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A retrospective review of dorsal locking compression plating for hallux metatarsophalangeal joint arthrodesis

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A retrospective review of dorsal locking compression plating for hallux metatarsophalangeal joint arthrodesis



Dr. Olivia Antos

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Medicine

Johannesburg, 2021

Declaration

I, Olivia Antos, declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Orthopaedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



12th day of November 2021

Dedication

This research report is dedicated to my daughter, Liana who gives my life meaning and my husband, Nabil Khan for all his love and support. I would also like to thank my sister, Sylvia Antos-Hanney for being my biggest fan and my parents, Wanda and Kazimierz Antos who believe in my dreams as much as I do.

Abstract

Purpose: In this retrospective study the primary aim was to radiographically evaluate the arthrodesis rate of the hallux metatarsophalangeal joint (MTPJ) using a dorsal compression plate without the use of additional fixation devices. The secondary aim was to assess patient satisfaction by using the self-reported foot and ankle score (SEFAS), comparing pre and post operative scores.

Methods: 32 patients (38 feet) who underwent hallux metatarsophalangeal joint arthrodesis using only a dorsal compression plate between January and December 2016 were assessed. Standardised weight bearing radiographs of the foot were taken at six weeks postoperatively to assess for union. Patient satisfaction was evaluated by comparing self-reported foot and ankle score pre and post operatively.

Results: 27 patients (32 feet) met the inclusion criteria for this study. Five of these patients had bilateral hallux metatarsophalangeal joint arthrodesis surgery. Of these, 87.5% were female and 12.5% were male. The mean age at the time of operation was 62 years (SD = 10.4). Radiographic union was seen in 29 (90.6%) feet at six weeks post surgery. The self-reported foot and ankle score demonstrated significant improvement from a preoperative score of 29 to a postoperative score of 41 at three year follow up.

Conclusion: The sole use of a dorsal compression plate demonstrated a union rate of 90.6% and an improved SEFAS score postoperatively, which yielded good to excellent results in patients who had undergone arthrodesis of the hallux metatarsophalangeal joint. These results are comparable to those where the gold standard for hallux metatarsophalangeal joint arthrodesis has been used. The use of the dorsal compression plate eliminates the need for an additional compression screw thus decreasing costs of implants, theatre time and x-ray exposure.

Level of evidence: IV

Acknowledgements

I would like to express my sincere gratitude to Professor N. Saragas for his guidance and input, as well as allowing me access to his patient's files so I could conduct this study. I would also like to thank Dr. Andrew Strydom for his guidance and valuable input throughout this research project.

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Nomenclature

AOFAS: American Orthopaedic Foot and Ankle Society

AP: Antero-posterior

ES: Effect size

LCP: Locking compression plate

MTPJ: Metatarsophalangeal joint

SD: Standard deviation

SEFAS: Self-reported foot and ankle score

SRM: Standardised response mean

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 Background

The hallux metatarsophalangeal joint (MTPJ) is a specialised joint containing a sesamoid mechanism. The metatarsal head has a convex cartilaginous surface, which articulates with the concave proximal phalanx. The collateral ligaments connect with the sesamoid ligaments. The hallux is moved by four groups of muscles and tendons: dorsally by the extensor hallucis longus and brevis, plantarly the flexor hallucis longus and brevis, medially by abductor hallucis and laterally by adductor hallucis [1].

The hallux MTPJ forms one of the crucial tripod structures of the foot, supporting about one third of the body weight. The main stabilisers of the joint are the capsule-ligamentous structures and therefore conditions affecting their integrity would lead to instability, abnormal motion and weight distribution. Therefore, disruption of the normal biomechanics leads to joint degeneration, pain and deformity.

Hallux metatarsophalangeal joint (MTPJ) arthrodesis is a successful procedure with good results [2, 3]. It provides good alignment correction of the first ray as well as pain relief from an arthritic hallux MTPJ.

Indications for hallux MTPJ arthrodesis include: [4]

- Severe hallux valgus deformity (Hallux valgus angle greater than 40°) not amenable to joint preserving procedures
- Degenerative joint disease resulting from inflammatory arthritides, autoimmune and crystal deposition conditions that are not responding to at least six months of conservative treatment
- Advanced hallux rigidus (osteoarthritis)
- As a salvage procedure for failed arthroplasty and joint preserving procedures
- Deformities due to muscle imbalances caused by neurological conditions (cerebral vascular accident, head injury, cerebral palsy)

Contra indications:

- Early osteoarthritis where joint preserving techniques are preferred
- Active infections
- Poor soft tissue envelope (poor skin status)
- Poor peripheral circulation

The gold standard for the construct used while performing an arthrodesis of the hallux MTPJ is a compression screw across the hallux MTPJ with a dorsal locking plate [5], however the available small surface area can make lag screw placement difficult. The hypothesis for this study is that the use of a contoured dorsal locking compression plate across the prepared surface should result in comparable arthrodesis rates.

To date, there is one study that has looked at success rates of hallux MTPJ arthrodesis using a contoured dorsal locking compression plate alone [6]. Therefore, this study presents a case series where a contoured dorsal locking compression plate was used alone for arthrodesis of the hallux MTPJ.

1.2 Literature review

Hallux MTPJ arthrodesis was first described for hallux valgus deformity by Broca in 1852 and then by Clutton in 1894 with satisfactory results [2]. Since then various procedures have been described to achieve better arthrodesis rates and alignment of the hallux. Hallux MTPJ arthrodesis is a highly successful procedure showing union rates of up to 100% [3, 7, 8, 9, 10, 11].

Conditions involving the hallux MTPJ can be managed in various ways and may include resection interposition arthroplasty, proximal phalanx or metatarsal head resurfacing hemiarthroplasty, total joint replacement or arthrodesis [12]. Compared to excision arthroplasty, arthrodesis is the most reliable surgical procedure as it is predictable, results in a better weight bearing capacity [13] and avoids complications such as instability, cock up deformity of the first ray and first ray shortening [14]. The disadvantages of arthroplasty of the hallux MTPJ are that it causes significant stiffness and early component loosening resulting in high failure rates which require revision surgery, often a salvage arthrodesis procedure [15].

Hallux MTPJ arthrodesis has been widely described as a treatment for end stage arthritis with the aim of eliminating pain and obtaining a stable plantigrade toe [16]. Studies have confirmed

that arthrodesis of the hallux MTPJ increases weight bearing on the medial column thereby restoring medial column stability and protecting the lesser MTPJ's and plantar fat pad by reducing transfer metatarsalgia [16, 17]. Further studies have also shown that eliminating motion at the hallux MTPJ causes no observable change in the gait pattern of patients that have undergone the procedure [16].

The main determinants of outcome after arthrodesis are:

- Choice of fixation [18]
- Method of joint surface preparation [19]
- Positioning of the hallux [20]
- Patient factors (co-morbidities and social habits) [21,
- Effective protection and good rehabilitation

Various fixation devices are available to achieve arthrodesis of the hallux MTPJ, including screws, plates, wires, staples, external fixators [5, 22, 23, 24, 25] or a combination.

Arthrodesis rates of up to 90 - 100% have been achieved with plate fixation [26] by using either locking or non-locking options that are pre contoured [3, 8, 10, 11, 27]. Some studies have shown that compression plates achieve higher arthrodesis rates as compared to locked plates [28, 29]. Screws have also been used as a means in achieving arthrodesis of the hallux MTPJ [28]. Cross configuration screws have been used alone with arthrodesis rates of up to 95% [20]. Screws can be combined with K-wire fixation or can be used with a dorsal neutralisation plate. Other fixation methods such as K-wires, K-wires with loops and staples have been used in the past but they have been shown to be biomechanically less stable [24, 31].

The combination of a lag screw across the MTPJ with a dorsal neutralisation plate has been shown to be the most stable construct [5, 18, 32] and is widely recommended as the fixation of choice in the arthrodesis of the hallux MTPJ.

The rate of hallux MTPJ arthrodesis depends on the preparation technique of the bony surfaces [33, 34]. Joint surface preparation can be achieved using planar cuts [33], curettage of cartilage using burrs [33] as well as cup and cone reamers [20, 34, 35]. Procedures that preserve bone length as well as convexity/concavity of the opposing surfaces have been shown to produce better arthrodesis rates and outcomes [19, 35].

Planar cuts are a quicker option for bony preparation but have the disadvantage of causing bone shortening if the desired position is not obtained and requires further resection [17]. Cup and cone reamers provide a larger surface area for arthrodesis [19]. They have the advantage of providing reproducible results [36] and allows for multi-planar alignment [17] as well as being biomechanically more stable [19]. Commercially available cup-and-cone reamers have the advantage of being user-friendly and lead to predictable results [35].

Percutaneous arthrodesis has been advocated for and results have been comparable to open arthrodesis with improved postoperative American Orthopaedic Foot and Ankle Society (AOFAS) score [37]. However, it has a steep learning curve and the risk of over resection of the metatarsal head, which may result in shortening and poor positioning.

The three-dimensional position of the toe is an important factor determining the outcome of the arthrodesis [17]. The best position has been reported to be neutral rotation, dorsiflexion depending on the medial longitudinal arch height and approximately 5° of valgus depending on the position of the lesser toes and the amount of hallux valgus interphalangeus. Varus is not acceptable [19, 30, 31, 38, 39, 40]. Dorsiflexion of the hallux MTPJ is determined intra operatively by pushing the foot on a flat sterile tray to simulate weight bearing. It ranges from 4° to 8° depending on the degree of arch height, but more importantly the hallux needs to clear the ground with walking and the tip of the toe must be able to touch the ground when it flexes at the interphalangeal joint [39].

Most frequent complications include malalignment, nonunion, malunion, need for hardware removal, arthritis of adjacent joints (interphalangeal arthrosis), osteonecrosis and osteitis [41].

Outcomes following arthrodesis include improved weight bearing, stability during gait [42], and decreasing pain from the arthritic joint and pressure from bunion removal. Recent hallux arthrodesis studies show good functional medium-term outcomes, with improved AOFAS scores and patient satisfaction rates [43, 44].

1.3 Study aim and objectives

The primary aim was to radiographically evaluate the arthrodesis rate of the hallux MTPJ using a dorsal locking compression plate without additional lag screw fixation.

The secondary aim was to assess patient satisfaction by using the self-reported foot and ankle score (SEFAS) functional scoring tool.

The overall study objective is to assess the rate of arthrodesis of the hallux MTPJ using the contoured dorsal compression locking plate alone and comparing the arthrodesis rate to that of other implants that have been used in the literature.

CHAPTER 2

METHODOLOGY

2.1 Research Question

Is the fusion rate using a dorsal locking compression plate comparable to the preferred method of a compression screw and dorsal neutralisation plate in hallux MTPJ arthrodesis?

2.2 Research Design

This research design was a cross sectional study comprising a retrospective review of radiographs and clinical notes as well as assessing patient satisfaction using the SEFAS score.

2.3 Materials and Methods

The records of 32 patients who had hallux MTPJ arthrodesis using a dorsal compression plate between January and December 2016 at the Netcare Linksfield Hospital were reviewed. Ethical approval was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand before data collection commenced.

There were 32 patients (38 feet) that were operated in 2016 and of these six were bilateral. There were incomplete records for five patients (six feet) and these were excluded from this study. Twenty-seven patients (32 feet) were included in this study. Demographics as well as medical comorbidities and social habits were documented (Table 3.1).

Standardised weight bearing radiographs of the foot were taken at six weeks postoperatively and assessed for union. Union was defined as bony bridging between the phalanx and metatarsal seen in both antero-posterior (AP) and lateral X-ray views [27]. The radiographs

were taken with the X-ray beam one metre from the cassette centred on the midfoot with a 15° inclination cephalad according to an international standardised protocol on weight bearing radiographs [1].

The SEFAS score has been validated specifically for foot and ankle surgery [45]. The SEFAS questionnaire was completed by 22 of the 27 patients who had undergone MTPJ arthrodesis at the time of data collection, which was three years post surgery.

2.4 Selection criteria

Patient selection criteria

Inclusion criteria:

- Patients ≥ 18 years of age
- Patients who underwent a hallux MTPJ arthrodesis between January and December 2016

Exclusion criteria

- Revision hallux MTPJ arthrodesis
- Incomplete records

2.5 Data Collection

The researcher assessed the X-rays and commented on whether there was radiographic evidence of arthrodesis across the hallux MTPJ. The patients were contacted telephonically three years postoperatively, consent was obtained and patient satisfaction was assessed using the SEFAS score. The SEFAS sores were compared for preoperative and postoperative values. The questionnaire was conducted in English.

Each patient received a unique study number thereby maintaining patient confidentiality.

An excel spreadsheet with the following variables was used to collect the data (see Appendix A):

- Patient number
- Gender and age
- Co morbidities/social habits
- Union: Yes/No
- SEFAS score

2.6 Data Analysis

2.6.1 Study sampling

For the present study sample size calculation for cross sectional studies formula [46] was used:

$n = \frac{z2*p(1-p)}{d2}$ where: n = sample size, z = standard normal variate (at 5% margin of error it is 1.96), p = expected proportion or prevalence/rate based on previous similar studies and d = margin of error (we used 5%, for a 95% confidence interval).

The proportion (p) (arthrodesis rate) from the largest single-surgeon patient series reported to determine arthrodesis rate for the hallux MTPJ using the recommended construct was used. In this study an arthrodesis rate of 98% was achieved [40] hence the optimum sample size for the present study was calculated to be 30 feet.

2.6.2 Data interpretation and statistical analysis

Data analysis was conducted using STATA version 14. Descriptive analysis was conducted to describe the study participants. For continuous variables such as age, the Shapiro Wilk test was used to determine the distribution of the data and the appropriate central tendency measure (i.e. mean (SD)/ median (IQR)) to report. For categorical variables frequency tables were computed.

To evaluate the arthrodesis rate of the hallux MTPJ using a dorsal compression plate, frequency tables were computed to count the proportion of hallux MTPJ's that were considered to have fused. To compare the fusion rate using the dorsal LCP and the fusion rate using the recommended construct [40], a chi-squared test was used.

In terms of the SEFAS questionnaire, responsiveness is the extent to which a questionnaire is able to detect changes over time or due to an intervention such as surgery [47]. Of the 27

patients that were included in this study, only 22 completed the SEFAS scores pre and post operatively. To test responsiveness effect size (ES) and standardised response means (SRM) were calculated. ES is calculated as the difference between the means before and after intervention divided by the standard deviation (SD) of the same measure before treatment [47]. SRM is calculated as the difference between the means before and after treatment divided by the SD of the change. For both, ES and SRM, values of 0.2, 0.5 and 0.8 were regarded as small, moderate and large effects, respectively [47].

2.6.3 Data processing

The data for the study was entered into an Excel spreadsheet prior to entering it into STATA version 14 for analysis. To process the data in preparation for analysis, the data was checked for errors in recording, duplicates and missing values.

2.6.4 Data analysis

Descriptive analysis was conducted for the demographic characteristics of the patients. A Shapiro Wilk test was used to determine the distribution of the continuous variables. The null hypothesis for a Shapiro Wilk test is that the data is normal; hence, a p-value of less than 0.05 indicates that the data is skewed. For skewed data medians and interquartile ranges (IQR) were reported, for normal data means and standard deviations (SD) were reported. To determine the arthrodesis rate of the hallux MTPJ using a dorsal compression plate, frequency tables were computed to count the proportion of hallux MTPJ's that were considered to have fused. To compare the arthrodesis rate using the dorsal LCP and the recommended construct [40], a proportions test was used.

2.7 Surgical technique

Patients were positioned supine. A thigh tourniquet was used in all cases. A medial incision was made over the hallux MTPJ and dissection continued through the medial capsule. The joint was adequately exposed for preparation. The joint surfaces were denuded of cartilage down to subchondral cancellous bone using power conical reamers. The subchondral bone was fenestrated to promote bone marrow elements leaking into the fusion site. The hallux was reduced in neutral rotation, appropriate dorsiflexion relative to the height of the medial longitudinal arch and physiological valgus. The position was held with a K-wire and checked

under fluoroscopy. The reduction was fixed with a contoured dorsal locking compression plate (Paragon 28 Gorilla® MTP Plating System or the Tornier MAXLOCK™ EXTREME™ System). The surgical site was irrigated and closure performed in a routine layered manner. Patients were instructed to follow a post-operative protocol of strict high elevation for the first two weeks, followed by heel weightbearing in an assistive wedge-heel post-operative shoe for another four weeks.

CHAPTER 3

RESULTS

The table below summarises the demographics, co morbidities and social habits of the patients who had a hallux MTPJ arthrodesis. (Table 3.1)

Table 3.1: Demographic characteristics of study patients (N=32)

CHARACTERISTICS	**TOTAL NUMBER OF PATIENTS (n=27)**
Age (years) Mean (SD)	62 ± 10.4
Gender N (%)	
Male	4 (12.5%)
Female	28 (87.5)
No of Comorbidities	
None	6 (22%)
One	7 (26%)
Two	7 (26%)
Three	7 (26%)
Smoking (Yes/No)	

Yes	1 (3%)
No	31 (97%)
Alcohol Use (Social/No)	
Social	16 (50%)
No	16 (50%)
Side of Surgery (L/R)	
Left Foot	8 (30%)
Right Foot	14 (52%)

The mean age at the time of operation was 62 years (SD = 10.4).

Of the 27 patients included in the study, the majority were female (refer to Figure 3.1). Fourteen feet (52%) had surgery on the right foot (refer to Figure 3.2). Seven patients had one comorbidity, seven patients had two, seven patients had three and six had no comorbidities. Of the seven with one comorbidity, all had united at six weeks whereas of the seven patients with two comorbidities, one patient had delayed union. Two patients with three comorbidities had delayed union. These comorbidities included diabetes, asthma, breast cancer, gout, rheumatoid arthritis, epilepsy and hypercholesterolaemia.

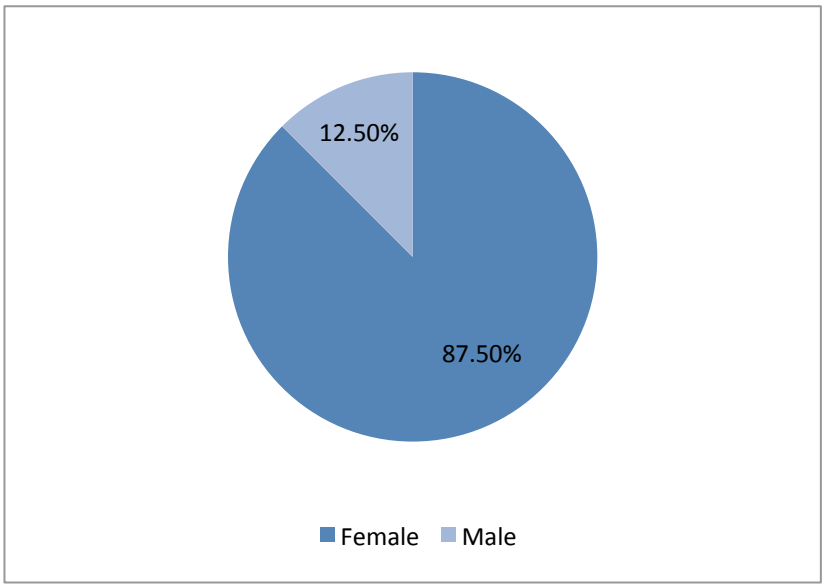


Figure 3.1: Gender distribution

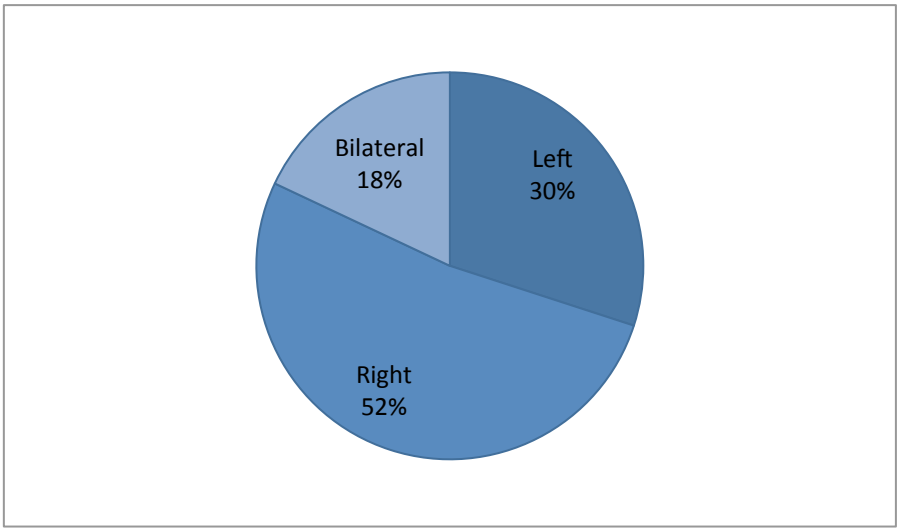


Figure 3.2: Side of surgery

There was however no difference with respect to gender, side of operation, smoking status and alcohol consumption ($p>0.05$) when comparing those feet that showed radiographic union at six weeks and those that had a delayed union.

Radiographic union (refer to Figure 3.1) was seen in 29 (90.6%) feet at six weeks. Neither of the three patients with a delayed union smoked cigarettes.

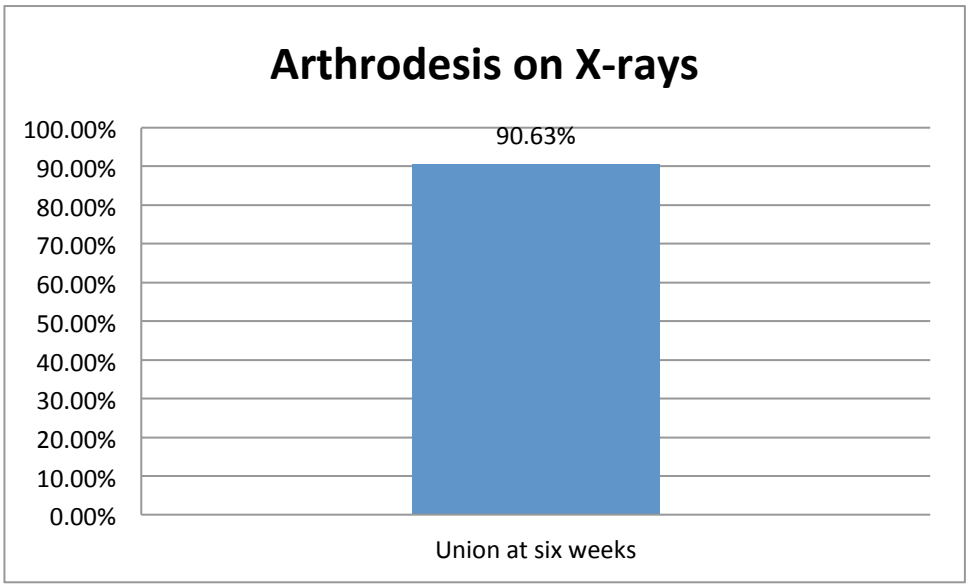


Figure 3.3: Graph showing radiographic union achieved at six weeks post surgery

The SEFAS questionnaire was completed by 22 patients and demonstrated improvement between preoperative assessment (mean score of 29) and postoperative follow-up (mean score of 41) indicating that functional scores improved following arthrodesis of the hallux MTPJ. The mean difference (12) between preoperative and postoperative assessment is shown in Table 3.2.

Table 3.2: SEFAS score improvement

	Pre-Op Mean (SD)	**Post-Op Mean (SD)**	**Mean Difference (SD)**	**ES**	**SRM**
SEFAS	29 (11.15)	41 (7.83)	12	1.07	0.94

Three feet demonstrated moist wounds and three feet had residual swelling at their two week follow up. At six weeks follow up all wounds had healed and there were no further complications.

CHAPTER 4

DISCUSSION

Hallux MTPJ arthrodesis is considered to be the gold standard for the treatment of many conditions that cause chronic pain and disability of the hallux as well as transfer metatarsalgia and keratosis of the lesser toes. Arthrodesis has been shown to provide a stable first ray, thereby eliminating painful motion and increasing weight-bearing distribution of the forefoot [3].

The success rate of hallux MTPJ arthrodesis varies widely, reported to be between 80-100% [40]. The combination of a lag screw across the MTPJ with a dorsal neutralisation plate has been shown to be the most stable construct [5, 18, 32] and is widely recommended as the construct of choice in the arthrodesis of the hallux MTPJ.

Historically, many complications were reported with the use of small fragment plates such as skin irritation and pressure symptoms [36] which led to the development of low profile, pre contoured dorsal plates with locking and non-locking screw options. The use of locking plates in hallux MTPJ arthrodesis, however, is gaining popularity due to the evolution of the dorsal plate [6] and the results in the current study are comparable to other devices used in hallux MTPJ arthrodesis as reported in the literature.

Good clinical outcomes are directly related to surgical technique and device used for internal fixation [48].

In the current study radiological arthrodesis was achieved at six weeks in 90.63% of the feet operated. Thirteen feet that showed radiographic union at six weeks had two or more co morbidities. Three feet went onto a delayed union (united at nine and ten weeks) and of these patients two had more than one comorbidity. There may be an association between patient comorbidities and arthrodesis rate however this cannot be concluded from this series and would require further studies.

None of the three patients who showed radiographic union beyond six weeks were smokers, nonetheless there is evidence in the literature that demonstrates an association between patients who smoke and complications of delayed union as well as wound healing [21, 49].

Meijer et al. recently published a study reviewing the use of a dorsal locking plate without making use of additional compression screw fixation across the MTPJ [6]. The results showed a radiological union rate of 97% and an overall low complication rate of 5% that included non-union and infection. These figures are in keeping with those that are stated in the literature.

Grondal et al. in their study of 22 cases showed the non-union rate for two crossed compression screws was 7.5% with the recommendation that the crossed screws should cross distal to the joint line [50, 51, 52]. Satisfactory interfragmentary compression has not been adequately achieved with the use of isolated dorsal plating, with retrospective studies revealing a non-union rate of 9.9% [35, 51, 53].

Polini et al. in 2003 recommended that the dorsal plate should be combined with an inter-fragmentary screw, making it twice as strong as two crossed screws from a biomechanical aspect [5, 32]. This has been shown by Sharma et al. to have a low non-union rate of 3.9% [54]. In our series the arthrodesis rate was 90.6%, which is comparable to previous studies.

In a study by Hunt et al. comparing locked versus non-locked plates in the arthrodesis of the hallux MTPJ it was shown that there was a trend towards higher rates of non-union in patients where a titanium dorsal locked plate was used. The authors speculated that the reason for this maybe a decreased ability to obtain compression across the arthrodesis site with the locked plate construct as well as inferior rigidity of the titanium plate that was used. It is critical to obtain interfragmentary compression to achieve arthrodesis [28].

In the current study, a titanium alloy (TI-6AL-4V) locking compression plate was used. It has excellent mechanical properties including superior biocompatibility, high strength and fracture toughness, excellent corrosion resistance and a Young's modulus of elasticity similar to cortical bone [55]. This plate has an oblong compression slot proximally to allow for compression of the MTPJ surface as well as locking screw options.

Joint surface preparation is one of the many important factors for achieving good results with MTPJ arthrodesis. The literature describes various methods that have been used including planar cuts, peg-and-socket or more spherical cup-and-cone techniques [17].

Peg-and-socket techniques provide innate stability but are technically demanding to perform, lose bone stock and result in shortening of the first ray [56, 57, 58, 59]. Planar cuts are a quicker option for bony preparation but have the disadvantage of causing bone shortening if the desired position is not obtained and requires further resection [17]. Curtis et al. reported greater

stiffness with the cup and cone method of joint preparation as compared with planar excision [19] as this provides surfaces that are adaptable, cater for precise positioning of the hallux MTPJ, create a larger surface area for arthrodesis and are biomechanically superior [17, 19, 38].

In the current study, the surgeon uses meticulous methods for joint preparation including drilling of the proximal and distal surfaces for the release of bone marrow elements into the arthrodesis site, which aids in union across this site.

In this series the SEFAS score improved post operatively as compared to the pre operative assessment. This is in keeping with Maffuli et al. who demonstrated improved satisfaction with the AOFAS score in their series [43, 44].

4.1 Recommendations

Based on the results from this study the following recommendations are made:

- Successful arthrodesis requires meticulous preparation of joint surfaces and careful surgical technique with regards to fixation.
- The use of a dorsal compression locking plate for MTPJ arthrodesis has shown good arthrodesis rates as well as functional outcomes. In this study, arthrodesis rate at six weeks was 90.63% and by ten weeks all patients had achieved arthrodesis of the hallux MTPJ. It can thus be recommended that a dorsal compression locking plate can be used without the need for an interfragmentary screw.
- Future prospective randomised studies on the use of the dorsal compression locking plate are required.
- A larger cohort of patients should be used for future study purposes.

4.2 Limitations

The limiting factor of this study was the small sample group as well as the fact that there was no control group. The patient records are from a single surgeon in the sub specialty of foot and ankle and therefore these results may not be fully reproducible. Only 22 patients participated in the SEFAS questionnaire thereby limiting numbers and not providing a true reflection of patient satisfaction.

A follow up study that includes multiple surgeons, a larger sample size as well as a control group may further strengthen the indications for using a contoured dorsal locking compression plate for hallux MTPJ arthrodesis.

CHAPTER 5

CONCLUSION

Arthrodesis of the MTPJ is a commonly performed procedure for a variety of indications. Many fixation combinations have been used, however this study demonstrates that with the evolution of dorsal locking plates, a contoured dorsal locking compression plate can be used alone in the arthrodesis of the hallux MTPJ with good results. Although all cases ultimately united, the results in this study show that using the contoured dorsal locking compression plate alone may require more time to union in ten percent of patients. Patient satisfaction improved post operatively as was shown by the SEFAS score.

Many factors play an important role in the arthrodesis rate of the hallux MTPJ including meticulous joint preparation and hallux positioning. Due to the limitations of this study, further large patient-based studies are necessary to advocate for the use of a contoured dorsal locking compression plate alone and to identify other factors which may affect union time in this construct.

Appendices

Appendix A: Ethics approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Olivia Antos et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180404

NAME: (Principal Investigator)	Dr Olivia Antos et al
DEPARTMENT:	Orthopaedic Surgery Foot and Ankle Unit, Linksfield Netcare Hospital
PROJECT TITLE:	A retrospective review of dorsal plating for hallux metatarsophalangeal joint arthrodesis
DATE CONSIDERED:	04/05/2018
DECISION:	Approved uncoditionally
CONDITIONS:	
SUPERVISOR:	Dr Andrew Strydom
APPROVED BY:	CB Penny Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	20/08/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **April** and will therefore be due in the month of **April** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Antes — 21/08/2018

Principal Investigator Signature — Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

17/04/2019

Dr O Antos and Professor NP Saragas
School of Clinical Medicine
Department of Surgery
Division of Orthopaedic Surgery
Medical School
University

Sent by e-mail to: olivia.antos@gmail.com

Dear Dr Antos

Re: **Protocol Ref No: M180404**
Protocol Title: *A retrospective review of dorsal compression plating for hallux metatarsophalangeal joint arthrodesis*
Principal Investigator: Dr O Antos and Professor NP Saragas

Thank you for your undated letter, received here on 03/04/2019.

We have noted and approve the addition of a patient satisfaction questionnaire.

Thank you for keeping us informed.

Yours Sincerely

.....

Mr I Burns
For the Human Research Ethics Committee (Medical)

Works2000/Iain0007/Acknowledge.docx

Appendix B: Title Change

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

03 January 2020
Person No: 784974
PAG

Dr O Antos
88 Meridian
AG De Witt Road
Solheim
1401
South Africa

Dear Dr Olivia Antos

Master of Medicine: Approval of Title

We have pleasure in advising that your proposal entitled *A retrospective review of dorsal plating for hallux metatarsophalangeal joint arthrodesis* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

17 May 2021
Person No: 784974
TAA

Dr O Antos
88 Meridian
AG De Witt Road
Solheim
1401
South Africa

Dear Dr Olivia Antos

Master of Medicine: Change of title of research

I am pleased to inform you that the following change in the title of your Research Report for the degree of **Master of Medicine** has been approved:

From:	**A retrospective review of dorsal plating for hallux metatarsophalangeal joint arthrodesis**
To:	**A retrospective review of dorsal locking compression plating for hallux metatarsophalangeal joint arthrodesis**

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix C: Hospital permission letters

The Orthopaedic
Foot and Ankle Unit

PROF. NICK P. SARAGAS
M.B.B.Ch (WITS); F.C.S. (S.A.) ORTHO; M.MED (ORTHO SURG) (WITS)

ORTHOPAEDIC SURGEON

PRACTICE LIMITED TO FOOT AND ANKLE

PR. NO. 2804611

Netcare Linksfield Medical Centre | Suite 303, 3rd Floor, 24 - 12th Ave. | Linksfield West, 2192
P O Box 1153, Highlands North, 2037
Tel: 011 485-1974 Fax: 011 640-5313 | Emergency 082 809 5915 |e-mail: saragaspractice@telkomsa.net
Accounts Department: Tel 011 454 1148 | Email: npsaccounts@telkomsa.net

6 November 2018

To whom it may concern

Dear Sir/Madam

This letter serves to confirm that Dr Olivia Antos has been granted my permission to access my patient records with regards to her MMed research project on a retrospective review of "The use of a compression dorsal plate for hallux metatarsophalangeal joint arthrodesis". These patients have all undergone surgery at the Linksfield Netcare Hospital. Furthermore she has my permission to contact my patients to complete a questionnaire regarding the functional scores.

This permission is granted provisionally and on instruction that all information so accessed must remain strictly confidential and will be used for statistical and analytical purposes only. No personal and/or patient treatment information will be disclosed or released to any third party during the course of or as a result of this study.

Yours sincerely

Prof N.P Saragas

Netcare Hospital Management (Pty) Limited

Tel: + 27 (0)11 301 0000
Fax: Corporate +27 (0)11 301 0499
76 Maude Street, Corner West Street, Sandton, South Africa
Private Bag X34, Benmore, 2010, South Africa

RESEARCH OPERATIONS COMMITTEE FINAL APPROVAL OF RESEARCH

Approval number: UNIV-2018-0028

Dr Olivia Antos

E mail: olivia.antos@gmail.com

Dear Dr Antos

RE: A RETROSPECTIVE REVIEW OF DORSAL PLATING FOR HALLUX METATARSOPHALANGEAL JOINT ARTHRODESIS

The above-mentioned research was reviewed by the Research Operations Committee's delegated members and it is with pleasure that we inform you that your application to conduct this research at Netcare Linksfield Hospital, has been approved, subject to the following:

i) Research may now commence with this FINAL APPROVAL from the Netcare Research Operations Committee.

ii) All information regarding Netcare will be treated as legally privileged and confidential.

iii) Netcare's name will not be mentioned without written consent from the Netcare Research Operations Committee.

iv) All legal requirements regarding patient / participant's rights and confidentiality will be complied with.

v) All data extracted may only be used in an anonymised, aggregated format and for the purposes of this specific study as specified in the proposal. The data may under no circumstances be used for any other purpose whatsoever.

vi) The research will be conducted in compliance with the GUIDELINES FOR GOOD CLINICAL PRACTICE IN HUMAN PARTICIPANTS IN SOUTH AFRICA (2016).

vii) Netcare must be furnished with a STATUS REPORT on the progress of the study at least annually on 30th September irrespective of the date of approval from the Netcare Research Operations Committee as well as a FINAL REPORT with reference to intention to publish and probable journals for publication, on completion of the study.

viii) A copy of the research report will be provided to the Netcare Research Operations Committee once it is finally approved by the relevant primary party or tertiary institution, or once complete or if discontinued for any reason whatsoever prior to the expected completion date.

ix) Netcare has the right to implement any recommendations from the research.

x) Netcare reserves the right to withdraw the approval for research at any time during the process, should the research prove to be detrimental to the subjects/Netcare or should the researcher not comply with the conditions of approval.

xi) APPROVAL IS VALID FOR A PERIOD OF 36 MONTHS FROM DATE OF THIS LETTER OR COMPLETION OR DISCONTINUATION OF THE TRIAL, WHICHEVER IS THE FIRST.

We wish you success in your research.

Yours faithfully 21/6/18

Prof Dion du Plessis
Full member: Netcare Research Operations Committee & Medical Practitioner evaluating research applications as per Management and Governance Policy

Shannon Nell
Chairperson: Netcare Research Operations Committee
Netcare Hospitals (Pty) Ltd
Date: 18/7/2018

Appendix D: Data Collection sheets

	Patient 1	
Patient demographics		
Age		
Gender		
Co morbidities		
Social habits	**Yes**	**No**
Smoking		
Ethanol use		
Arthrodesis on X-rays (Y/N)	**Yes**	**No**
SEFAS score		

Appendix E: SEFAS score

Date when answering: D D — M M — Y Y Y Y

SELF-REPORTED FOOT & ANKLE QUESTIONNAIRE (SEFAS)

We would like you to answer the 12 questions below. Each question is graded from 0- 4
4 = the mildest or least troublesome and 0 = the most severe or most troublesome.

Please cross the box that best describes your condition during the last 4 weeks

1. How would you describe the pain you usually have from the foot/ankle in question? 4 ☐ None 3 ☐ Very mild 2 ☐ Mild 1 ☐ Moderate 0 ☐ Severe	5. How much has the pain from the foot/ankle in question interfered with your usual work including housework and hobbies? 4 ☐ Not at all 3 ☐ A bit 2 ☐ Moderately 1 ☐ Greatly 0 ☐ Totally
2. For how long have you been able to walk before severe pain arises from the foot/ ankle in question? 4 ☐ No pain up 30 min. 3 ☐ 16-30 minutes 2 ☐ 5-15 minutes 1 ☐ Around the house only 0 ☐ Unable to walk at all because of severe pain	6. Have you been limping when walking because of the foot/ankle in question? 4 ☐ No days 3 ☐ Only one or two days 2 ☐ Some days 1 ☐ Most days 0 ☐ Every day
3. Have you been able to walk on uneven ground? 4 ☐ Yes, easily 3 ☐ With little difficulty 2 ☐ With moderate difficulty 1 ☐ With extreme difficulty 0 ☐ No impossible	7. Have you been able to climb *a flight of* stairs? 4 ☐ Yes, easily 3 ☐ With little difficulty 2 ☐ With moderate difficulty 1 ☐ With extreme trouble 0 ☐ Impossible
4. Have you had to use an orthotic (shoe insert), heel lift or special shoes? 4 ☐ Never 3 ☐ Occasionally 2 ☐ Often 1 ☐ Most of the time 0 ☐ Always	8. Have you been troubled by pain from the foot/ ankle in question in bed at night?) 4 ☐ No 3 ☐ Only one or two nights 2 ☐ Some nights 1 ☐ Most nights 0 ☐ Every night
9. How much has pain from the foot/ankle in question affected your usual recreational activities? 4 ☐ Not at all 3 ☐ A bit 2 ☐ Moderately 1 ☐ Greatly 0 ☐ Totally	11. After a meal (sat at a table) how painful has it been for you to stand up from a chair because of the foot/ankle in question? 4 ☐ Not at all painful 3 ☐ Slightly painful 2 ☐ Moderately painful 1 ☐ Very painful 0 ☐ Unbearable
10. Have you had swelling of your foot? 4 ☐ None at all 3 ☐ Occasionally 2 ☐ Often 1 ☐ Most of the time 0 ☐ All the time	12. Have you had a severe sudden pain shooting, stabbing or spasms from the foot/ankle in question? 4 ☐ No days 3 ☐ Only one or two days 2 ☐ Some day 1 ☐ Most days 0 ☐ Every day
13. If needed, would you have the same procedure again?	Yes ☐ No ☐

THANK YOUR FOR COMPLETING THESE QUESTIONS

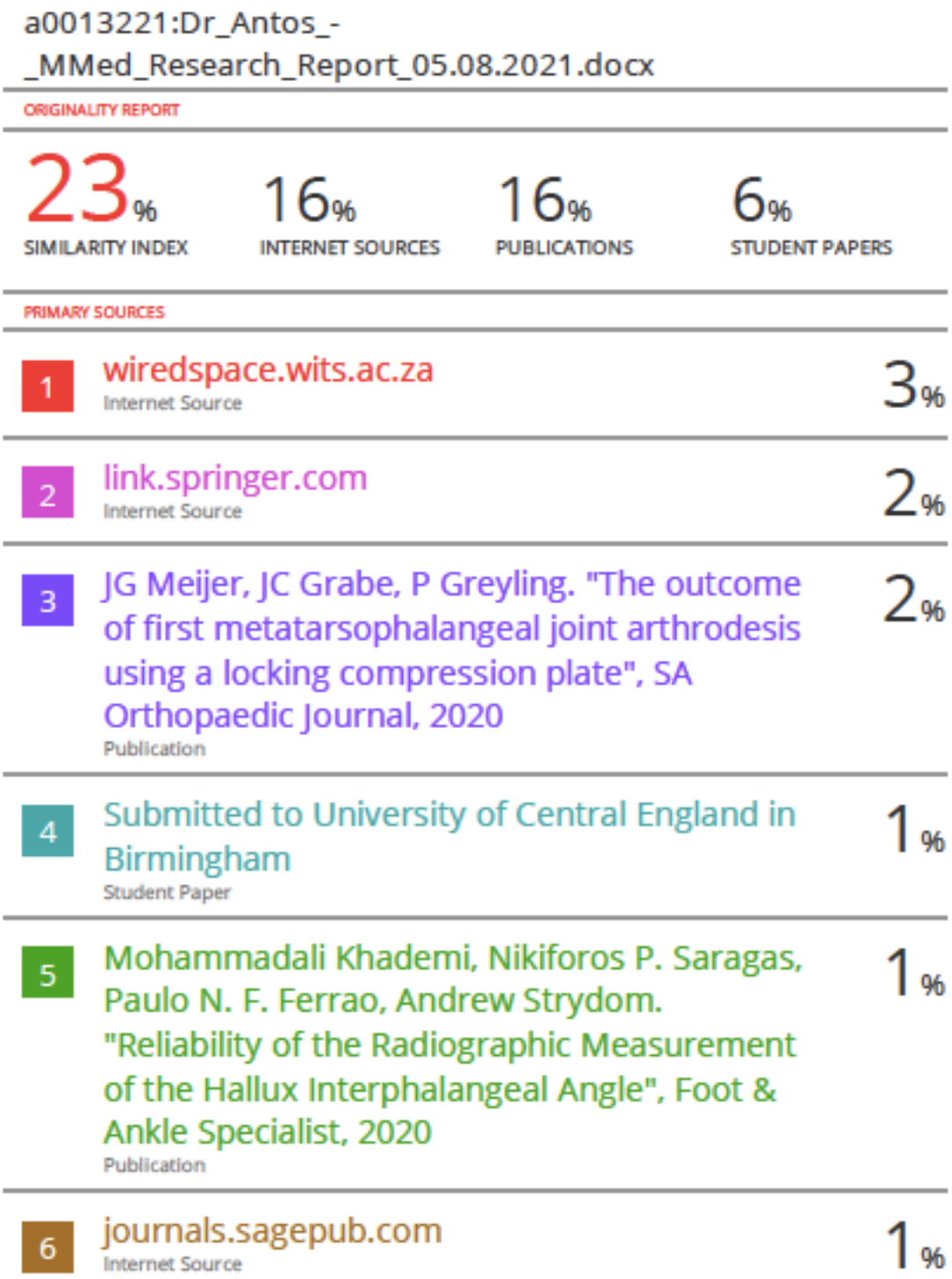
Appendix F: Data spread sheet

Patient number	Age	Gender	Co morbidities	Smoking
Patient 1	78	F	AF, cholesterol CCF	No
Patient 2	27	F	Macrodactyly R big toe	No
Patient 3	73	F	None	No
Patient 4	58	F	Diabetic, HPT, Bronchiectasis	No (previous smoker)
Patient 5	65	F	Prediabetic, breast ca, asthmatic	No
Patient 6	57	M	HPT	No
Patient 7	67	F	Breast Ca 2012 (HRT)	No
Patient 8	73	F	HPT, prev DVT	No
Patient 9a	54	F	Rheumatoid Arthritis, Diabetic	No
Patient 9b	54	F	Rheumatoid Arthritis, Diabetic	No
Patient 10	77	F	HPT, GORD	No
Patient 11	61	F	None	No
Patient 12	73	F	Gout, HPT	No
Patient 13a	66	M	Gout, cardiac bypass surgery (open heart)	No
Patient 13b	66	M	Gout, cardiac bypass surgery (open heart)	No
Patient 14a	29	F	None	Yes (18/day 11 years)
Patient 14b	29	F	None	Yes (18/day 11 years)
Patient 15	61	F	Gout, Diabetic, Hypothyroidism	No
Patient 16a	61	F	HPT	No
Patient 16b	61	F	HPT	No
Patient 17	61	F	Rheumatoid arthritis, Epileptic, Cholesterol	No
Patient 18	48	F	Diabetic, Cholesterol, HPT	Yes (15/day fpr 10 years)
Patient 19	69	F	Gout, HPT	No
Patient 20a	56	F	Hypothyroidism	No
Patient 20b	56	F	Hypothyroidism	No
Patient 21	57	M	Rheumatoid arthritis	No
Patient 22	67	F	None	No
Patient 23	49	F	Rheumatoid arthritis	No
Patient 24	67	F	Throat ca with radiation 20 years ago, hypothyroidism, Diabetic	No
Patient 25				
Patient 26	75	M	HPT	No
Patient 27	66	F	Gout, hypothyroidism,	No
Patient 28	68	F	HPT	No
Patient 29	48	F	None	No
Patient 30	68	F	Hypothyroidism, GORD, Cholesterol	No
Patient 31a	68	F	None	No
Patient 31b	68	F	None	No
Patient 32	54	F	Rheumatoid arthritis, Hypothyroidism, Cholesterol	No (previous smoker)

Patient number	Alcohol use	Date of surgery	Side of surgery	Date of x-rays
Patient 1	No	18.01.2016	L foot	03.03.2016
Patient 2	No	03.02.2016	R foot	22.03.2016
Patient 3	No	24.02.2016	R foot	08.04.2016
Patient 4	No	25.02.2016	R foot	No x-rays
Patient 5	Social	29.02.2016	R foot	14.04.2016
Patient 6	Social	29.02.2016	L foot	14.04.2016
Patient 7	Social	31.03.2016	L foot	13.05.2016
Patient 8	No	31.03.2016	R foot	17.05.2016
Patient 9a	No	04.04.2016	L foot	20.05.2016
Patient 9b	No	10.10.2016	R foot	29.11.2016
Patient 10	No	07.04.2016	L foot	20.05.2016
Patient 11	No	13.04.2016	L foot	27.05.2016
Patient 12	No	18.04.2016	R foot	30.05.2016
Patient 13a	No	05.05.2016	R foot	17.06.2016
Patient 13b	No	05.05.2016	L foot	17.06.2016
Patient 14a	Social	30.05.2016	R foot	No x-rays
Patient 14b	Social	30.05.2016	L foot	No x-rays
Patient 15	Social	04.06.2016	R foot	12.07.2016
Patient 16a	Social	11.07.2016	R foot	26.08.2016
Patient 16b	Social	11.07.2016	L foot	26.08.2016
Patient 17	No	27.07.2016	R foot	09.09.2016
Patient 18	Social	15.08.2016	R foot	04.10.2016
Patient 19	Social	05.09.2016	R foot	18.10.2016
Patient 20a	No	07.09.2016	R foot	27.10.2016
Patient 20b	No	07.09.2016	L foot	27.10.2016
Patient 21	No	14.09.2016	L foot	No x-rays
Patient 22	Social	19.09.2016	R foot	01.11.2016
Patient 23	Social	21.09.2016	L foot	08.11.2016
Patient 24	No	29.09.2016	L foot	21.11.2016
Patient 25				
Patient 26	Social	05.10.2016	R foot	21.11.2016
Patient 27	No	26.10.2016	R foot	12.12.2016
Patient 28	Social	07.11.2016	R foot	22.12.2016
Patient 29	social	10.11.2016	R foot	29.12.2016
Patient 30	No	21.11.2016	R foot	No x-rays
Patient 31a	Social	23.11.2016	R foot	05.01.2017
Patient 31b	Social	23.11.2016	L foot	05.01.2017
Patient 32	Social	30.11.2016	L foot	13.01.2017

Patient number	Arthrodesis on X-rays	Complications	SEFAS pre	SEFAS post
Patient 1	Yes	None	28	31
Patient 2	Yes	None	40	41
Patient 3	Yes	None	44	46
Patient 4	Yes	Moist wound, healed	10	38
Patient 5	No (union at 10 weeks)	None	25	48
Patient 6	Yes	None	18	31
Patient 7	Yes	Moist wound, healed	29	47
Patient 8	Yes	None	29	41
Patient 9a	Yes	None	39	18
Patient 9b	Yes	None	35	26
Patient 10	Yes	None	No answer	
Patient 11	Yes	None	40	45
Patient 12	Yes	None	34	47
Patient 13a	Yes	None	No answer	
Patient 13b	No (union at 10 weeks)	None		
Patient 14a	Yes	None	34	47
Patient 14b	Yes	None	27	47
Patient 15	Yes	None	No answer	
Patient 16a	Yes	None	No answer	
Patient 16b	Yes	None		
Patient 17	No (union at 9 weeks)	None	No answer	
Patient 18	Yes	Residual swelling 2/52	7	46
Patient 19	Yes	None	48	48
Patient 20a	Yes	None	17	39
Patient 20b	Yes	None	14	38
Patient 21	Yes	None	29	41
Patient 22	Yes	None	No participation	
Patient 23	Yes	None	20	45
Patient 24	Yes	Moist wound, healed	24	48
Patient 25			Excluded	
Patient 26	Yes	None	No answer	
Patient 27	Yes	Residual swelling 1/52	35	44
Patient 28	Yes	None	No answer	
Patient 29	Yes	Residual swelling 1/52	32	42
Patient 30	Yes	None	48	48
Patient 31a	Yes	None	No answer	
Patient 31b	Yes	None		
Patient 32	Yes	None	19	33

Appendix G: Plagiarism/turn-it-in report cover sheet



a0013221:Dr_Antos_-_MMed_Research_Report_05.08.2021.docx

ORIGINALITY REPORT

23%	16%	16%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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3	JG Meijer, JC Grabe, P Greyling. "The outcome of first metatarsophalangeal joint arthrodesis using a locking compression plate", SA Orthopaedic Journal, 2020 Publication	2%
4	Submitted to University of Central England in Birmingham Student Paper	1%
5	Mohammadali Khademi, Nikiforos P. Saragas, Paulo N. F. Ferrao, Andrew Strydom. "Reliability of the Radiographic Measurement of the Hallux Interphalangeal Angle", Foot & Ankle Specialist, 2020 Publication	1%
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Appendix H: Turn-it-in letter of motivation

Division of Orthopaedic Surgery

Faculty of Health Sciences, 4M Room 12, Wits Medical School, 7 York Road, Parktown 2193
• Tel: +27 11 717-2538 • Fax: +27 11 717-2551

UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG

Faculty of Health Sciences, University of the Witwatersrand

04/08/2021

RE: LETTER OF MOTIVATION – TURN-IT-IN REPORT

To whom it may concern,

Please accept Dr Olivia Antos' Turn-it-in report for her MMed Research Report entitled A retrospective review of dorsal locking compression plating for hallux metatarsophalangeal joint arthrodesis. Despite the high similarity index (23%), the research report has not been plagiarised as common medical terminology pertaining to the topic was used.

Yours sincerely,

Dr. A. Strydom

Supervisor

Prof N. Saragas

Co-supervisor

Appendix I: References

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