Patient-reported outcome measures after distal radius fracture at Chris Hani Baragwanath Academic Hospital

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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

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Declaration

I, Serge Lwamba Kayuba, 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.

(Signature of candidate)

3rd day of October 2022, in Johannesburg (Wits)

Dedication

This study is dedicated to Prof M.T. Ramokgopa, who gave me the precious opportunity to study Orthopaedic Surgery at the University of the Witwatersrand.

To my beautiful wife and friend, Mrs C.A. Kayuba, for her outstanding support throughout all the years spent together; and to my exceptional children Daniella and Daniel, who are a blessing to us. I love you all.

To God Almighty: thank you for the guidance, strength, protection, skills, and healthy life. All of these, we offer you.

Abstract

Background: The distal radius fracture is a common orthopaedic injury with a bimodal distribution: high energy in younger patients and low energy in older patients. The incidence is higher in the geriatric population due to osteoporosis and there is an increased fracture risk after a fall. This fracture is treated in different ways (surgical or non-surgical treatment), depending on the treating surgeon's decision and the fracture type. In the past two decades, the management of distal radius fractures has dramatically changed from mainly conservative to increased surgical treatment. Many studies have been done on distal radius fractures, yet questions on gold standard treatment remain, especially in our population group. Should all patients be operated on?

Methodology: This was a retrospective cohort study with a prospective recall of patients treated for distal radius fractures at Chris Hani Baragwanath Academic Hospital. One hundred and fifty-two (n=152) patients treated for a distal radius fracture at our institution, over a two-year period (01 July 2019 to 30 June 2021) were included in the study. The patients were grouped into two groups: surgical treatment group (77 patients) and non-surgical treatment group (75 patients). The minimum follow-up period was three months (Range: 3 months to 5.5 months). Two vetted tools were used in this study to collect data on patients' experience of pain and function after either operative or non-operative management of a distal radius fracture namely the Quick Disabilities of the Arm, Shoulder and Hand (DASH) and Visual Analogue Scale (VAS) scores. An interpreter was used to help with translation in local languages.

Results: A total of 152 patients consented to participate in the study after they had been treated for distal radius fracture at Chris Hani Baragwanath Academic Hospital. Of the 152 participants, 52.8% were female and 47.2% were male. Two-thirds of the participants were older than 40 years. AO/OTA 2R3 A, B and C fracture types were included in the study groups. There was a total of 70 AO/OTA 2R3 A, 26 AO/OTA 2R3 B and 56 AO/OTA 2R3 C fracture types. Of all the distal radius fractures, 59.2% were sustained on the left side. Half of the patients had surgical treatment. In the analysis of AO/OTA type B and type C fractures outcomes in patients aged 50 years and older, a mean DASH score of 20,6 (SD: 17.7) for the surgical group and a mean DASH score of 16.4 (SD: 16.6) for the non-operative group was found. It was found that surgical treatment did not improve the mean DASH scores in patients aged 50 years and older (p=0,23), but there was a significant decrease in the mean DASH scores

in younger patients (p=0.003). Furthermore, there was no significant difference in the VAS between the surgical and non-operative group. Lastly, the Quick DASH scores were influenced by age and type of injury while the VAS scores were not.

Conclusion: This study highlighted that at our institution, distal radius fractures mainly affect females above the age of 50 years with the main mechanism of injury being a fall on an outstretched hand. It was found that surgical treatment of distal radius fractures did not improve the mean DASH scores of patients aged 50 years and older. Furthermore, there was no significant difference in the VAS between the surgical group and the non-operative group. Therefore, this study encourages non-operative management of distal radius fractures in older adults (50 years and older) due to similar pain and function outcomes. Lastly, it was found that the Quick DASH scores were influenced by age and type of injury while the VAS scores were not. Further trials with larger sample sizes and longer follow-up periods are required to provide further evidence.

Acknowledgements

I want to express my heartfelt gratitude to Prof C.T. Frey for his supervisory role and excellent support during the research.

My sincere gratitude to Dr M. Jingo and Dr B. Milner for their assistance during the research period.

I thank the CEO of Chris Hani Baragwanath Academic Hospital for the permission to conduct the study at the hospital.

Finally, I would like to thank Mr. M. Maluleke, the nursing staff and colleagues who helped me collect the data despite the difficulties brought by the Covid-19 pandemic.

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Nomenclature

AO/OTA	Association for Osteosynthesis/Orthopaedic Trauma Association
ASA	American Society of Anaesthesiologists
CHBAH	Chris Hani Baragwanath Academic Hospital
DASH	Disabilities of the Arm, Shoulder and Hand
DRF	Distal Radius Fracture
ORIF	Open Reduction Internal Fixation
PRWE	Patient-Rated Wrist Evaluation
VAS	Visual Analogue Scale
POP	Plaster of Paris
K-wire	Kirschner wire
FOOSH	Fall on outstretched hand
CEO	Chief Executive Officer

CHAPTER 1
INTRODUCTION AND LITERATURE REVIEW

1.1 Background

The distal radius fracture (DRF) is a common orthopaedic injury with a bimodal distribution: high energy in younger patients and low energy in older patients. The incidence is higher in the geriatric population due to osteoporosis and increased risk of falls (1, 2). This fracture is treated in different ways (surgical or non-surgical treatment), depending on the treating surgeon's decision and the fracture type. In the past two decades, the management of distal radius fractures has dramatically changed from conservative to surgical treatment. Many studies have been done on distal radius fractures, yet questions on standard treatment remain (2, 3).

1.2 Classification of distal radius fractures

Many classification systems have been described in the literature for distal radius fractures (1). The most used classification systems are:

- Fernandez classification: this classification aimed at providing a system that primarily focused on the mechanism of injury to accurately classify injuries in an attempt to standardize treatment, while also suggesting stability and associated lesions. It does not serve much in the understanding of the distal radius fracture (Figure 1.1)

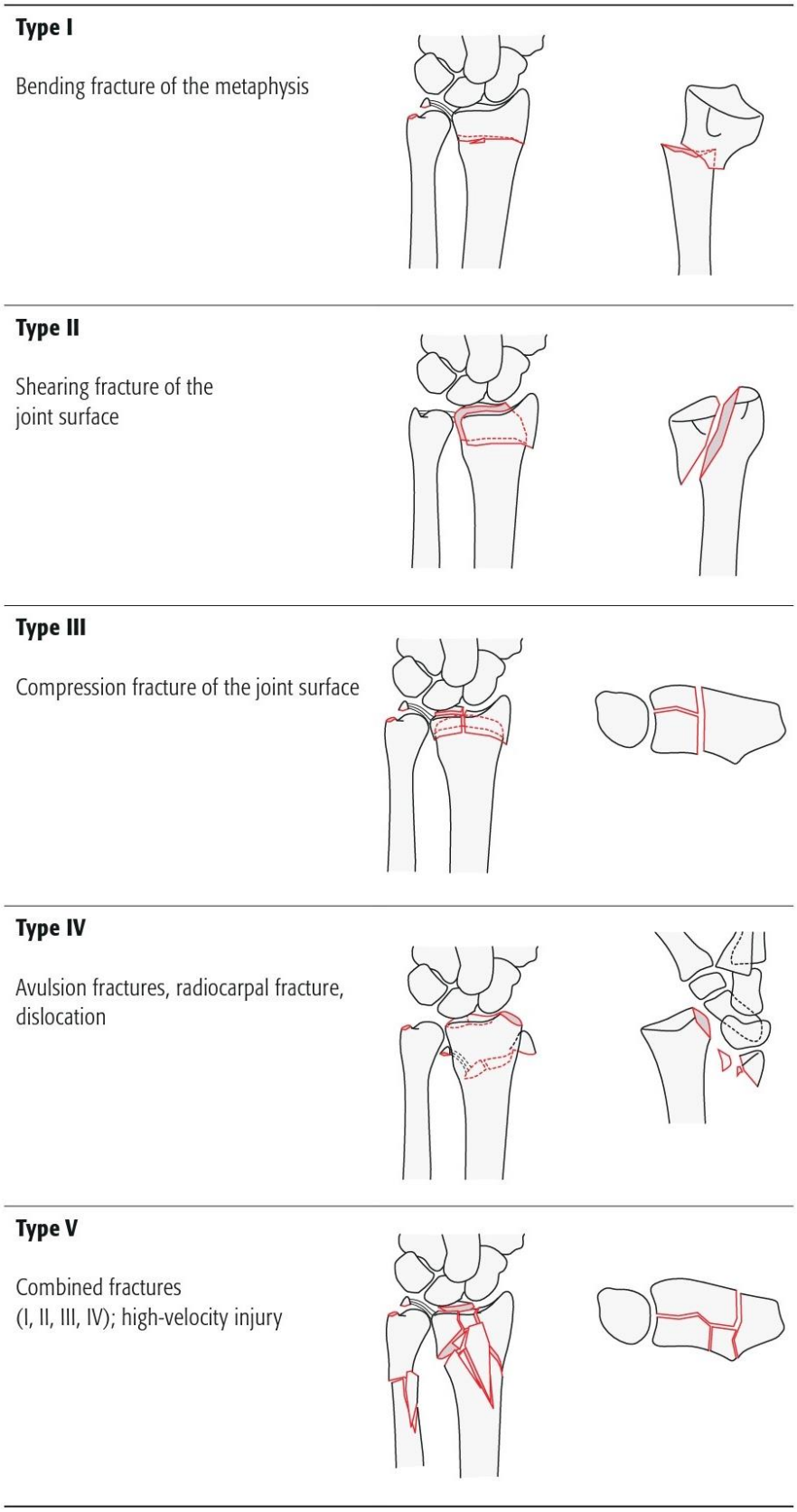
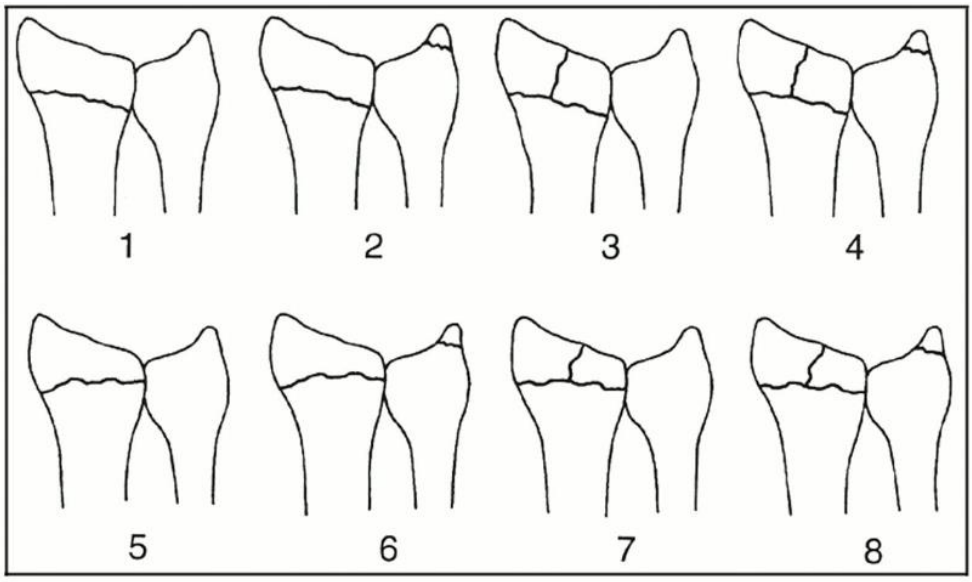


Figure 1.1: Fernandez classification (4)

- Frykman classification: it is based on the joint involvement (radiocarpal and/or radioulnar) with or without ulnar styloid fracture. This classification is mainly a description of the fracture pattern. It does not give the direct treatment of distal radius fractures (Figure 1.2).



