INCIDENCE OF IPSILATERAL INTRA-ARTICULAR DISTAL RADIUS AND SCAPHOID FRACTURES AT CHRIS HANI BARAGWANATH AND CHARLOTTE MAXEKE ACADEMIC HOSPITALS

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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

Johannesburg, 2018

DECLARATION

I, Kgabu Richard, 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 Orthopedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

Signature…  …

21th day of November 2018

Dedication

This work is dedicated to my family, who showed me support during the difficult times of my career. To my son, Ntandoyenkosi Masego, you have been the source and a pillar of my strength. God is faithful and never fails.

ABSTRACT

Introduction

Ipsilateral distal radius and scaphoid fractures are rare as reported in the literature due to limited research work that has been done on this subject. The literature is populated with case study reports and only two large studies have reported an incidence of 0.7 to 6.5 percent on these fractures. The purpose of our study was to assess the incidence of ipsilateral distal radius and scaphoid fractures at our local hospitals, and then compare this incidence with that reported in the published literature.

Methods

This was a prospective study. Plain radiograph images were studied from two academic hospitals (Chris Hani Baragwanath and Charlotte Maxeke Johannesburg) in Johannesburg, for a period of six months i.e. January – June 2017. One hundred and eight patients met the inclusion criteria, all intra-articular distal radius fractures admitted during this period were analysed for associated scaphoid fractures on admission, at two weeks post-operatively and at six weeks post-injury. An excel spreadsheet was used to collect the data that included: age, sex, mechanism of injury and whether or not scaphoid fracture was diagnosed on admission.

Results

Five of 108 patients had ipsilateral distal radius and scaphoid fractures. All five patients were young and the mechanism of injury was high velocity related, i.e. fall from a height or a motor

vehicle collision. There were four males and one was female, two of the scaphoid fractures were missed at presentation, of the two one was treated non-operatively and the other treated operatively at a later stage. Age distribution was from 18 to 86 years; male patients sustained distal radius fractures at a young age and the incidence decreased with an advanced age, however, female patients had a higher incidence at an advanced age.

Conclusion

The incidence of ipsilateral distal radius and scaphoid fractures is uncommon; our study reported an incidence of 4.62 percent, which is in keeping with that reported in the available literature (0.7 to 6.5 percent). Our study ran for a short duration of six months and subsequently, a short follow-up of six weeks post-injury but it reported a similar result to that found in two large studies in the literature. We believe that with a long term follow-up, our study could have a potential to show an increased incidence of distal radius and scaphoid fractures in our clinical setting.

ACKNOWLEDGEMENTS

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Dr. M. Jingo: Research staff for valuable scientific input

Dr. B. Milner: Research staff for valuable scientific input

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Nomenclature

AO	Arbeitsgmeinschaft fur Osteosynthesefragen
CEO	Chief Executive Officer
CHBAH	Chris Hani Baragwanath Academic Hospital
CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
CT	Computer Tomography
HREC	Human Research Ethics Committee
MRI	Magnetic Resonance Imaging
ORIF	Open Reduction and Internal Fixation
PACS	Picture Archiving and Communication System
POP	Plaster Of Plaster

CHAPTER 1

1. Introduction and literature review

1.1 Introduction

Ipsilateral distal radius and scaphoid fractures are uncommon (1). Distal radius fractures can be easily diagnosed especially when completely displaced. They are common adult injuries and comprise 10 to 25 percent of all fractures (2). The distal radius constitutes the main injury and may determine the resultant management (3). Scaphoid fractures on the other hand are always a challenge to diagnose. One needs to have a high index of suspicion. Scaphoid fractures constitute 60 percent of all carpal bone fractures (2). The scaphoid is the most common of the carpal bones to fracture. It can be missed easily, leading to inadequate treatment and consequently complications of non-union and carpal instability.

In 2014 during my three months outreach rotation at one of the peripheral hospitals, we admitted a number of distal radius fractures of which six were associated with scaphoid fractures. It is important to note that a scaphoid injury was missed at the initial presentation, two of the patients required fixation and the other four were treated non-operatively since the displacement was less than a millimetre. Literature reports pertaining to these combined injuries are very limited.

1.2 Literature review

Ipsilateral fractures of the distal radius and scaphoid fractures are uncommon injuries. The literature reported incidence of these combined fractures to vary from 0.7 to 6.5 percent (4).

1.2.1 Patho-anatomy

Intra-articular distal radius fractures are usually bimodal in distribution, the one group being young adults with good bone stock. Their mechanism of injury is usually a fall from a height or high-energy motor-bike/vehicle accidents. Literature reports that a very high energy impact is necessary for the development of these injuries (5). High-energy trauma significantly raises the risk of simultaneous fractures of distal radius and scaphoid fractures (6). The other group of patients susceptible to these type injuries is the elderly patients with poor bone stock/quality. They usually sustain a very low velocity injury (i.e. a fall from a standing position); typically these are elderly women who are post-menopausal and usually osteoporotic.

The typical mechanism of a scaphoid fracture is the same as that of a distal radius fracture, which results from a fall on an outstretched hand with the wrist hyper-extended and in radial deviation at impact. The scaphoid impacts against the distal radius causing a fracture in the middle (waist) of the scaphoid (7). This also subjects the dorsal radius and scaphoid-lunate ligament at risk of injury. The scaphoid is an oddly shaped, peanut-sized, carpal bone and is predominately covered by hyaline cartilage. It resides in a unique orientation in the human carpus at 47° flexion and 20° radial deviation (13). The cartilage covering of the carpal bones makes the diagnosis of scaphoid fractures difficult to assess at initial presentation, especially when it is undisplaced. The scaphoid is not different to the intra-capsular bone and unites by primary bone healing without any callus formation.

1.2.2 Clinical presentation

Patients present with generalised severe wrist pain with or without a deformity following trauma, and is very difficult to clinically distinguish whether it is a distal radius or scaphoid fracture that has resulted in the deformity of the wrist as both have the same mechanism of injury. The clinical examination may be limited due to the pain. With isolated scaphoid fractures, pain may be localised to anatomical snuff box or scaphoid tubercle and these are reliable signs and 100 percent sensitive (7), thereby combining these clinical signs improves the diagnosis of scaphoid fractures (see Table 1.1).

Table 1.1 Clinical prediction tests in diagnosing scaphoid fractures (9)

Clinical test	**Specificity (%)**	**Sensitivity (%)**
Snuff box tenderness	40	90
Tenderness over scaphoid tubercle	57	87
Scaphoid compression	92	94
Combined	74	100

1.2.3 Diagnosis

Fracture diagnosis has been confirmed by radiological imaging studies namely:

(i) Conventional radiographs:

Seventy percent of scaphoid fractures can be confirmed on the initial radiograph (7). Lateral and anterior-posterior views are standard. Dedicated scaphoid clenched fist and ulnar deviation views are difficult to obtain in the acute presentation due to pain. Repeated X-rays at ten to 14 days in a case of suspected scaphoid fracture may show some lysis, thereby, confirming the suspected diagnosis. Wrist anterior-posterior and lateral views maybe adequate to make a diagnosis of distal radius intra-articular fractures, as they tend to be the obvious fractures.

(ii) Computer Tomography (CT):

Computer Tomography is expensive compared to plain X-rays. It can be used to confirm the diagnosis of scaphoid fractures although its sensitivity is low compared to bone scintigraphy (7). In distal radius fractures, a CT scan is reserved for complex intra-articular fractures with severe comminution and is used as a pre-operative planning adjunct as opposed to making a diagnosis.

(iii) Bone scintigraphy:

Scaphoid fractures can be ruled out with confidence using bone scans (7). It is therefore recommended as a second diagnostic modality of choice after plain X-rays. Its sensitivity is close to 100 percent (7). It is an expensive and invasive tool that requires intravenous radioactive isotopes.

(iv) Magnetic Resonance Imaging (MRI):

MRI is often recommended as a diagnostic modality, it shows better results because it is more sensitive and specific compared to the bone scan (7). There is no exposure of the patient to radiation and it is useful for the assessment of associated ligament injuries.

1.2.4 Classification

Classification systems are designed to categorise: the fracture type, injury severity and to serve as a guide for treatment and prognosis (14). There are various classification systems for distal radius fractures, which are available in the literature. These classifications systems have revealed important characteristics of the distal radius fractures and others proven to be more useful than others, however, no single classification is adequate. For the purpose of our study, the Arbeitsgmeinschaft fur Osteosynthesefragen (AO) and Frykman's classification systems were used to define intra-articular fractures as radio-carpal and radio-ulnar fractures (see Figures 1.1, 1.2 and Table 1.2). Scaphoid fractures have numerous classification systems that have been reported in literature, and have prognostic significances (8).

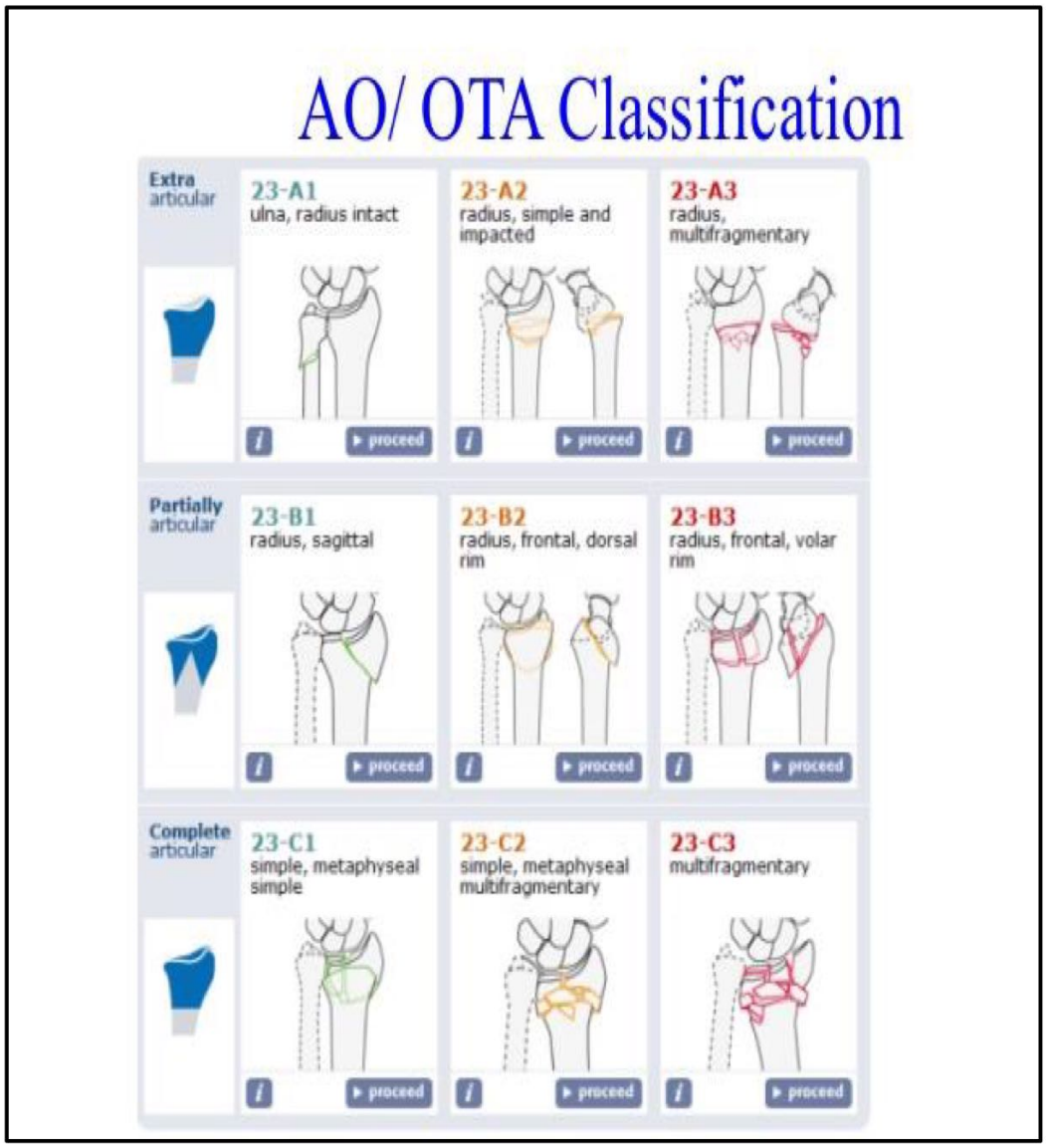

Figure 1.1 A/O classification diagrams (16)

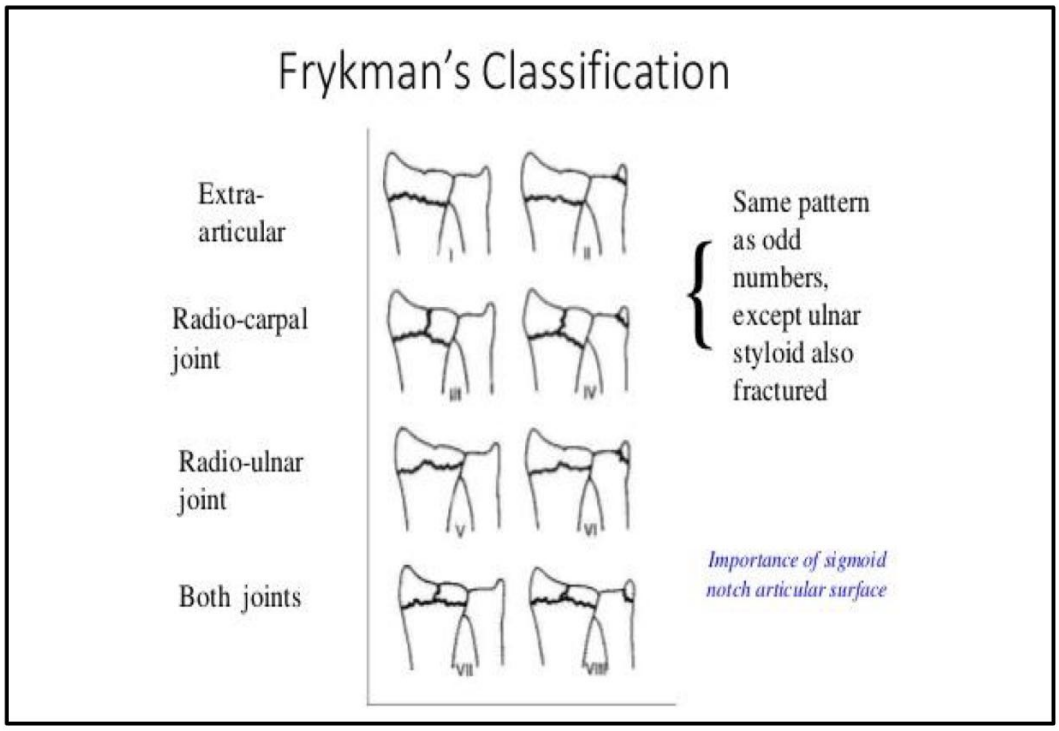

Figure 1.2 Frykman's classification diagrams (17)

Table 1.2 Scaphoid fracture classifications (9)

Anatomical site	**Russe**	**Prosser distal pole**	**Compson**
Tuberosity		Type I tuberosity Type II distal intra-articular Type III osteochondral fracture	Type 2 dorsal sulcus
Waiste	Oblique Transverse Vertical oblique (5%)		Type 1 The surgical waist
Proximal pole fracture			Type 3 The proximal pole

1.2.5 Problem statement

To our knowledge no study has been done specifically on ipsilateral intra-articular distal radius and scaphoid fractures in adults. The reports presented in the literature include: other carpal bone fractures and dissociation in both children as well as in the adult population. Therefore, we conducted this study to find possible answers on ipsilateral intra-articular distal radius and scaphoid fractures in adults.

1.3 Study Aim and Objectives

1.3.1 Aim

To assess the incidence of ipsilateral intra-articular distal radius and scaphoid fractures in adult patients at Chris Hani Baragwanath Academic Hospital (CHBAH) and Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), over a six-month period.

1.3.2 Study objectives

- To identify ipsilateral intra-articular distal radius and scaphoid fractures
- To compare our statistics with the available literature

CHAPTER 2

2. Methodology

2.1 Research Question

Are ipsilateral intra-articular distal radius and scaphoid fractures uncommon in adults?

2.2 Research Design

This was a prospective study. Plain radiographs of patients with intra-articular distal radius fractures were identified from the general orthopaedic trauma admissions at CHBAH and CMJAH.

2.3 Material and Methods

Study materials included in our study were: adult X-rays with intra-articular distal radius B and C type fracture AO and Frykman fractures iii to viii (see Figures 1.1 and 1.2, respectively). Plain radiograph images of the wrist were studied on admission, at two weeks post-operatively and at six weeks post-injury. A diagnosis was made by the analysis of plain radiographs and no other additional tests were used to aid the diagnosis of both distal radius and scaphoid fractures.

2.4 Selection Criteria

2.4.1 Patient Inclusion Criteria:

- Adult wrist X-rays with a distal radius fracture (18 years and older)
- Intra-articular distal radius fracture of AO type B and C classifications (see Figure 1.1)
- Intra-articular distal radius fracture of Frykman iii to viii type (see Figure 1.2)

2.4.2 Patient Exclusion Criteria:

- Extra-articular distal radius fractures
- Distal radius fracture with carpal bone dissociation without scaphoid fractures
- Distal radius fracture with old carpal bone fractures
- Patients lost to follow-up

2.5 Sample of Patients

The sample of our patients was purposefully selected and included all adults wrist X-rays showing an intra-articular distal radius. A pre-assessment of all distal radius fractures was done prior to admission, and it was found that there were over 100 patients from each hospital. Therefore a sample size of one hundred X-rays taken over six-month period was sufficient for our study. There were no controls to compare with; as the incidence of ipsilateral intra-articular distal radius and scaphoid fractures at our hospitals was assessed.

2.6 Data Collection

A data sheet was used to collect the patients' information such as the mechanism of injury, age, sex, whether/not there was a scaphoid fracture at initial presentation and if it was diagnosed. Confidentiality was maintained by not using patients' names and ethics approval was obtained from the Human Research Ethics Committee (HREC) (Medical), University of the Witwatersrand (clearance number: **M160476**). Permissions to conduct the study at the CHBAH and CMJAH were granted by the Chief Executive Officers (CEOs), respectively.

Data were collected by searching on the patients' admission files for all distal radius fractures, and then by examining their X-rays both at the time of admission and at follow-up visits. Consent was obtained from patients to use their radiographs during the study, and there was no risk involved.

2.7 Data Analysis

The data were described using descriptive analysis together with percentage calculations. Data were presented using bar graphs.

CHAPTER 3

3. Results

One hundred and seventy two radiographs were collected over a period of six months; 95 were from CHBAH and 77 from CMJAH. Sixty two and 46 radiographs were included, respectively. One hundred and eight X-rays met our inclusion criteria. There were five patients with ipsilateral distal radius and scaphoid fractures, making a 4.62 percent incidence of associated intra-articular distal radius and scaphoid fractures at our local hospitals.

Regarding the scaphoid fractures, four were at the waist and one was at the distal pole. Three of the five scaphoid fractures were minimally displaced; two were displaced with one of the two being a trans-radial trans-scaphoid peri-lunate dislocation. Two of the scaphoid fractures were missed at initial presentation, the ipsilateral distal radius was fixed with Open reduction internal fixation (ORIF) and a volar locking plate but the scaphoid was overlooked and only fixed later. The other fracture was minimally displaced and required non-operative management.

The mean age of the ipsilateral distal radius and scaphoid fractures was 31.4 years; whereas the mean age of the distal radius fractures was 40 years with a range of 18 to 86 years. Male patients seemed to dominate in both the ipsilateral distal radius and scaphoid fractures (see Figure 3.1), and in the distal radius fractures as well. Intra-articular distal radius and scaphoid fractures were observed in four males and in one female. They were all associated with high velocity impact.

Table 3.1 Demographics of ipsilateral distal radius and scaphoid fractures

	Side injured	Age	Sex	Radius fracture	Scaphoid fracture	Mechanism of injury	Radius treatment	Scaphoid treament	Diagnosed at presentation
1	Left	36	F	Radio-carpal	Waist displaced	Fell from height	Volar plate	Herbert type screw	Yes
2	Right	28	M	Radio-carpal	Waist displaced	Motor vehicle accident	Volar plate	Non operative	No/ missed
3	Left	27	M	Radio-ulnar	Waist	Motor vehicle accident	Non operative	Non operative	No/ missed
4	Left	34	M	Radial styloid	Distal pole & lunate dislocation	Fell from height	K-wires	K-wires	Yes
5	Right	32	M	Radio-carpal	waist	Motor vehicle accident	Volar plate	Non operative	Yes

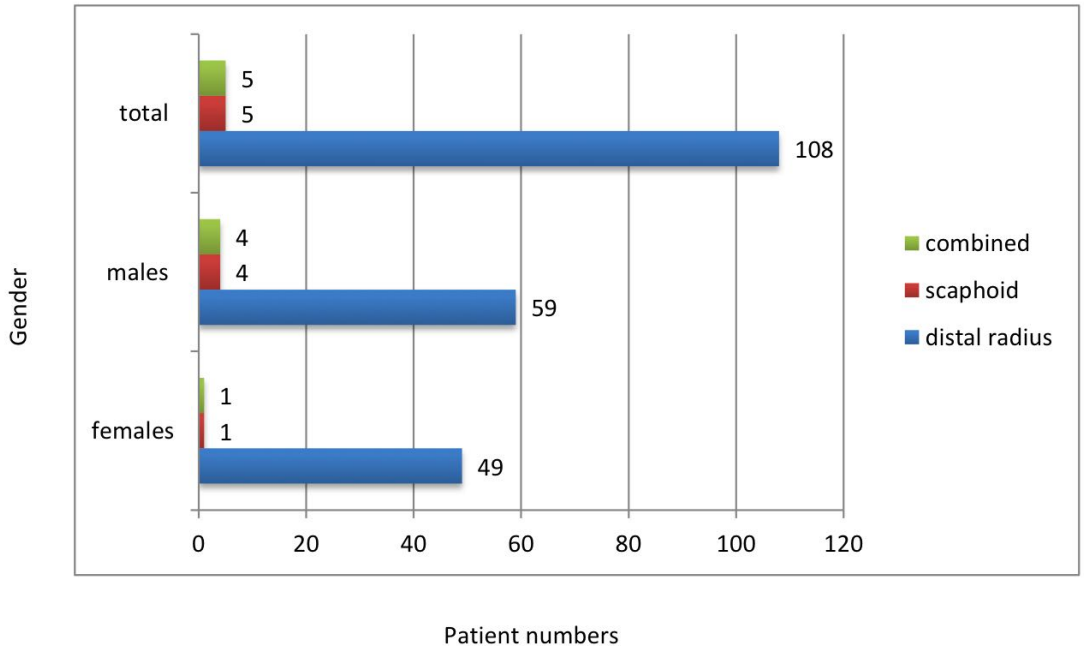

Figure 3.1 Gender specific incidence of distal radius and scaphoid fractures

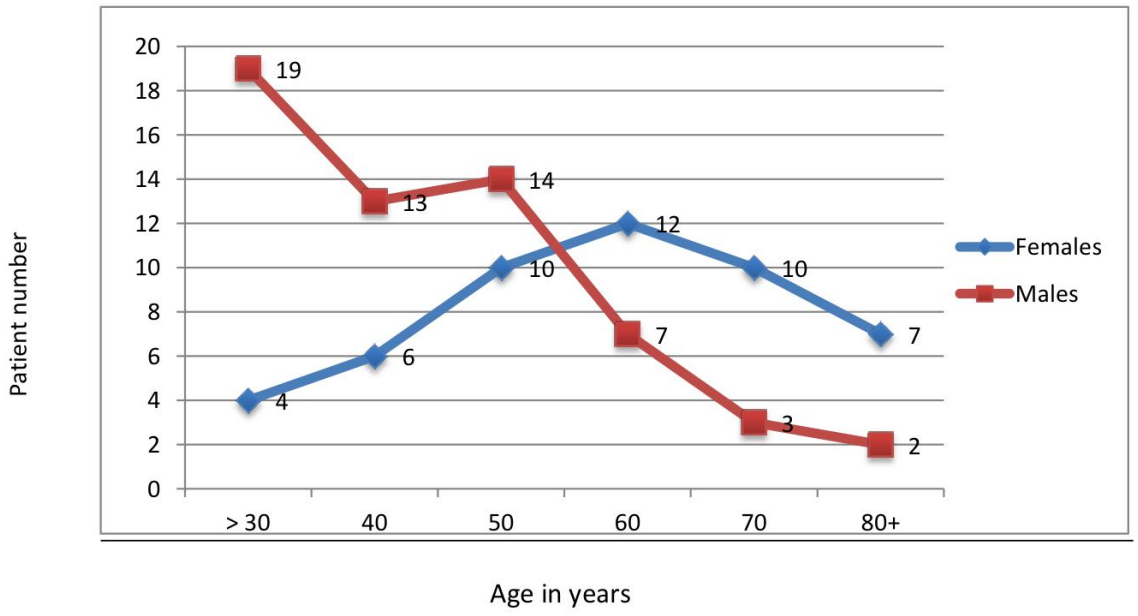

Figure 3.2 Age specific incidence of distal radius fractures

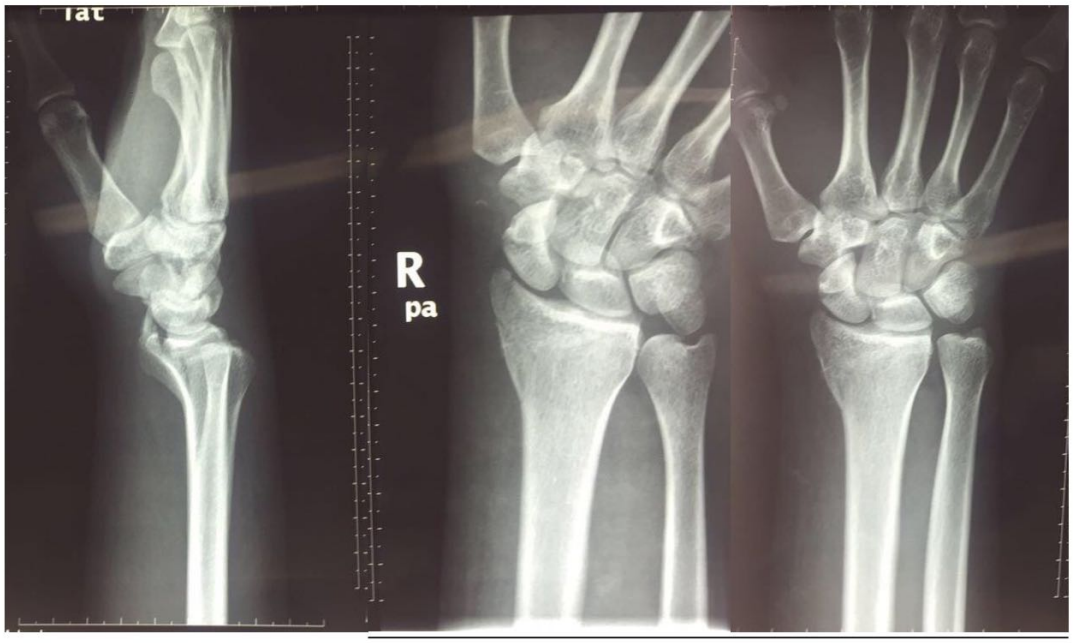

Figure 3.3 X-rays demonstrating a distal radius and scaphoid fracture

Figure 3.4 X-rays showing a distal radius fracture post fixation with missed scaphoid fracture

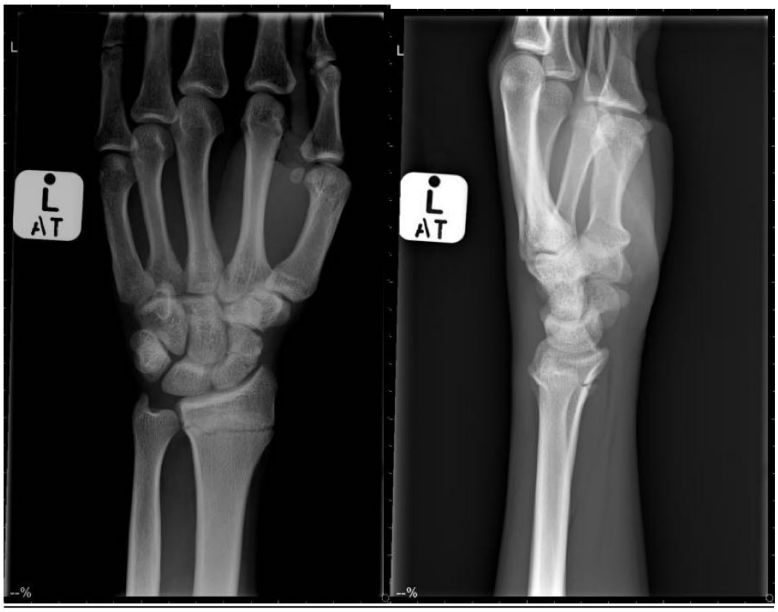

Figure 3.5 X-rays showing an undisplaced ipsilateral distal radius and scaphoid fractures

Figure 3.6 X-rays showing an undisplaced ipsilateral distal radius and scaphoid fracture treated non-operatively

CHAPTER 4

4. Discussion

The mechanism of injury for the distal radius fracture is similar to that of scaphoid fracture, it is therefore necessary to thoroughly examine the wrist joint to exclude an associated scaphoid fracture with a distal radius fracture. High energy is required to produce the combination of these fractures, and this is usually seen in young patients. The literature reports age distribution for the ipsilateral distal radius and scaphoid injuries from the third to the fifth decade (14). Our study showed an age distribution from 27 to 36 years (see Table 3.1), which is still in keeping with the age distribution reported in the literature. There is some controversy regarding which fracture occurs first, distal radius or scaphoid. Mayfield and Moller (1980) suggested that scaphoid fractures occur first, this required a high-energy transfer and the continued axial loading as a result wrist extension produces a radius fracture (11). However, Frykman (1967) in his experimental study proved that the distal radius fracture would occur before the scaphoid fracture (17). He further showed that the wrist position at impact to the ground was important in ascertaining the type of fracture that will be produced. Distal radius fractures will occur at angles between 45° and 90°, and an angle greater than 90° will result in a fracture dislocation of the carpus. It remains unknown as to which fracture happens first, but we know that high velocity is required to produce these type of injuries and in our study most of the patients were involved in a motor vehicle collision.

Mayfield (1980) in his experimental study showed that hyper-extension of the carpus resulted in a scaphoid fracture; he suggested that the dorsal part of the scaphoid impacts the dorsal rim of the distal radius, thereby, leading to a fracture (11).

Generally a decision to use operative option is based on the displacement and amount of angulation of these fractures. Undisplaced distal radius and scaphoid fractures can be successfully treated non-operatively. A distal radius fracture dictates the treatment as well as the final outcome (3). Most authors believe that if the distal radius is undisplaced, it warrants non-operative management, but if displaced, fixation of both distal radius and scaphoid fractures is favoured (4).

Currently, we are aware of two large studies that showed a similar incidence of combined distal radius and scaphoid and fractures of 0.7 to 6.5 percent. Chih-Hung Chang et al. (2000) in their series of 908 distal radius and 127 scaphoid fractures, had eight associated distal radius and scaphoid fractures, including five men and three women. Their study was retrospective and was done over a ten-year period. Our study was prospective for a period of six months. Hove et al. (1994) did a prospective three-year study. They registered 2330 distal radius fractures and 390 scaphoid fractures, twelve of which had combined injuries. Hove et al. (1994) study included patients from the ages of 11 to 90 years with both intra-articular and extra articular distal radius fractures.

Our study on the other hand, included adults from 18 years of age and older, and it demonstrated that distal radius fractures is much common in male patients at a young age, and as they age the

incidence decreases. Moreover, in the female counter part distal radius fracture is more common as the age increases i.e. distal radius fractures are common in older patients with decreased incidence at a young age (see Figure 3.2).

4.1 Recommendations

Based on our results, we recommend that every patient who presents with a distal radius fracture after a high velocity mechanism, an X-rays of the wrist should be done to exclude an associated carpal bone fracture. In a suspected associated ipsilateral distal radius and scaphoid fracture, young male patient with a history of motor vehicle accident or fall from a height. A special tool such as an MRI scan should be done to confirm the diagnosis.

4.2 Limitations

The challenge was collecting X-rays at the time of admission. This was because we used two different hospitals (CHBAH and CMJAH) for our study. In one hospital, patients were at times taking their X-rays home once discharged, and when they came for review their previous X-rays were either lost or forgotten. Another challenge was the use of the Picture Archive System (PACS) system, which was recently introduced at our hospitals to archive X-ray images. Only two technicians were trained to use the system, and as a result some of the X-rays were not successfully captured on the system. At follow-up, most of our patients had two X-rays done by the end stage of our data collection, so we had to analyse X-rays of two occasions instead of three. We did not include patients who were treated acutely with manipulation Plaster of Paris

(POP) and discharged from the emergency. Only the radiographs of admitted patients were reviewed.

Chapter 5

5. Conclusion

Ipsilateral intra-articular distal radius and scaphoid fractures are uncommon. This study has demonstrated similar results with that in published literature. High energy is required to produce this type of injury, and this is common in young male patients as demonstrate in Figure 3.2. Finally, further research with sufficient archiving system in place is necessary to confirm our findings and those in the literature.

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Appendix A: Letter of permission to conduct study at CHBAH

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE
CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 1 March 2016

TITLE OF PROJECT: Incidence of ipsilateral intra-articular distal radius and scaphoid fractures at Chris Hani Baragwanath Academic Hospital

UNIVERSITY: Witwatersrand

Principal Investigator: RD Kgabu

Department: Orthopaedics

Supervisor (If relevant): T Sefene/C Sathekga

Permission Head Department (where research conducted): Yes

Date of start of proposed study: March 2016
Date of completion of data collection: Dec 2018

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

- Permission having been granted by the Human Research Ethics Committee 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: 01 March 2016

.....
Approved/Not Approved
Hospital Management
Date: 02/03/16

Appendix B: Human Research Ethics Clearance certificate

R14/49 Dr Richard Kgabu

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160476

NAME: (Principal Investigator)	Dr Richard Kgabu
DEPARTMENT:	Orthopaedics Chris Hani Baragwanath Academic Hospital Charlotte Maxeke Johannesburg Academic Hospital
PROJECT TITLE:	Incidence of Ipsilateral Intra-Articular Distal Radious and Scaphoid Fractures at Chris Hani Baragwanath Academic Hospital
DATE CONSIDERED:	06/05/2016
DECISION:	Approved unconditionally
CONDITIONS:	Additional Study-site (05/05/2017)
SUPERVISOR:	Dr T Sefeane and Dr C Sathekga
APPROVED BY:	Professor P. Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	20/12/2016

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 10004,10th floor, Senate House/3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/We fully understand the the conditions under which I am/we are authorised 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 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 review 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).

Principal Investigator Signature

Date 21 NOVEMBER 2018.

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES