

Ethics reference number certificate

UNIVERSITY of the WESTERN CAPE

OFFICE OF THE DIRECTOR: RESEARCH
RESEARCH AND INNOVATION DIVISION

Private Bag X17, Bellville 7535
South Africa
T: +27 21 959 4111/2948
F: +27 21 959 3170
E: research-ethics@uwc.ac.za
www.uwc.ac.za

07 February 2020

Dr P Jonsson
Faculty of Dentistry

Ethics Reference Number: BM19/10/17

Project Title: Quality of life assessment after fibula free flap reconstruction for mandibular defects post benign tumour ablative surgery.

Approval Period: 3 February 2020 – 3 February 2021

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

Permission to conduct the study must be obtained and submitted to the Committee for record-keeping.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

NHREC REGISTRATION NUMBER -130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.