Type	Fracture
I	Extra-articular radial fracture
II	Extra-articular radial fracture with an ulnar fracture
III	Intra-articular fracture of the radiocarpal joint without an ulnar fracture
IV	Intra-articular fracture of the radius with an ulnar fracture
V	Fracture of the radioulnar joint
VI	Fracture into the radioulnar joint with an ulnar fracture
VII	Intra-articular fracture involving radiocarpal and radioulnar joints
VIII	Intra-articular fracture involving radiocarpal and radioulnar joints with an ulnar fracture

Figure 1.2: Frykman classification (5)

- Melone classification: this is a classification of distal radial articular fractures. The medial fragments and their strong ligamentous attachments to the carpus and the ulnar styloid have been termed the medial complex. Displacements of this complex is the basis for classification of articular fractures into four types. This classification gives the displacement and orientation of articular fragments and the possible periarticular soft tissue injuries (nerve, tendon) which guides the treatment. It does not address the extraarticular fractures of the distal radius (Figure 1.3).

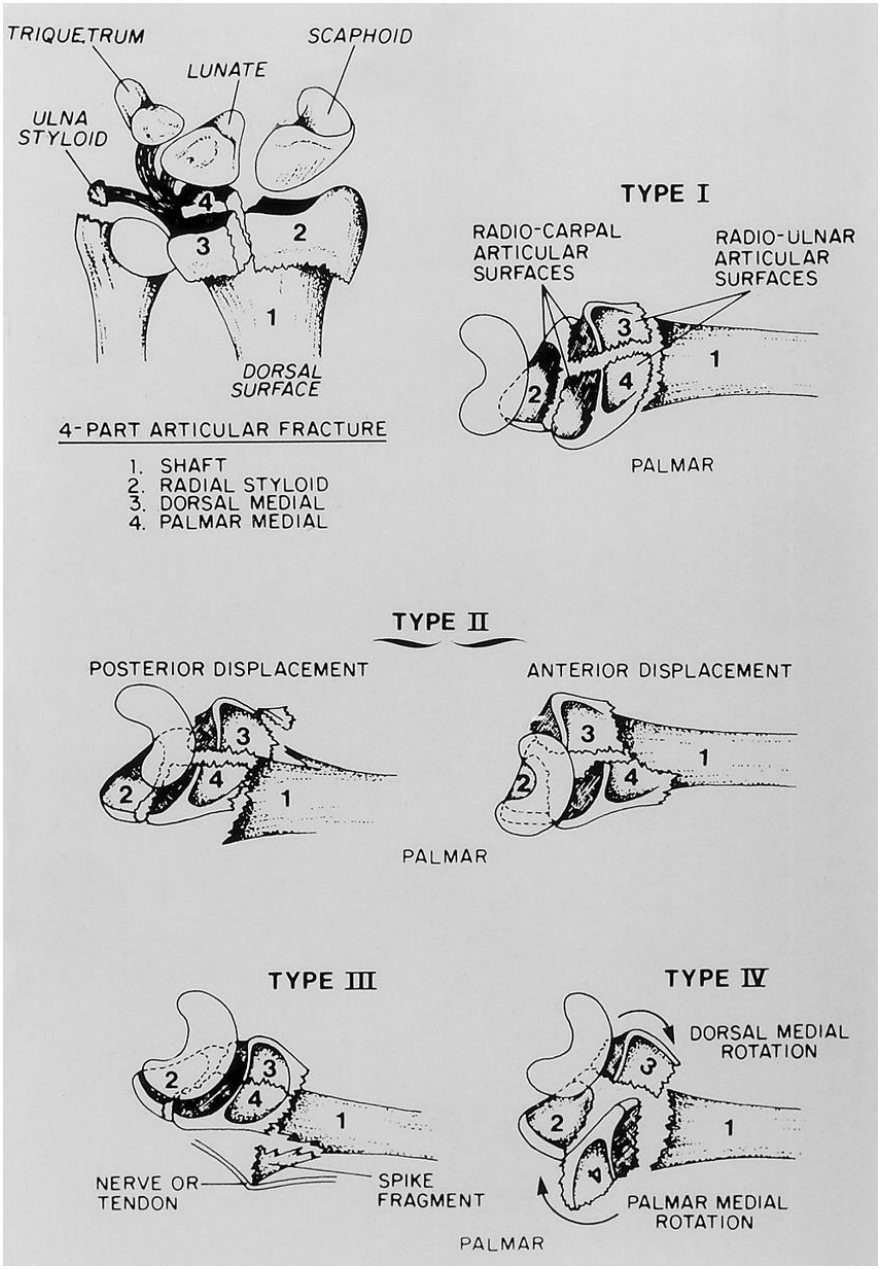


Figure 1.3: Melone classification (6)

- AO/OTA classification: it is more comprehensive, universal, and classify all fractures. It is commonly used for research. The AO/OTA classification includes both extra-articular and intraarticular fractures with a detailed sub-classification (Figure 1.4). In this study, the AO/OTA classification system will be used to make good comparisons with the other studies.

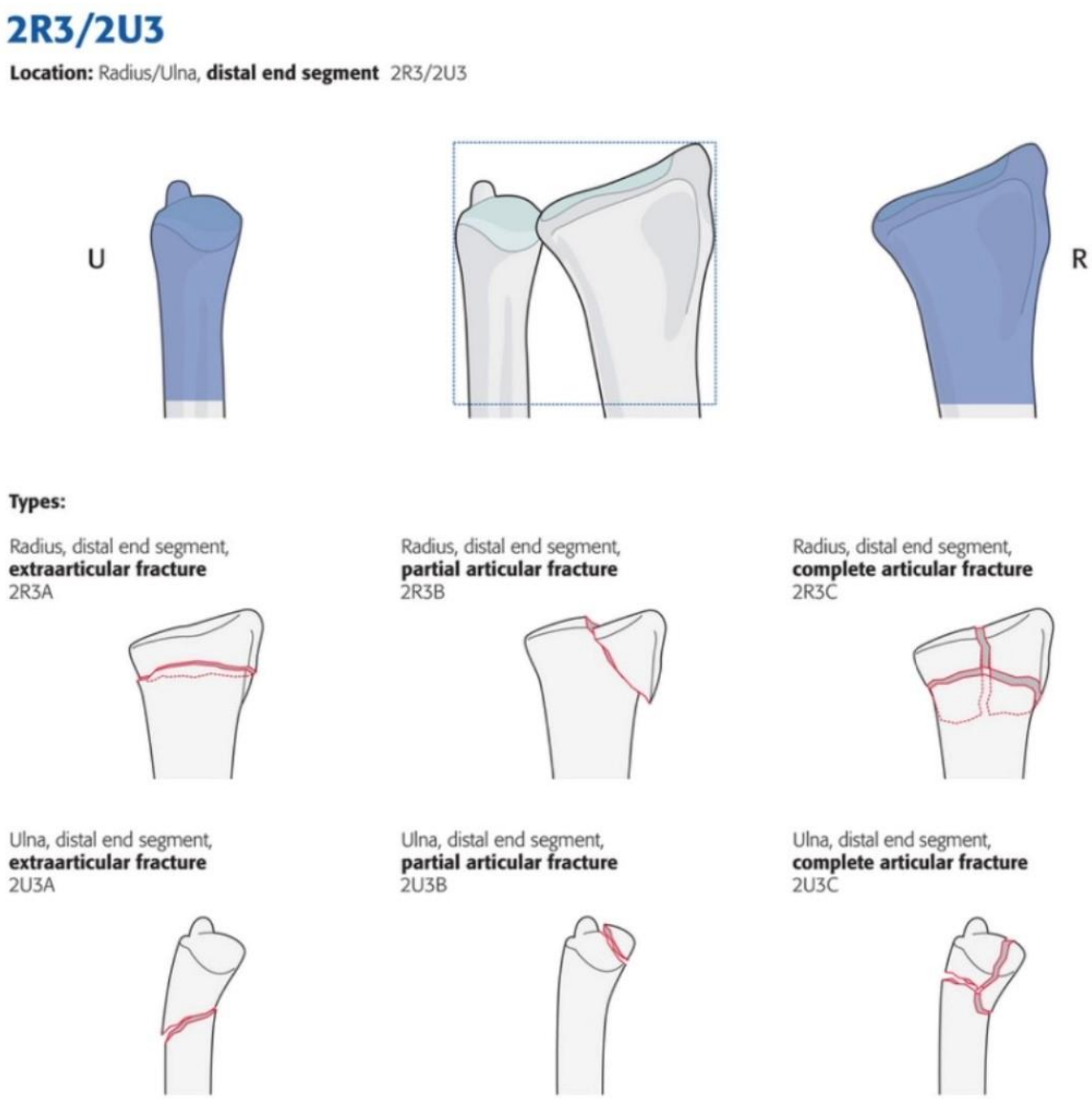


Figure 1.4: 2018 AO/OTA Distal Radius Fracture Classification (7)

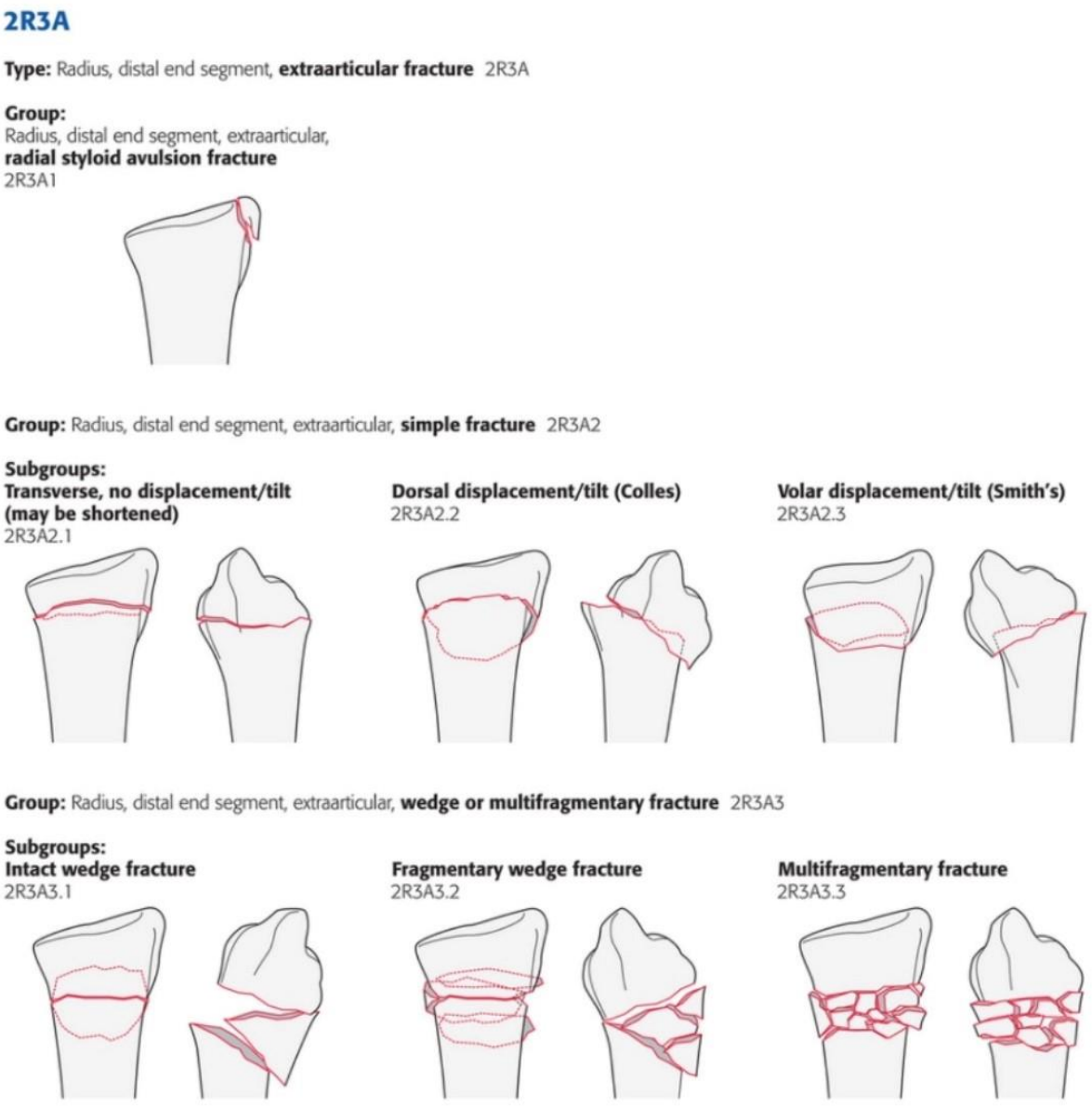


Figure 1.5: 2018 AO/OTA Distal Radius Fracture Classification – Type A (7)

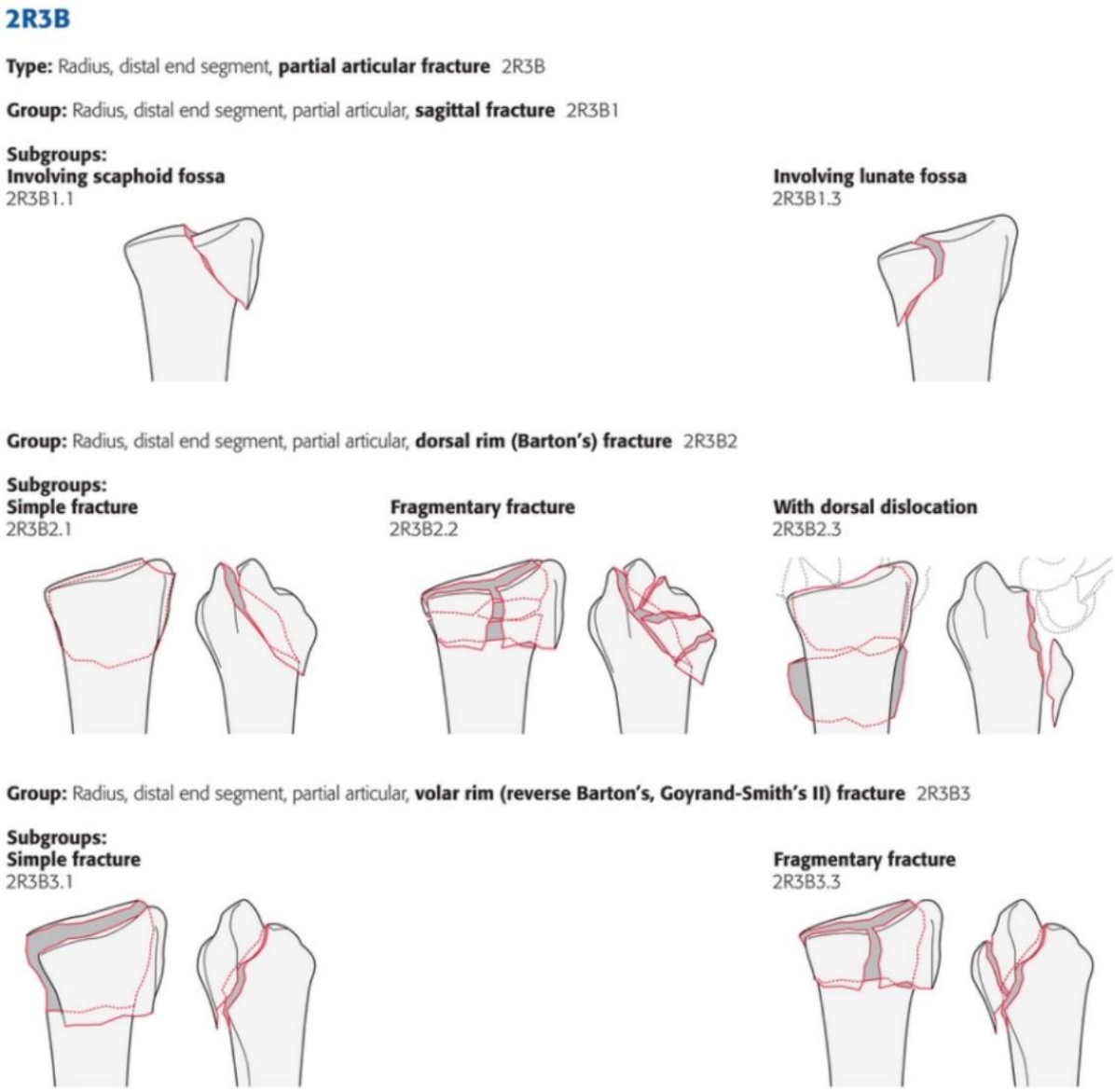


Figure 1.6: 2018 AO/OTA Distal Radius Fracture Classification – Type B (7)

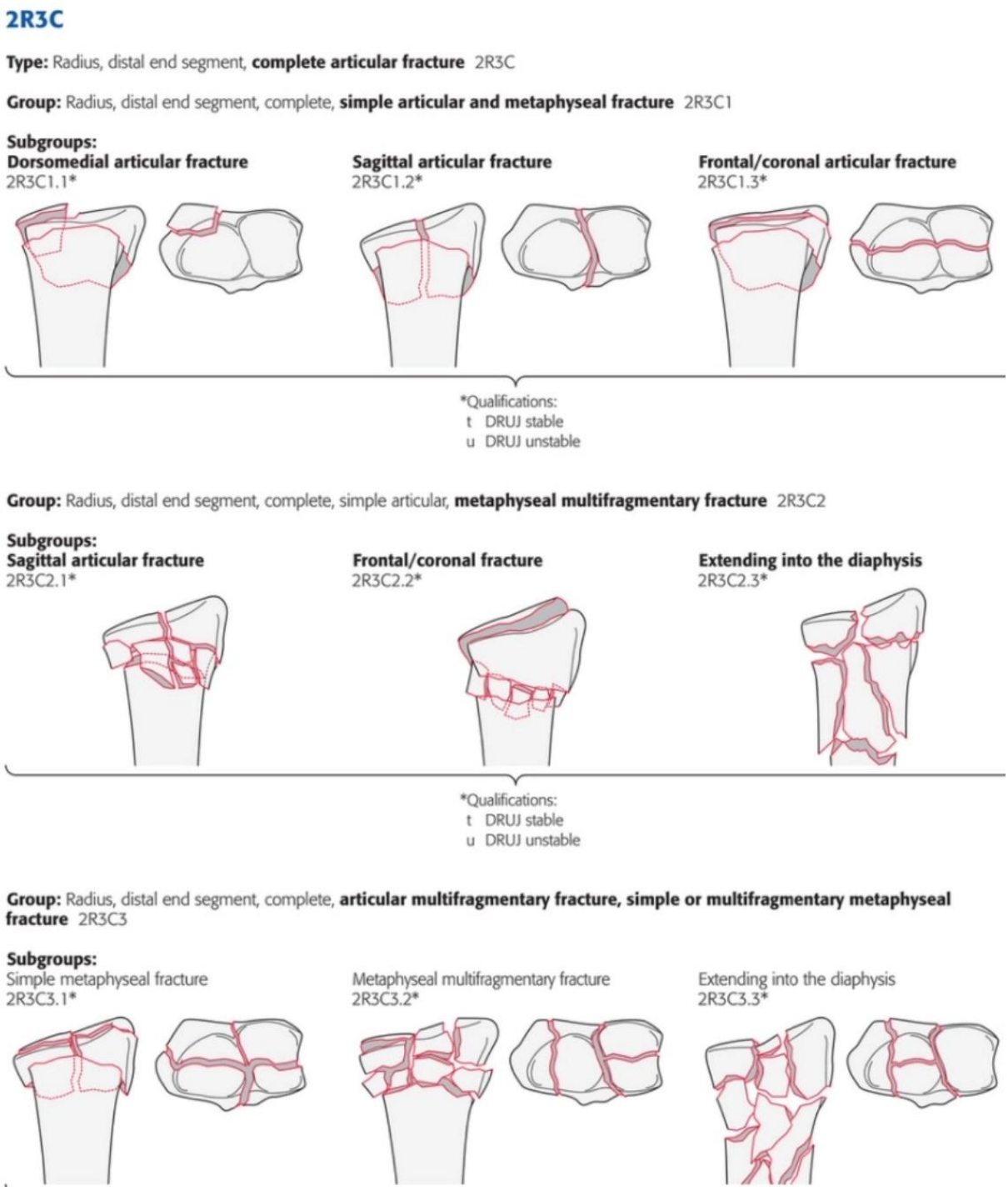


Figure 1.7: 2018 AO/OTA Distal Radius Fracture Classification – Type C (7)

1.3 Literature review

When reviewing the literature on distal radius fractures, a study by Landgren et al. (8) investigated the influence of surgical treatment on the subjective outcome in patients treated for a distal radius fracture (DRF). Over a 10-year-period, the study included 3 666 patients aged 18 to 98 years. Around 22% of patients were operated on using different surgical methods (mainly volar locking plate), and 78% were treated non-surgically (8). The Disabilities of the Arm, Shoulder and Hand **(**DASH) score was used to assess the outcome one year after the distal radius fracture (8). They found that despite the change in implants over time, there was no improvement in the median DASH score at one year after surgery, and the shift to surgical treatment did not influence the subjective outcome in the cohort (8). This study had a larger sample size (3 666 patients) than most of the other studies. Also, the follow-up was done over a long period (one year), reflecting the long-term outcome of DRF treatment. It is a good study with solid evidence.

In another study, Toon et al. (9) compared open reduction internal fixation (ORIF) with volar locking plates versus non-operative management of closed displaced intraarticular distal radius fractures. They found no difference in the DASH and MAYO wrist scores between the ORIF and the non-operative groups (9). The ranges of motion of the injured wrists were not significantly different; also no significant differences were noted in grip strength and Visual Analogue scale (VAS) for pain (9). At 12 months follow-up, this study showed no difference in overall functional outcomes for distal radius fractures treated either with plaster cast immobilisation or with ORIF (volar locking plates), independent of radiographic outcome (9). It is well known that intra-articular DRF is an indication for surgery (1). In this study, intra-articular fractures were treated non-surgically and the results show a comparative functional outcome between the two groups (surgical and non-surgical) (9). It should be noted that the study sample size was small (60 patients).

Raudasoja et al. (10) investigated the importance of radiological results in 60 patients (a total of 63 wrists) operated on for a DRF. The patients were examined radiologically and clinically. All the participants completed Patient-Rated Wrist Evaluation (PRWE) and Quick DASH questionnaires. The investigators reported a significant correlation between radial shortening and PRWE and the Quick DASH scores. Step-off on the radius articular surface showed no difference in the Quick DASH evaluation (10). Furthermore, dorsal and volar tilt showed no statistical correlation with clinical outcomes, nor did patient's age (below or above 60 years)

affect the PRWE or the Quick DASH results (10). The study concluded that a good reduction of the fracture (radial height restoration and congruence of the articular surface) was associated with a good functional outcome (10). Although the study only looked at surgical treatment, with no comparison with non-operative treatment of patients with DRF, the authors showed that restoration of radial height and congruence of the articular surface have a better outcome (10). This is contrary to the opinion of many authors as cited by Toon et al. (9), who found no significant correlation between the functional outcome and the radiological outcome.

Larouche et al. (11) investigated the functional outcomes of DRF treatment in 129 non-frail patients older than 55 years (age range 55 to 90 years) subdivided into two groups: an operative group comprising 55% of patients and a non-operative group (closed reduction and cast immobilisation) having the remainder of patients. Patients were assessed both clinically and radiologically and a questionnaire was used to assess functionality. There was no difference in patient-reported outcomes at one-year follow-up between the ORIF group and the closed reduction group (11). Attention to radial shortening and gaps in the articular surface should be made as they are associated with worse patient-reported outcomes (11). These results are comparable with the findings reported by Raudasoja et al. (10). Larouche et al. (11) and Raudasoja et al. (10) believe that restoration of radial height and congruence of the articular surface has a better functional outcome. It should be noted that younger patients were excluded from this study. Regardless, this is an excellent comparative study with a good sample size.

Hohmann et al. (12) studied the relationship between the radiological alignment of united DRF and functional outcomes in elderly patients. In this retrospective study, 118 patients were included. DASH and PRWE scores were used as outcome measures. Radiographic measures were done on standard radiographs. They suggested that minor deformities of the distal radius (in respect to radial height and inclination, ulnar variance) following either surgical or non-surgical treatment may be clinically irrelevant and may not impact patient-perceived outcomes. This led them to conclude that significant deformities of the distal radius will negatively affect patient-related outcome measures (12). As highlighted by Raudasoja et al. (10) and Larouche et al. (11), the investigators recommend restoration of the distal radius radiographic parameters (mainly the radial height) to achieve a better functional outcome.

In a review article on the DRF in the elderly, Levin et al. (13) found no consensus regarding the treatment despite the increased number of osteoporosis-related fractures. The treatment

goals are to provide good function and a pain-free limb. Although operative treatment improves alignment, the radiographic outcome does not correlate with better clinical outcomes. This is strong evidence given the number of studies (48 studies) summarised, eight being level I or level II studies.

Heidgerd et al. (14) evaluated the functional outcome in adult patients after DRF. They assessed 60 patients treated 12 months before the study (30 treated surgically and 30 non-surgically). The patients' ages ranged between 18 and 64 years. Objective and subjective means were used to assess the outcome. They found that the range of motion at the final examination was better in the surgical group compared to the non-surgical group though the pain level at the final analysis, related to treatment, was varied, and no statistical significance was noted (14). The particularity of this study is that it included younger patients compared to previous studies. Unfortunately, there is no specification on the assessment period after the DRF to indicate if these are short-term or long-term results. The better range of motion in the surgical group seems to make no difference in the results, with the overall functional outcome being comparable between the two groups (14).

A study by Plant et al. (15) investigated the correlation between radiological outcomes and the patient-reported functional outcomes, physical measures of function and health-related quality of life in patients with a DRF. It included 50 patients between 26 and 85 years, treated surgically with percutaneous pinning or a volar plate. Post-operatively, the palmar tilt and ulnar variance were measured and were correlated to the measures above at three, six and twelve months. The results showed that radiological parameters had a poor correlation with the patient-reported outcomes and the physical measures of function (grip and pinch strengths, and range of motion) at all intervals (15). This study gives short-term and long-term results; it shows no difference between the two in terms of the influence of radiological outcomes over the functional (objective and subjective) outputs (15). Questions arise from the use of radiological parameters to determine the success of the treatment because restoration of normal radiological parameters in the distal radius may not be associated with a satisfactory functional outcome.

Xavier et al. (16) assessed the correlation between the clinical and radiographic results with DRF that were surgically treated with a volar locking plate. They evaluated 64 patients, with a minimum follow-up of six months postoperatively. The assessment included the range of

motion, grip strength, the DASH score and radiographic examination. They reported little correlation between the clinical results (objective and subjective) and the radiographic outcomes of DRF treated surgically (volar locking plate) (16). Radial shortening was the only radiographic parameter to change the patients' objective clinical results while subjective results (DASH scores) were affected by age, extension range of motion and grip strength, and had no correlation with radiographic outcomes (16). This study evaluated only the surgical treatment of DRF without comparison to the non-surgical treatment to see if there is any difference in the functional outcome between patients explicitly treated with a volar locking plate and those treated non-surgically.

A systematic review and meta-analysis by Ju et al. (17) compared the treatment outcomes between the surgical and non-surgical treatment of DRF in the elderly. A total of eight studies were included, with 440 patients in the surgical groups and 449 in the control groups. The DASH score was the primary outcome measure, whereas the functional and radiological assessments were secondary. The authors concluded that both treatment methods of DRF in the elderly produce similar results based on their findings (17). This is a combined result of many studies from reliable sources that shows a similarity of results in all of them and is comparable with most of the studies discussed earlier.

In a systematic review by Diaz-Garcia et al. (18), the authors analysed the complications and outcomes of treating unstable DRF in the elderly. They reviewed 2 039 papers from Medline, Embase, and Cinahl Plus, a broad primary literature search. From these studies, 21 were chosen, of which eight were randomised controlled trials, three were prospective cohort studies, and ten were retrospective case series. The patient mean age was 60 years and older. In a secondary literature search that was more specific, the researchers identified 504 papers and only eight of these were included in the secondary review. Of these articles, three were level I randomised controlled trials, one was a level II prospective cohort study, and four were case series. Five standard techniques were used to manage DRF: volar locking plate system, non-bridging external fixator, bridging external fixator, percutaneous Kirschner-wire fixation and cast immobilisation. The authors reported statistically significant differences for wrist range of motion, grip strength and DASH scores, but this may be clinically irrelevant. There were also substantial differences in the volar tilt and ulnar variance amongst the various management groups, with worse radiographic outcomes in the cast immobilisation group. Significant differences were detected in the complication rates, with cast immobilisation having the lowest

rate. Volar locking plate fixation had significant major complications (nerve injuries, complex regional pain syndrome, flexor pollicis longus injury, carpal tunnel syndrome), requiring additional surgical intervention (18). This shows that operative treatment should have a good indication as it can bear many complications. Non-operative management appears to be a safer option for the patient compared to operative treatment.

In the same line of thought, Thorninger et al. (19) investigated the complications of volar locking plating of DRF. This retrospective study comprises 576 patients treated between 2009 and 2013, with a 3.2-year follow-up. The median patient age was 63 years (15 to 87 years). The overall complication rate was 14.6%. Complications included: carpal tunnel syndrome or change in sensibility, nerve injuries, and tendon injuries. There was no significant association between the complication rate and surgeon experience. The reoperation rate was 10.4% (19). This complication rate of 14.6% is substantial. It implies that surgeons should be cautious when treating DRF surgically, considering all the parameters affecting the outcome.

Mulders et al. (20) investigated the non-operative treatment of displaced DRF. Their study evaluated the functional outcomes, measured with the DASH questionnaire, in patients with displaced DRF treated non-operatively with an adequate closed reduction confirmed on radiograph. A total of 116 patients were included in the study. The median age was 62 years. DASH scores were prospectively collected at three, six and twelve months. They found that non-operative treatment of displaced DRF after adequate closed reduction confirmed on radiograph had acceptable functional outcomes after 12 months, however at the expense of 40% subsequent surgeries, with younger patients being more likely to undergo subsequent surgery than older patients (20). This leads us to suggest that non-operative treatment is an acceptable mode of treatment in older patients with displaced DRF. Although the literature has proposed the predictors for loss of reduction, it is still not easy to predict which fracture is going to secondarily displace. Therefore, some studies have suggested that displaced DRF are treated primarily operatively to avoid subsequent surgery, particularly in younger patients.

Zhang et al. (21) studied the effects of surgical and non-operative treatment on wrist function in patients with DRF. The study included 97 patients, aged between 18 and 84 years, with a follow-up of more than 12 months. Evaluation was based on Sartiento's modification of the Gartland and Werley score. Efficacy was assessed with wrist pain as the focus. Their results show better wrist function scores in the surgical group than in the non-operative group. The

ulnar wrist pain incidence had no significant difference between the two groups (surgical versus non-surgical) (21). This is one of the few studies that have shown a better overall effect of surgical treatment of DRF in comparison to non-operative treatment although it has found no significant difference in terms of ulnar wrist pain incidence. The evidence is not strong enough as this was a retrospective study, and the sample size might be too small to demonstrate the difference between the two treatment modalities.

A systematic review and meta-analysis by Li et al. (22) assessed the role of non-operative treatment and volar locking plate fixation in the elderly patients with DRF. This analysis included 11 studies with moderate quality and patients aged 50 years and older. The results have shown that the volar locking plate did not improve the DASH score, decrease complications, or improve range of motion. The volar locking plate group had better grip strength and radiographic outcome than the non-operative group (22). It should be noted that this study included younger patients (less than 65 years) and has found similar results in younger and older patients in terms of the functional outcome. The only weakness might be the small number of studies included in the systematic review and meta-analysis and the insufficient evidence.

A systematic review and meta-analysis by Ochen et al. (23) compared operative treatment to non-operative treatment of DRF in adults. It included randomised control trials and observational studies. This combination increases the value of the study as compared to meta-analyses of randomised control trials alone. A total of 23 studies were included, 8 being randomised control trials and 15 observational studies. The overall results showed a significant improvement in the medium-term (less or equal to 1 year) DASH score after operative treatment compared with non-operative treatment. No difference in complication rate was observed. A significant increase in grip strength was noted after operative treatment. No improvement in the medium-term DASH score was found in the sub-group that only included patients aged 60 years or older, compared with a larger improvement in studies that included patients aged 18 years or older (23). This suggests that operative treatment is more effective and has a better outcome in younger patients than in the elderly, in the medium-term. Unfortunately, they did not have a long-term follow-up of the patients (more than 1 year) to determine what the outcome would be. As we know, many studies have reported the long-term outcome to be comparable between operative and non-operative treatments, particularly in the elderly patients.

DeGeorge et al. (24) conducted a retrospective study on the outcomes and complications of operative versus non-operative treatment of DRF in patients aged from 18 to 64 years. The study had a large sample size with more than 34,184 DRF and a 6-year follow-up period. Operative treatment of DRF was shown to have significantly lowered fracture malunion rates and secondary procedures. However, the complication rates, specifically stiffness, were increased. On the other end, non-operative treatment had lower complication rates but with an increased incidence of secondary procedures (24). We have noticed that this study is one of the most extended follow-ups reported in the literature, with a sample size large enough to determine the missed details with small sample sizes thus increasing the strength of the study. In spite of this, the problem is that large administrative databases are subject to errors associated with inaccurate documentation. Of note is that the authors did not report the functional outcomes of operative versus non-operative treatment of DRF, which could have been of significant benefit in the current study's analysis, when comparing the similarities between the two studies (e.g., inclusion of younger patients).

Zhang et al. (25) conducted a meta-analysis comparing volar plate fixation to non-operative treatment of DRF in older patients (60 years of age and older). A total of five randomised control trials were included. The primary outcome of interest was the DASH score, and secondary outcomes were grip strength, pain scores, range of motion and complication rates. The follow-up period was at least 12 months. Zhang et al. found reduced DASH scores and improved grip strength in subjects receiving open reduction and internal fixation with volar plating. There were no significant differences in the wrist joint range of motion, pain scores and rates of complications between the operative and the non-operative treatments in older patients (60 years of age or older) (25). These findings are contrary to the results obtained from many studies described in the previous paragraphs, where the authors found no difference in the DASH scores between the two treatments modalities. Some weaknesses in this meta-analysis are noted. Firstly, the overall quality of studies included in this meta-analysis was moderate, thus affecting the strength of the evidence and secondly, the study sample size was too small to provide strong evidence.

Alharbi et al. (26) investigated the efficacy and safety of operative versus non-operative management of adult patients with DRF in a systematic review and meta-analysis. Seven studies were included with a total of 14 279 patients (4 025 patients in the operative group and 10 254 patients in the non-operative group). The outcome measures were the DASH scores and

the rates of complications. The included studies were three randomised control trials, three retrospective cohort studies and one prospective cohort study. The average follow-up period was 12 months. The mean age of patients was 67 years. The authors found that operative management of DRF helps to improve the medium-term DASH scores as compared to non-operative treatments in adults, with no difference in overall complication rates (26). These findings are comparable to those reported by Zhang et al. (25). Again, the only issue is the small number of included studies however, the sample size was large enough.

Other investigators are currently comparing closed reduction and casting versus open reduction internal fixation. Ian et al. (2) are presently conducting a combined randomised and observational study. The aim of the trial is: "To determine whether plating leads to better pain relief and better function and is more cost-effective than closed reduction and casting of displaced distal radius fractures in adults aged 60 years and older". The results are yet to be published. In addition, a similar study is being conducted by Mulders et al. (3).

In conclusion, Landgren et al. (8), in a study including 3 666 patients aged 18 to 98 years, found that despite the change in implants over time, there was no improvement in the median DASH score one year after surgery. The shift to the surgical treatment did not influence the subjective outcome in the cohort. On the other hand, Ochen et al. (23) had different findings. In a systematic review and meta-analysis including 23 studies (2254 patients), they reported that their overall results showed a significant improvement in medium-term (less or equal to 1 year) DASH score after operative treatment in comparison to non-operative treatment. There was a substantial improvement in studies that included patients aged 18 years or older, but no improvement in the medium-term DASH score was found in the subgroup that only included patients aged 60 years or older.

At Chris Hani Baragwanath Academic Hospital (CHBAH), most intra-articular DRFs are treated surgically. Looking at our own clinical experience, we are of the opinion that some of these fractures can be treated non-operatively, however it should be mentioned that the indication for either treatment should be noted from the beginning. Based on the findings reported in the literature, it would be of interest to know which patients would benefit from surgery for the treatment of distal radius fractures in our population.

1.4 Study Aim and Objectives

The aim of the study was to assess the patient-reported functional outcome measures after a distal radius fracture at CHBAH from 07 November 2019 to 07 November 2021.

The objectives of this study were to:

1. Identify patients with a distal radius fracture, coming for the routine follow-up to the outpatient department
2. Assess patient-reported outcome measures using the Quick DASH and VAS scores three to six months post-treatment (by filling in a questionnaire)
3. Determine the correlation between the Quick DASH and VAS scores and the type of treatment used (outcome for surgical treatment versus non-surgical treatment)

CHAPTER 2
METHODOLOGY

2.1 Research Question

Is there any correlation between the different methods of treatment (surgical versus non-surgical) and the patient-reported outcomes in patients with a distal radius fracture in a South African population treated at CHBAH?

2.2 Research Design

A retrospective cohort study with a prospective recall of patients treated for a distal radius fracture (surgically or non-surgically) was carried out.

Study Population

The study included all patients who met the inclusion criteria and were treated for a distal radius fracture at CHBAH. Patients included in the study were between three- and six months post-treatment. The calculated study sample size using the sample size calculator from ClinCalc.com was 150 patients (75 treated surgically and 75 treated non-surgically).

Study Site

CHBAH data indicate that 51 330 patients were treated at the orthopaedic trauma outpatient department between 2013 and 2017 (an average of 10 266 trauma patients a year). In 2017 alone, approximately 160 distal radius fractures were treated surgically. The number of patients treated non-surgically is higher based on the orthopaedic emergency department's monthly statistics, but there are no recorded yearly statistics.

2.3 Materials and Methods

Patients were invited to participate in the study as they came for routine follow-up to the upper limb orthopaedic outpatient department clinic. The only prerequisite was that they had a distal radius fracture in the past that was now healed. Healing was defined as a minimum of 3 months after fracture. The average time was 3.5 months (Range: 3 months to 5.5 months). Two vetted tools were used in this study to collect data on patient’s experience of pain and function after operative or non-operative management of a distal radius fracture namely the Quick DASH and the VAS scores.

2.3.1 Quick DASH

The Quick DASH is a shortened version of the 30-item DASH which is a self-reported questionnaire that looks at the ability of respondents to perform certain activities with their upper extremities. It uses a five-point Likert scale that correlates with a function level and severity. The score ranges from 0 (no disability) to 100 (very severe disability) (27-30). The Quick DASH is a vetted questionnaire translated into 27 languages. It has a reliability score of 0.96 and validity of 0.70 (27-30). A translator was used in our study as we used a questionnaire in English.

2.3.2 Visual Analogue Scale

The VAS measures a characteristic in this study that ranges across a continuum of values used in clinical and epidemiological research. Pain VAS is unidimensional and most accurate when patients are in pain at the time of investigation or within 24 hours when pain intervenes. The VAS is very easy to administer and acceptable to patients. The VAS has reliability in literate and illiterate of 0.94 and 0.71, respectively. Its validity cannot be evaluated due to the absence of a gold standard.

2.4 Selection Criteria

Inclusion criteria:

- Patients 18 years of age and older
- Patients with a healed isolated distal radius fracture
- Surgically treated patients or non-surgically treated patients

Exclusion criteria:

- Patients with previous injuries to the same limb
- Patients with associated injuries that might have an impact on the distal radius fracture

2.5 Data Collection

Patients were assessed at their three to six-month follow-up visit at the CHBAH orthopaedics outpatient department. Once informed consent was obtained (see Appendix A), a questionnaire (Quick DASH score) was given to the patient to assess the functional outcome (see Appendix B). The Quick DASH Score is a validated and standardised disability of the arm, shoulder and hand score (27-30).

The VAS score was used to determine the level of pain at the fracture site (see Appendix C). A data collection sheet was used to record the patient assessment and the questionnaire (see Appendix D).

2.6 Data Analysis

Categorical variables were described and presented using frequencies and percentage tables. Numerical variables were summarised using mean and standard deviations or median and interquartile ranges, as appropriate, depending on the distribution of the values. The statistical tests used are shown in the next chapter. A *p*-value of less than 0.05 was regarded as statistically significant. STATA (version 14) statistical software was used for this purpose.

CHAPTER 3

RESULTS

A total of 152 patients consented to participate in the study after being treated for a distal radius fracture at CHBAH. Of the 152 participants, 52.8% were female and 47.2% were male. Two-third of participants were older than 40 years. Patients with AOT 2R3 A, B and C fracture types were included in the study groups. A total 70 AO/OTA 2R3 A, 26 AO/OTA 2R3 B and 56 AO/OTA 2R3 C fracture types were included. Of all the distal radius fractures, 59.2% were sustained on the left side. Half of the patients had surgical treatment. Surgical treatment was indicated in 50.7% of the patients. A detailed breakdown of the pattern of the DRF in this study is shown in Table 3.1.

Table 3.1: Socio-demographic and clinical characteristics

Variable	Frequency	
	N	**%**
Gender		
Female	82	53.0
Male	70	46.1
Age (Mean = 46.9, SD = 14.5)		
Type of fracture		
Type A 	71	50.7
Type B 	13	9.3
Type C 	56	40.0
Mechanism of injury		
Assault	4	2.6
Fall	138	90.8
Motorbike accident	1	0.7
Motor vehicle accident	9	5.9
Side of injury		
Left	90	59.2
Right	62	40.8
Handedness		
Left	12	7.9
Right	140	92.1
Treatment type		
Non-surgical	75	49.3
Surgical	77	50.7

Figure 3.1 below represents the distribution of patients according to age. A unimodal distribution is observed in the study with the highest prevalence of DRF occurring between the ages 50 and 59 years. The majority of the patients (65%) were above the age of 40 and very few patients were below 20 years of age.

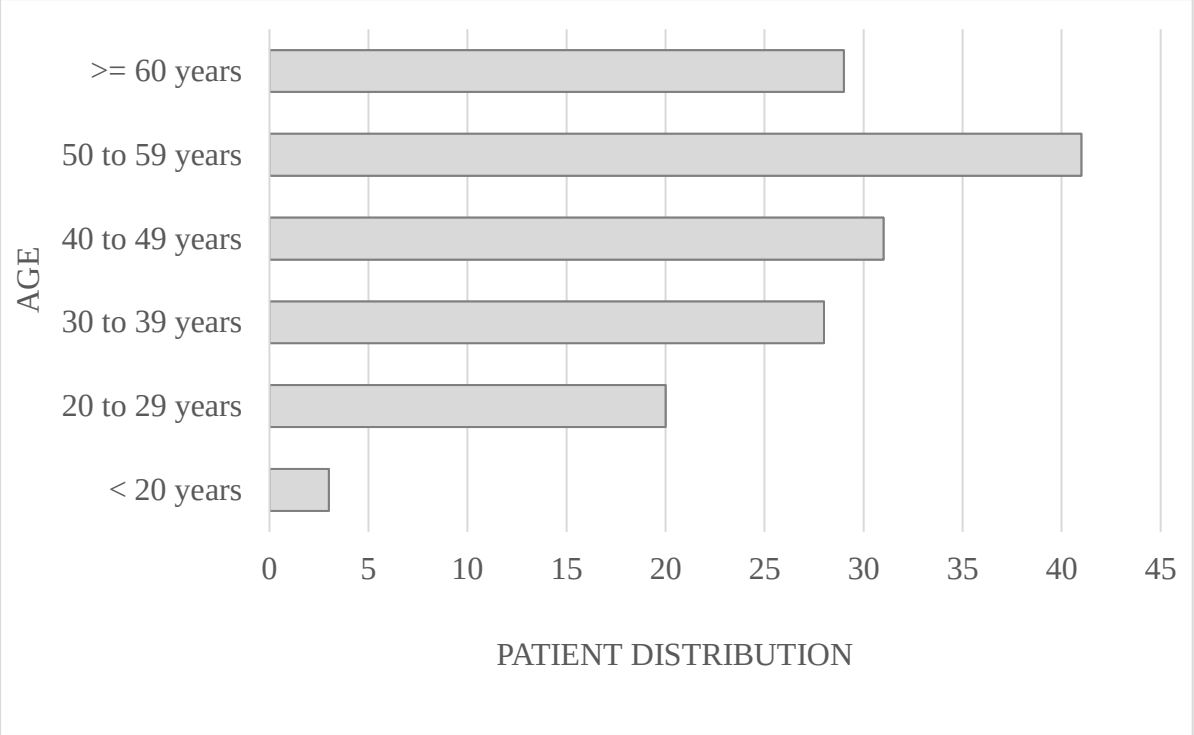


Figure 3.1: Distribution of DRF according to age

The number of patients treated surgically is substantial in both younger adult and older adult patients. This is illustrated in Figure 3.2 below.

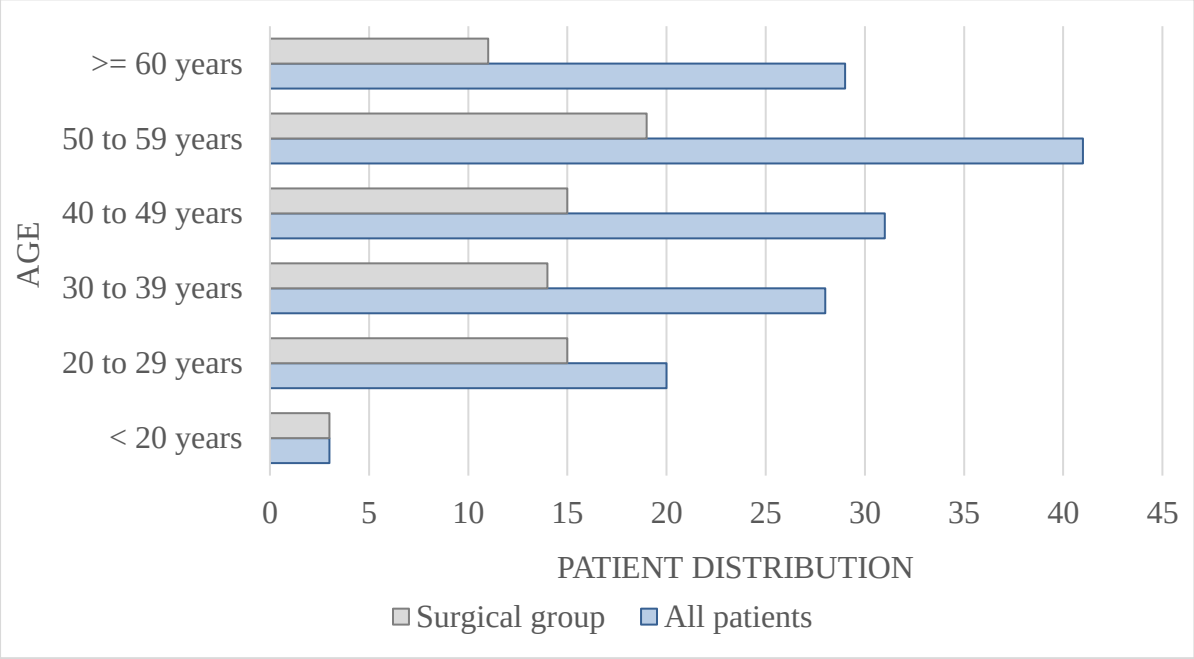


Figure 3.2: Proportion of DRF treated surgically.

The AO/OTA type A fracture was observed in 62% of the patients treated with a Plaster of Paris alone (POP), whereas most AO/OTA type C fractures were treated with an ORIF. A small proportion of distal radius fractures (mainly AO/OTA type C) received an external fixation and Kirschner-wire (K-wire), as shown in Table 3.2.

Table 3.2: Distribution of patients who had a distal radius fracture stratified by type of treatment

Type of fracture	**Treatment type**			
	Surgical			**Non-Surgical**
	External fixation n (%)	K-wire + POP n (%)	ORIF ± POP n (%)	POP (Only) n (%)
Type A	0 (0.0)	5 (7.0)	22 (31.0)	44 (62.0)
Type B	0 (0.0)	0 (0.0)	7 (53.9)	6 (46.1)
Type C	4 (7.1)	4 (7.1)	29 (51.8)	19 (33.9)

AO/OTA type A fractures were generally treated non-surgically compared to AO/OTA type C fractures that required surgical intervention. This is illustrated in Table 3.3 below.

Table 3.3: Distribution of patients who had a distal radius fracture stratified by type of treatment

Type of injury	**Treatment type**	
	Non-surgical n (%)	Surgical n (%)
Type A	44 (62.0)	27 (38.0)
Type B	6 (46.2)	7 (53.8)
Type C	19 (33.9)	37 (66.1)

There are five VAS indicators and four different types of treatment, of which the highest treatment is POP with 51 (68%) and the lowest in the treatment with 0%, as shown in Table 3.4. Most patients had a VAS score in the interval of 40 to 59 and only a few patients had a VAS score of more than 59, as represented in Table 3.4.

Table 3.4: Distribution of patients' VAS stratified by treatment type

VAS	**Treatment type**			
	Surgical			**Non-surgical**
	External fixation n (%)	K-wire n (%)	ORIF n (%)	POP (Only) n (%)
0 - 19	0 (0.0)	1 (11.1)	10 (15.6)	3 (4.0)
20 - 39	1 (25.0)	5 (55.6)	40 (62.5)	51 (68.0)
40 - 59	3 (75.0)	2 (22.2)	13 (20.3)	18 (24.0)
60 - 79	0 (0.0)	0 (0.0)	1 (1.6)	3 (4.0)
80 - 100	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)

Table 3.5 below illustrates the Quick DASH scores of the 152 patients. The majority of patients had results between 0 and 35 on the Quick DASH. Poor results were recorded in 19% of patients (more than 35).

Table 3.5: Distribution of patients' Quick DASH score

Score (Interpretation)	N (%)
0 - 5 (Very Good)	52 (34)
6 - 15 (Good)	14 (9)
16-35 (Satisfactory)	58 (38)
>35 (Poor)	28 (19)

Figure 3.3 below is a graphic representation of the proportion of Quick DASH scores, showing that the majority of patients (38%) had a satisfactory result (score = 16 to 35) and 19% of patients had a poor result (score > 35).

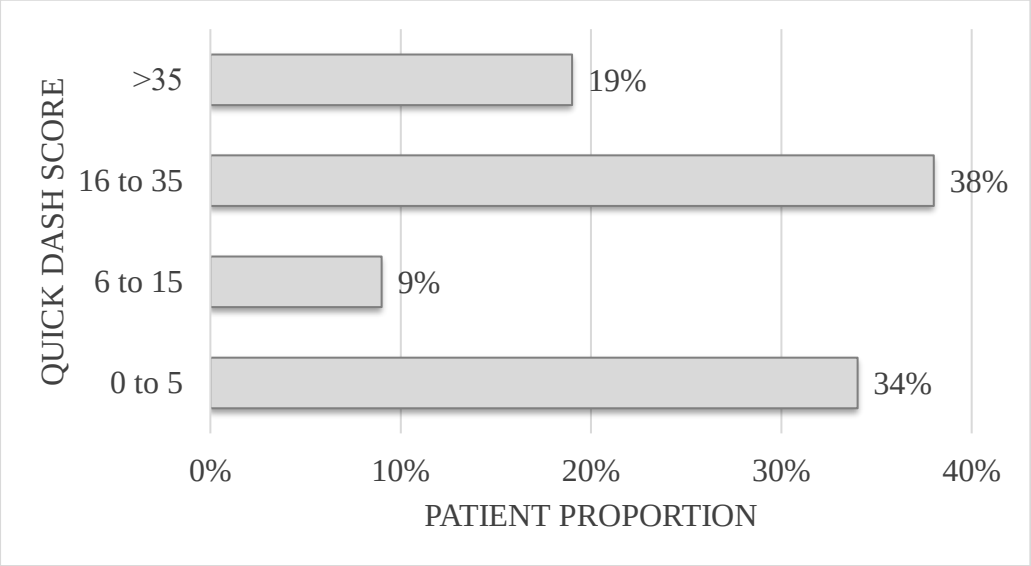


Figure 3.3: Proportions of categorised Quick DASH scores

The majority of patients in both the surgical (62%) and non-surgical (68%) groups had a VAS score between 10 and 20 (mild pain). Four per cent (4%) and fourteen per cent (14%) in the non-surgical and surgical groups, respectively reported no pain at all (VAS = 0). When comparing the different age groups, there was no significant decrease in the mean VAS with the surgical treatment compared to non-surgical treatment in all age groups. This is illustrated in Table 3.6 and Table 3.7.

Table 3.6: Test of association between VAS and type of treatment for Type B and C fractures combined (t-test)

Age group	**Treatment type**				***p*-value**
	Surgical		**Non-surgical**		
	Mean VAS (Range)	SD	Mean VAS (Range)	SD	
>= 60	22.9 (20-40)	7	27.5 (20-60)	14	0.2272
50 - 59	23.4 (0-40)	11.1	25 (20-40)	8.7	0.3490
40 - 49	23.4 (0-40)	11.1	30 (20-40)	10	0.1286
30 - 39	15 (0-40)	13.3	25 (20-40)	8.7	0.0975
20 - 29	20 (0-40)	12.7	80 (60-100)	20	0.1045
< 20	-	-	-	-	-

Table 3.7: Test of association between VAS and type of treatment for Type C fractures only (t-test)

Age group	**Treatment type**				***p*-value**
	Surgical		**Non-surgical**		
	Mean VAS (Range)	SD	Mean VAS (Range)	SD	
>= 60	20 (20-20)	0	30 (20-40)	10	0.2500
50 - 59	24.5 (20-40)	8.4	26.7 (20-40)	9.5	0.3120
40 - 49	24.5 (20-40)	8.4	40 (40-40)	0	0.0004
30 - 39	12.5 (0-20)	9.7	30 (20-40)	10	0.1740
20 - 29	20 (0-40)	13.4	80 (60-100)	20	0.1051
< 20	-	-	-	-	-

The association between DASH and the type of treatment was analysed using the t-test as shown in Table 3.8 and Table 3.9. It was fond that surgical treatment did not improve the DASH scores of patients aged 50 years and older, but there was a significant decrease in the mean DASH score in the operative group compared to non-operative group for patients below 50 years of age. The *p*-value was statistically significant for patients under the age of 50 but there was no significant difference in the older patients (50 years old and above). This is illustrated in Table 3.8, Table 3.9, and Table 3.10 below.

Table 3.8: Test of association between Quick DASH and type of treatment for Type B and C fractures combined (t-test)

Age group	**Treatment type**				***p*-value**
	Surgical		**Non-surgical**		
	Mean DASH (Range)	SD	Mean DASH (Range)	SD	
>= 60	15.3 (0-43.18)	15.1	18.2 (0-59.09)	18.5	0.3792
50 - 59	23.7 (2.27-77.27)	18.4	15.2 (0-45.45)	15.0	0.1231
40 - 49	7.8 (0-22.72)	9.5	27.7 (0-45.45)	15.3	0.0156
30 - 39	2.9 (0-13.63)	4.3	23.3 (6.81-36.36)	11.1	0.0265
20 - 29	13.2 (0-40.9)	12.8	87.5 (79.54-95.45)	8.0	0.0072
< 20	-	-	-	-	-

Table 3.9: Test of association between Quick DASH and type of treatment for Type B and C fractures comparing younger to older adults(t-test)

Age group	**Treatment type**				***p*-value**
	Surgical		**Non-surgical**		
	Mean DASH (Range)	SD	Mean DASH (Range)	SD	
>= 50	20.6 (0-77.27)	17.7	16.4 (0-59.09)	16.6	0.230
20 - 49	8.3 (0-40.9)	10.6	36.2 (0-95.45)	26.5	0.003

Table 3.10: Test of association between Quick DASH and type of treatment for Type C fractures only (t-test)

Age group	**Treatment type**				***p*-value**
	Surgical		**Non-surgical**		
	Mean DASH (Range)	SD	Mean DASH (Range)	SD	
>= 60	0 (0-0)	0	33 (22.72-43.18)	10.3	0.0959
50 - 59	27.1 (2.27-77.27)	19.8	16.2 (0-45.45)	16.8	0.1265
40 - 49	12.9 (0-29.59)	11.4	37.5 (31.81-43.18)	5.7	0.0357
30 - 39	2.9 (0-13.63)	4.3	33 (29.54-36.36)	3.5	0.0396
20 - 29	10.1 (0-20.45)	9.3	87.5 (79.54-95.45)	8.0	0.0353
< 20	-	-	-	-	-

CHAPTER 4
DISCUSSION

The distal radius fracture commonly affects young and elderly patients (1, 2). As opposed to a bimodal distribution of the frequency of distal radius fracture, a unimodal distribution was observed in this study, where 65% of patients were above the age of 40 with the highest prevalence of distal radius fracture occurring in patients between the ages 50-60 years old. The frequency of distal radius fracture in the geriatric population has been attributed to changes in bone metabolism (osteoporosis) that predisposes to low energy fractures (1, 2). Osteoporosis may have played a role in the findings reported in this study as most patients were aged 50 years and above (predominantly females), with the most prevalent mechanism of injury (90.8%) being a fall on an outstretched hand. Although not statistically significant, mainly older women were affected in the current study, and this is in keeping with the sex-related bone density and age-related development of osteoporosis mainly due to post-menopausal changes (1, 2).

Also, although 35% of fractures were observed in younger patients (less than 40 years old), the primary mechanism of injury as stated above was a fall on an outstretched hand which, in this study, does not meet the generalisation that high energy is required to cause a distal radius fracture in a young patient (1). This mechanism of injury is in keeping with the fact that the most significant proportion of distal radius fractures in this study was classified as AO/OTA type A; however, the forces that caused the fracture could not precisely be quantified.

The proportion of patients treated surgically and conservatively was comparable. At first glance, this finding may reflect a lack of consensus on the best approach to managing or treating a distal radius fracture. Although surgical treatment is now becoming a standard therapeutic option in the general orthopaedic community, the findings reported did not seem to reflect this (2, 3). Furthermore, it is essential to note that most participants had an x-ray classification of AO/OTA type A of the distal radius fracture which did not influence the management modality. Nevertheless, displaced intraarticular fractures at CHBAH, where this study was carried out, are mainly managed surgically; this may explain the increased number of patients in the surgical group. Many studies have been done on distal radius fractures, yet a consensus on the standard treatment has not been reached (2, 3).

The majority of patients in both the surgical group (62%) and the non-surgical group (68%) reported a VAS score of 10 to 20 (mild pain); there was no difference between patients' reported VAS scores between the surgical and non-surgical group for the different age groups. This is consistent with the findings reported by Toon et al. (9), Heidgerd et al. (14) and Zhang et al. (25). Toon et al. (9) reported that there were no significant differences on the VAS for pain between operative and non-operative management of closed displaced intra-articular distal radius fractures in their cohort. Heidgerd et al. (14) noticed that the pain level at the final analysis (12 months after treatment), related to the treatment, was varied, and no statistical significance was noted. Zhang et al. (25) found no significant differences in pain scores between operative and non-operative treatments in older patients (60 years of age and older). These findings were not influenced by independent factors such as age and type of fracture.

Eighty-one per cent (81%) of patients had a Quick DASH score between 0 and 35 (reported as satisfactory to very good functionality). Looking at the different age groups, this study revealed a significant decrease in the mean DASH score in the operative group compared to non-operative group for patients below 50 years of age (see Table 3.8 and Table 3.9 in Chapter 3). The *p*-value was statistically significant for patients under the age of 50 but there was no significant difference in the older patients (50 years old and above). Of note is that these findings were influenced by the independent factors mentioned above: e.g., age and type of fracture. These findings are consistent with many studies that reported good functionality in both surgical and non-surgical groups on the Quick DASH and other vetted self-reported functionality questionnaires. Discussed below are some of the studies where the findings are comparable with the findings reported in the current study. Larouche et al. (11) investigated the functional outcome of distal radius fracture in 129 patients older than 55 years. They found no difference in patient-reported outcomes at one-year follow-up between the ORIF group and the closed reduction group. Ju et al. (17), in a systematic review and meta-analysis including eight studies, concluded that both treatment methods produced similar results in the elderly. Li et al. (22), in their systematic review and meta-analysis on the role of non-operative treatment and volar locking plate fixation for elderly with distal radius fracture, found that the volar locking plate did not improve the DASH scores of their patients aged 50 years and older. Ochen et al. (23), in a systematic review and meta-analysis comparing operative treatment and non-operative treatment of distal radius fractures in 2 254 adult patients, reported that their overall results showed a significant improvement in medium-term (less or equal to one year) DASH

score after operative treatment in comparison to non-operative treatment. There was a substantial improvement in studies that included patients aged 18 years or older, but no improvement in the medium-term DASH score was found in the subgroup that only included patients aged 60 years or older.

The results obtained in the current study did not compare to those reported by Landgren et al. (8), Toon et al. (9), Zhang et al. (25) and Alharbi et al. (26). Landgren et al. (8) found that despite the change in implants over time, there was no improvement in the median DASH score one year after surgery. The shift to the surgical treatment did not influence the subjective outcome in the cohort. Of note is that the authors did not categorise the patients by age groups when comparing the two treatment modalities despite their large sample size. Toon et al. (9) found no difference in the DASH and MAYO wrist scores between the ORIF and the non-operative groups at 12 months follow-up. Their study included only 60 patients, and these were not categorised by age group as well for an appropriate comparison. Zhang et al. (25) compared volar plate fixation to non-operative treatment of distal radius fracture in older patients (60 years or older). They found reduced DASH scores and improved grip strength in subjects treated surgically. This meta-analysis included only five studies, with a moderate quality. Alharbi et al. (26) investigated the efficacy and safety of operative versus non-operative treatment of 14 279 adult patients with distal radius fracture (mean age of 67 years). They found that operative treatment of distal radius fractures helps to improve the medium-term DASH scores compared to non-operative treatment. Unfortunately, there was no breakdown of comparative results per age group to confirm the similarity of results between younger and older adults.

There were few patients with poor results in this study. Twenty-eight patients (19%) had a DASH score of more than 35. Among them, twenty patients were treated non-operatively (POP), eight with ORIF and one with an external fixation. Most of them complained of persistent stiffness after removal of the POP or the external fixator. Others had persistent pain. A reason for these poor results may be to the short follow-up period (3 to 6 months). These patients will most likely improve in a long-term follow-up, as demonstrated in most long-term studies. In addition, eleven patients had an AO/OTA type C fracture, which is the worst type with a poorer prognosis.

The findings in this study are consistent with studies in both developing and developed countries i.e., there is no significant difference between surgical and non-surgical management of distal radius fracture in older adults (50 years and older in the current study). Furthermore, non-operative management carries the benefit of less anaesthetic and postoperative complications.

These findings may inform the orthopaedic practice in different settings. However, special consideration should be made where specific radiological findings indicate surgical management over non-surgical management. Overall, when absolute indications are considered carefully, there seems to be differences in the functional and pain outcomes reported by patients, whether they are treated surgically or non-surgically.

Inferences made from this study may be limited by the study design (retrospective), sample size and language barrier. Small sample sizes may affect the statistical significance of different parametric tests. Despite these limitations, the findings of this study correlate with existing studies of varying study designs and larger sample sizes.

4.1 Limitations

Patients were not followed-up long term. Furthermore, patients who did well after treatment may not have returned to the clinic/were lost to follow-up which may have skewed the data. The sample size in this study was small, thus affecting the kind of statistical analyses that can be performed and inferences made from the study results. Furthermore, recall bias can affect participants' responses to the study questionnaires. In addition, incomplete records (some patients did not have x-rays) affected the recruitment of patients to the study. COVID-19 restrictions also played a role in the recruitment of participants due to the poor attendance of patients at the outpatient department. Some patients also required an interpreter for the VAS and Quick DASH scores which might have resulted in a loss of understanding and incorrect responses being given during translation.

4.2 Recommendations

A multi-centred prospective randomised controlled trial with Quick DASH translated in South African local languages to reduce bias, and with a long-term follow-up is recommended.

Furthermore, the development of clear guidelines with absolute indications for surgical management of distal radius fractures will encourage non-surgical management of these fractures particularly in older adults due to similar pain and function outcomes. The findings obtained from most studies previously discussed recommend that older patients (55 years or older) have comparable functional outcomes (objective and subjective) with both operative and non-operative treatment.

CHAPTER 5
CONCLUSION

This study highlighted that distal radius fractures mainly affect females above the age of 50 years with the main mechanism of injury being a fall on an outstretched hand. The surgical treatment of distal radius fracture did not improve the mean DASH scores of patients aged 50 years and older. Furthermore, there was no significant difference in the VAS between the surgical group and the non-operative group. Therefore, this study encourages non-operative management of distal radius fractures in older adults (50 years and older) due to similar pain and function outcomes. Lastly, it was found that the Quick DASH scores were influenced by age and type of injury while the VAS scores were not. Further trials with a larger sample size and longer follow-up periods are required to provide further evidence.

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Appendices

Appendix A: Study Information Sheet and Informed Consent Form

Study title: Patient-reported outcome measures after distal radius fracture.

Good day Sir/ Madam,

We, Dr S.L. Kayuba and Professor C. Frey are doing a research study on the outcome of distal radius fracture treatment. Research is a process used in seeking new knowledge. In this study, we want to know the functional outcome after treatment of a distal radius fracture to help improve the care of our patients in the future.

We are inviting you to take part in a research study.

This study is a retrospective study with a prospective recall. The participant will be given a questionnaire to fill in. Questions are about the symptoms that the participant may experience after treatment and their impact on their daily activities. This will take five to ten minutes of your time. Information obtained from the participant will be kept confidential, and a code will be assigned to them as an identifier in the study. No procedures will be performed on the participant.

The study period: 07 November 2019 - 07 November 2021.

There is no risk involved in this study as no procedure will be performed. Anonymity is guaranteed.

There is no direct benefit to the participant in this study. The study's objective is the possibility of better care for patients in the future.

Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which the participant is otherwise entitled. There is no requirement to provide a reason for rejection or withdrawal. Any data collected on such a person will be destroyed unless the participant consents to its retention.

There will be no cost associated with participation.

Personal information will be treated in the strictest confidence and will only be available to the Principal Investigator and his Supervisor.

The only rare exceptions would normally be:

1. Personal information will be disclosed if required by law
2. The Human Research Ethics Committees of the University of the Witwatersrand may exceptionally require personal data to respond to a formal complaint or for a compliance audit

If results are published, this may, exceptionally, lead to cohort, or more rarely, individual identification. All data collected during the study will be securely retained for two (2) years if a scientific publication arises and six (6) years if there is no publication. After that, it will be destroyed accordingly.

Contact details of researcher:

Dr Kayuba: Cell: 0730734840; email address: drklwamba@gmail.com

Outputs

The information furnished by the participant will be used for my MMed and might be published in a journal. I am willing to share the outputs with the participant after the study is completed.

Contact details of HREC administrator and chair

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg. A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

If you have any concerns over how the study is being conducted, please contact the Chairperson of this Committee, Professor Clement Penny, who may be contacted on telephone number 011 717 2301 or by e-mail. The telephone numbers for the Committee secretariat are 011 717 2700/1234, and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za.

Thank you for reading this Study Information Sheet.

Date: July 2019

Consent Form

Title of project: Patient-reported outcome measures after distal radius fracture

Name of researcher: Dr SL Kayuba

I ……. agree to participate in this research project. The research has been explained to me, and I understand my participation.

I agree that my participation will remain anonymous YES NO (please circle)

I agree that the researcher may use anonymous quotes YES NO

in his research report

I agree that the researcher may take photos of me YES NO

(But not my face)

I agree that the information I provide may be used YES NO

anonymously by other researchers following this study

Name of Participant	Date
Signature of Participant	
Name of the person obtaining consent	Date
Signature of the person obtaining consent	

Appendix B: Quick DASH (31)

*Quick*DASH

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Do heavy household chores (e.g., wash walls, floors).	1	2	3	4	5
3. Carry a shopping bag or briefcase.	1	2	3	4	5
4. Wash your back.	1	2	3	4	5
5. Use a knife to cut food.	1	2	3	4	5
6. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
7. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
8. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*	NONE	MILD	MODERATE	SEVERE	EXTREME
9. Arm, shoulder or hand pain.	1	2	3	4	5
10. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
11. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

*Quick*DASH DISABILITY/SYMPTOM SCORE = $\left(\left[\frac{(\text{sum of n responses})}{n}\right] - 1\right) \times 25$, where n is equal to the number of completed responses.

A *Quick*DASH score may not be calculated if there is greater than 1 missing item.

Appendix C: Visual Analogue Scale (32)

Appendix D: Data Collection sheet

Data will be recorded as follows:

File Number:

Age:

Date of birth:

Sex:

Type of fracture:

Mechanism of injury:

Months after injury:

Date of injury:

Side of injury and hand dominance:

Date of treatment/intervention:

Date of assessment/administration of questionnaire:

Treatment type:

Co-morbidity:

Visual Analogue score:

Quick DASH score:

American Society of Anaesthesiologists (ASA) classification:

Appendix E: Hospital CEO clearance letter

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 4th April 2019

TITLE OF PROJECT: Patient reported outcome measures after distal radius fracture.

UNIVERSITY: Witswatersrand

Principal Investigator: Dr S.L Kayuba

Department: Orthopaedic Surgery

Supervisor : Prof C Frey

Permission Head Department (where research conducted): Yes

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital. The CEO / management of Chris Hani Baragwanath Academic Hospital is accordingly informed and the study is subject to:-

- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- The Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- The MAC will be informed of any serious adverse events as soon as they occur
- Permission is granted for the duration of the Ethics Committee Approval.

.....
Recommended
(On behalf of the MAC)
Date: 4/4/2019

.....
Approved/~~Not Approved~~
Hospital Management
Date: 09/04/2019

Appendix F: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Serge Lwamba Kayuba

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M190812 MED18-11-013

NAME: (Principal Investigator)	Dr Serge Lwamba Kayuba
DEPARTMENT:	Orthopaedics Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	Patients reported outcome measures after distal radius fracture at Chris Hani Baragwanath Academic Hospital
DATE CONSIDERED:	30/08/2019
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Chris Frey
APPROVED BY:	Dr C Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	07/11/2019

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 in Room 301, 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 August and will therefore be due in the month of August each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date 07/11/2019

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES