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EVALUATION OF MEDICAL INTERNS' KNOWLEDGE AND CONFIDENCE IN ORTHOPAEDIC SURGERY AT THE UNIVERSITY OF THE WITWATERSRAND'S ACADEMIC HOSPITAL COMPLEX IN JOHANNESBURG, SOUTH AFRICA



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

Johannesburg, 2023

Declaration

I, Michael Harland Terreblanche, declare that this Research Report is my own, unaided work.

It is being submitted for the Degree of Master of Medicine in 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)

16th day of April 2023 in Johannesburg, South Africa

Dedication

This research report is dedicated to my family: my mother, Di; my late father, Chris, and my brothers, Peter and John; without whose unwavering support and encouragement I would never have reached this point in my career.

To my beloved mother, Di, thank you for helping to steer my ship at a time in my life when I was rudderless. After losing my father at a young age, you stepped in, took charge so decisively, and did everything in your power to help me get into medical school so that I could pursue my dream of becoming a doctor. You have been my biggest and most loyal supporter during my career as a training doctor and later as a training surgeon. I could not have come this far without your enduring love and care. You have been the perfect role model to me, and I hope one day to impart the values and principles which you so gracefully lived your life by onto my own children, as a tribute to the wonderful mother you have been to me.

To my brother, Pete, thank you for always being there for me; for the hours of telephone conversations we would have which allowed me to air my frustrations and offered me great insight and perspective, and a tremendous amount of solace too. Those conversations would always calm me down when I felt overwhelmed and panic-stricken by the amount of studying I always felt needed to be done. Your gutsiness, hunger and desire to succeed, dedication and perseverance both on the rugby field at school and on the famous Umsundusi river inspired me to want to develop those qualities in myself. Thank you for inspiring those qualities in me, Pete, as I believe they were completely necessary for me to be able to complete my medical journey.

To my brother, John, thank you for always being in my corner. You had your own personal challenges to deal with during my training, but you made sure to never leave me feeling short of your support, love and care. There are so many qualities of yours that I admire but for the purposes of this dedication, I have chosen one that stands out amongst the others. I have always admired your ability to explain some of the most complex matters to me in such simple, understandable terms. It is a quality of yours which has inspired me to want to do the same for the patients who have been under my care during my medical career. It is often difficult to explain medical terminology, diagnostic tests and medical procedures to a lay person in simple, understandable terms but you inspired me to want to do this for my patients. I believe it is such an important skill for a medical professional to be equipped with, and something I have always

endeavoured to do, so I am incredibly thankful to you for instilling that in me, so that I could try to be a better doctor to my patients.

To my late father, Chris, thank you for inspiring me to want to become a doctor. I fondly remember asking you all sorts of questions about medicine and biology and the human body as an inquisitive teenager, and you always patiently explained things to me and appeased my thirst for knowledge. It breaks my heart that you did not live long enough to witness me graduating from medical school and subsequently going on to become an orthopaedic surgeon, as I'm sure this would have made you incredibly proud, being such a highly regarded orthopaedic surgeon yourself. How great it would be for us to discuss all things orthopaedics today. For me to learn from you the tips and tricks you had learnt over your career, and for me to share with you my experiences as a training doctor and training orthopaedic surgeon. What I would give to be able to have these conversations with you today. But far above being a doctor and an orthopaedic surgeon, you were my Dad, and the greatest Dad myself, Pete and John could have ever asked for. You taught me how to laugh, how to be humble and how to be generous. I will forever be grateful for the immense impact you had on my life.

To all of you, a few words over one or two pages will never, ever do justice to the gratitude I feel for all the support, love and care you have always shown me. However, I do hope it goes some way to showing how much I truly appreciate each one of you and the unique role you have played in shaping me into the doctor and person I am today.

Abstract

Background

Junior doctors' knowledge and confidence in the assessment and treatment of musculoskeletal disorders and injuries has previously been shown to be limited, both locally and internationally. This has far-reaching consequences, not least of which is sub-optimal patient care. The aim of this study was to evaluate the effectiveness of current undergraduate orthopaedic training in South Africa.

Materials and methods

Medical interns rotating through the orthopaedic departments of three academic hospitals in Johannesburg, South Africa were surveyed, using a validated questionnaire consisting of twenty-five questions, to assess their knowledge of orthopaedic surgery. Furthermore, they were asked to rate their self-perceived confidence levels relating to various aspects of the care of individuals with musculoskeletal problems using a 5-point Likert scale. The future career interest of the interns was also recorded.

Results

Seventy-eight completed questionnaires were included in this study for analysis. Ninety six percent (96%) of the medical interns in this study failed to achieve basic cognitive competency concerning knowledge of orthopaedic surgery. Three out of seventy-eight medical interns in this study achieved basic theoretical competency in orthopaedic surgery. The interns' mean score in the 25-question examination was 40.7% (SD 13.4%) with a range of 17 – 69%. Ninety two percent (92.3%) of participants reported that they were either confident or highly confident in orthopaedic surgery. Future career choice had no influence on the knowledge of orthopaedic surgery.

Conclusion

The effectiveness of South African undergraduate training of orthopaedic surgery is deficient. Recent South African medical graduates' knowledge of orthopaedic surgery is inadequate, with a mean score of 40.7% in the Freedman and Bernstein questionnaire, and only 3.8% of interns achieving theoretical competency. The graduates demonstrated inappropriate confidence in orthopaedic surgery with only 7.7% acknowledging a lack of confidence. Interns' future career

interest was not found to have a significant association with knowledge of orthopaedic surgery. This study suggests that, in South Africa, orthopaedic undergraduate training needs reform.

Acknowledgements

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I would like to thank Prof. A. Robertson for his huge contribution to this report. The completion of this report would not have been possible without your input and advice.

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Nomenclature

AIDS	Acquired Immunodeficiency Syndrome
BOA	British Orthopaedic Association
CEO	Chief Executive Officer
CHBAH	Chris Hani Baragwanath Academic Hospital
CI	Confidence Interval
CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
ENT	Ear, Nose and Throat
GP	General Practice
HEQF	Higher Education Qualifications Framework
HIV	Human Immunodeficiency Virus
HOD	Head of Department
HJH	Helen Joseph Hospital
HPCSA	Health Professions Council of South Africa
HREC	Human Research Ethics Committee
IQR	Interquartile range
SA	South Africa
SD	Standard Deviation
UK	United Kingdom
USA	United States of America

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Chapter 1: Introduction and literature review

1.1 Background

1.1.1 Epidemiology and impact of musculoskeletal disorders

Musculoskeletal disorders are common. Disorders of the musculoskeletal system comprise approximately 20 – 30% of visits to primary health care facilities and emergency departments and up to 50% of visits in individuals 75 years of age and older. [1 – 4] In South Africa (SA), the prevalence of musculoskeletal disorders at primary health care facilities has been shown to be more than 30%. [5] Furthermore, musculoskeletal disorders represent the most common cause of severe chronic pain and physical disability. [6] In the United Kingdom (UK), up to 25% of all surgical procedures are trauma and orthopaedic related. [4] Musculoskeletal disorders and orthopaedic injuries incur significant costs on the financial resources of healthcare facilities and on societies and economies through loss of productivity. [1, 4, 7 – 9] In summary, musculoskeletal disorders are highly prevalent, they cause considerable pain and disability, and they are a significant strain on human and financial resources.

1.1.2 High burden of musculoskeletal pathology and orthopaedic trauma in SA

There is a high burden of trauma in SA, resulting in large volumes of musculoskeletal injuries. [10, 11] Coupled with the high trauma burden, there is a high burden of human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS), and lifestyle diseases such as obesity and diabetes in SA. [12, 13] The impact of these conditions on orthopaedic departments at healthcare facilities around SA is large.

1.1.3 Inappropriate referrals to orthopaedic surgery departments in SA

To add to the high burden of appropriately referred individuals to orthopaedic departments, orthopaedic departments in SA are often faced with many inappropriate referrals. [14] The benefits of appropriate referral of individuals, with timeous surgical care and subsequent timeous discharge from hospital and earlier return to work and saving hospital costs have been elucidated in the literature. [15] Inappropriate referrals are likely the result of inadequate musculoskeletal education. In addition, poor or limited musculoskeletal education has also

been found to result in the unnecessary use of diagnostic tests, inappropriate prescriptions and a lack of diagnostic suspicion of uncommon but limb and/or life-threatening conditions. [16] In SA, where resources are often extremely limited, ineffective use of these valuable resources needs to be curtailed.

1.2 Literature review

1.2.1 Knowledge and confidence in orthopaedic surgery amongst medical practitioners

Locally and internationally, junior doctors' knowledge of orthopaedic surgery has been shown to be poor. [17–31] Junior doctors' confidence levels in musculoskeletal medicine has been shown to be low. [21, 23, 24, 32, 33] Knowledge and confidence in the assessment and treatment of musculoskeletal disorders amongst experienced primary care practitioners has also been proven to be low. [34] The self-perceived confidence in musculoskeletal medicine amongst junior doctors in SA has been highlighted as an area of future research. [20] In spite of low levels of confidence and knowledge of musculoskeletal medicine amongst medical graduates, universities around the world continue to allocate insufficient time and resources towards the teaching and training of orthopaedic surgery at undergraduate and postgraduate levels. [18, 25, 35, 36]

Certain diagnostic and therapeutic skills, such as how to inject or aspirate the knee and shoulder joints, have been listed as core skills which the South African family practitioner should be able to perform. [37, 38] Furthermore, it has been shown that primary care physicians demonstrated low levels of confidence in the performance of knee joint aspirations and shoulder joint injections. [34]

1.2.2 Inadequate knowledge of orthopaedic surgery and its impact on patient care

In addition to a large percentage of qualified medical doctors' knowledge of musculoskeletal medicine and orthopaedic surgery being limited, some of their practices have been shown to be detrimental to patient outcomes too. [14, 16, 39, 40] In one study, initial misdiagnosis was the only factor associated with a time delay to arthrotomy in children with septic arthritis of the hip joint, a condition which requires emergent surgical care, without which a poor outcome is almost certain. [40, 41] Incorrect or missed diagnoses not only have unfavourable consequences for individuals (patients), but they have also been shown to have a negative impact on the financial resources of healthcare facilities by contributing to medical negligence claims. [42]

1.2.3 Freedman and Bernstein questionnaire

In 1998, Freedman and Bernstein designed a basic competency examination in musculoskeletal medicine. [43] It consists of twenty-five questions which cover a range of topics relevant to orthopaedic surgery (including the assessment and management of certain orthopaedic emergencies, questions pertaining to musculoskeletal anatomy and other general musculoskeletal topics). An open response format is provided for the answers to these questions, to eliminate guesswork from skewing the results of the answers. The recommended answers were provided by the investigators who designed the questionnaire. The examination was reviewed by 124 chairpersons of orthopaedic residency programs in the USA. The chairpersons were asked to rate the importance of each question and suggest a pass mark. The mean pass mark (and standard deviation) they recommended was 73.1 ± 6.8%. The mean importance score of the 25 questions was 7.0 out of 10. The examination was given to eighty-five residents in their first postgraduate year at the University of Pennsylvania in the USA. The authors showed that 82% of eighty-five residents failed this validated musculoskeletal competency examination, highlighting the deficiencies of musculoskeletal education in USA medical schools. [43] Based on the findings of their study, the authors believed that course content was too narrow with a focus on inpatient care of patients, and that course content needed to be broadened to include more contact hours of students and to allow students greater exposure to common outpatient orthopaedic problem; or that other residency programs should compensate for any reduced exposure to musculoskeletal training at undergraduate level.

In a later study by the same authors, in response to criticism that orthopaedic surgeons may over-emphasise the importance of topics with surgical relevance, this same questionnaire was given to a large sample of directors of internal medicine residency programs. [44] The questionnaire was completed by 240 directors of these internal medicine residency programs. The pass mark recommended by the 240 internal medicine directors was 70.0 ± 9.9% and the mean importance score for all 25 questions as rated by the 240 directors was 7.4 out of 10. [44] This questionnaire has thus been validated by orthopaedic surgeons, as well as internal medicine specialists, and as such has been used by many investigators as the instrument of choice in studying the adequacy or inadequacy of musculoskeletal teaching around the world.

1.2.3.1 Strengths and limitations of the Freedman and Bernstein questionnaire

Although the Freedman and Bernstein questionnaire has several strengths (namely: it covers a range of important and relevant topics relating to musculoskeletal medicine which require cognitive competency for patient care to be optimised; the format is open-ended to eliminate guessing and it has been validated by multiple program directors of both orthopaedic surgery and internal medicine residency programs in the USA); it does have certain weaknesses and criticisms too. One of the limitations of the Freedman and Bernstein questionnaire is that it has not been validated for relevance in a developing country (although it has been utilised by authors who have previously published on this subject matter in South Africa). [17 – 20] Perhaps a greater focus on questions pertaining to musculoskeletal problems prevalent in developing countries, such as South Africa, (for example: musculoskeletal tuberculosis, hand sepsis, cervical spine trauma and/or the assessment and treatment of polytrauma patients both of which are frequently seen as a result of high velocity motor vehicle collisions, a common mechanism of injury in developing countries) would offer greater insights into the knowledge of orthopaedic surgery amongst recent medical graduates in developing countries.

1.2.4 International experience of musculoskeletal education and assessment

Numerous authors have utilized the Freedman and Bernstein questionnaire to assess the knowledge of musculoskeletal medicine amongst newly qualified medical practitioners. [17 – 31] A study in the UK, showed that only 21% of newly qualified medical doctors passed the cognitive competency questionnaire created by Freedman and Bernstein. [21] The authors recommended appropriate steps be taken to improve the quantity and quality of training in musculoskeletal medicine in the United Kingdom. Ninety-four percent (94%) of Nepalese medical interns failed to achieve theoretical competency in the same examination (questionnaire) and the authors of this study similarly recommended improvements be made in the medical school curriculum as well as in teaching methods. [30] Fifty percent (50%) of final year medical students in an Indian study achieved theoretical competence in the Freedman and Bernstein questionnaire and similar recommendations of greater exposure to orthopaedics in the medical school curriculum was recommended by these authors. [26] An Australian study revealed theoretical competency of 39.4% amongst medical interns at Flinders University, South Australia. [29]

1.2.5 South African experience of musculoskeletal education and assessment

In South Africa, similarly low levels of cognitive competency have been reported. Dachs *et al*., in a study performed in Cape Town, found that 91% of medical interns did not achieve a mark higher than the pass mark suggested by Freedman and Bernstein and thus failed to achieve theoretical competency. [17] A follow up to this study, to determine if two months of post-graduate training in orthopaedics had any impact on the knowledge of orthopaedics amongst medical interns, demonstrated that 85.7% of interns still failed to show theoretical competency in the Freedman and Bernstein questionnaire despite receiving two months of post-graduate exposure to orthopaedic surgery. [18] Several changes to the way orthopaedics is taught at the authors' institution were implemented based on the findings of their two studies. These included, but are not limited to, rostering medical students to shadow the on-call orthopaedic surgery registrar on duty, upgrading the online resources accessible to medical students, and ensuring that teaching by consultant and training orthopaedic surgeons is monitored by having regular and formal feedback from students in the form of evaluations of their teachers. Coetzee *et al*., showed similarly low scores on the Freedman and Bernstein questionnaire amongst medical interns with a 94% failure rate. [20] They also sought to determine if there was a difference in cognitive competency between graduates from the various health sciences faculties in South Africa and found that the top two performing universities had longer pre-clinical rotations in musculoskeletal medicine and that the top performing university ensured revision of course work through more frequent examinations. They suggested that perhaps such educational methods should be incorporated at other health science faculties in SA.

Undergraduate teaching of orthopaedic surgery is not standardised at medical schools in SA. [18, 20] Time allocated to teaching orthopaedic surgery to medical undergraduates in SA varies amongst medical schools and averages between four and six weeks, during the entire five to six years of undergraduate teaching at medical schools in SA. [18] Some of the medical schools in SA combine teaching of orthopaedic surgery with teaching of other specialties, effectively reducing exposure to orthopaedics even further. Some medical schools in SA do not require their medical students to perform after-hours duties. [17, 18]

Postgraduate training of orthopaedic surgery in SA is not standardised either. However the duration of training for medical interns is standardised to a period of two months, at an accredited health care facility, as set out by the Health Professions Council of South Africa (HPCSA). [45]

1.2.6 Relationship of future career interest and knowledge of orthopaedic surgery

Several studies have demonstrated that future career interest has correlated with musculoskeletal knowledge (scores in the Freedman and Bernstein theoretical examination). [21, 23]

In order to reduce the burden that orthopaedic departments in SA experience, it is imperative that junior medical doctors and non-orthopaedic specialists become proficient in the diagnosis and management of common and important orthopaedic conditions, regardless of their future career choices. Junior medical doctors' proficiency in managing orthopaedic conditions would minimise the morbidity associated with sub-optimal treatment of individuals with orthopaedic conditions or injuries and would also free up learning and training opportunities for training orthopaedic specialists working in teaching hospitals. [46 – 48]

For this to be realised, undergraduate and postgraduate (internship) teaching and training of orthopaedic surgery should become standardised, and more time and resources should be allocated to the teaching and training of orthopaedic surgery to medical students and medical interns (hereafter referred to as interns) in SA.

1.3 Motivation for the current study

Medical school curricula are fluid and constantly evolving. The outcomes of the changes to these curricula need to be regularly re-assessed. Therefore, the reason for this study is to re-evaluate undergraduate training of orthopaedic surgery and musculoskeletal medicine in South Africa. Furthermore, as far as the primary investigator of this study is aware, self-reported confidence levels in orthopaedic surgery amongst newly qualified medical graduates have never been formally evaluated in the South African setting.

The findings of this study could provide co-ordinators and administrators with an opportunity to improve undergraduate and/or postgraduate orthopaedic training in SA.

1.4 Aims and objectives of the study

This study aims to assess the effectiveness of undergraduate training of orthopaedic surgery in South Africa, by evaluating the knowledge of orthopaedic surgery and self-perceived confidence in orthopaedic surgery amongst recently qualified medical graduates at three academic hospitals.

This will serve as a measure of undergraduate teaching of orthopaedic surgery in South Africa.

The objectives of the study are:

1. To document the demographic profile of the study participants

2. To determine the interns' level of knowledge of orthopaedic surgery utilising the Freedman and Bernstein questionnaire

3. To determine the interns' self-perceived confidence levels in orthopaedic surgery, using a five point Likert scale

4. To determine if a future career interest in musculoskeletal medicine has an influence on the interns' overall knowledge of orthopaedic surgery

Chapter 2: Methodology

2.1 Research question

What is the current state of orthopaedic undergraduate training in South Africa?

2.2 Study design

This study was a prospective questionnaire-based study.

2.3 Materials and methods

The interns at the study sites were invited to participate in the study on the first day of their orthopaedic rotation during their internship. Participation in the study was completely voluntary and the interns were asked to sign an informed consent document (see Appendix A) indicating their willingness to participate in the study.

The interns were asked to answer the Freedman and Bernstein questionnaire and a five point Likert scale (see appendix B) after a printed copy of the questionnaire (see appendix B) was distributed to each intern.

An invigilator was present when the interns completed the questionnaire to prevent the interns from copying one another or cheating. The interns were not allowed to make use of the internet, any textbooks or other study material while completing the questionnaire. No time limit was set for the interns to complete the questionnaire.

A five-point Likert scale was utilised for the questions pertaining to the interns' self-perceived confidence levels. Scores of 1 and 2 were considered 'not confident', scores of 3 were considered 'confident' while scores of 4 and 5 were considered 'highly confident'.

The interns' answers to the Freedman and Bernstein questionnaire were marked by the primary investigator of this study according to the answer memorandum provided in the original study published by Freedman and Bernstein. [43] A maximum score of one point was possible for each answer. [43] Partial marks were awarded to questions which had multiple answers, as per the memorandum in the Freedman and Bernstein study. [43] A pass mark of 73.1 ± 6.8% was selected as this was the pass mark that was determined in the original study by Freedman and Bernstein. [43] Each intern's overall individual score in the Freedman and Bernstein questionnaire (out of a maximum of 25) was multiplied by four to obtain a percentage. To determine the overall intern

score for each question, the individual intern scores for each question were summed and then multiplied by four to obtain a percentage.

2.4 Study sites

The study was conducted on a sample of South African-trained medical interns who rotated through the orthopaedic surgery departments at Chris Hani Baragwanath Academic Hospital (CHBAH), Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) and Helen Joseph Hospital (HJH) during the course of the year 2019.

2.5 Study sample

The study was conducted from 1 January 2019 until 1 July 2019.

Inclusion criteria (criterion):

1. South African-trained medical interns

2. Interns rotating through orthopaedic surgery for the first time

Exclusion criteria:

1. Interns who had obtained prior orthopaedic experience (e.g. if he/she had done any extra-curricular elective rotation in orthopaedic surgery at undergraduate level; or if he/she had any previous experience as a healthcare provider – specifically as a nurse, occupational therapist or physiotherapist)

2. Any intern who had previous exposure to the study questionnaire

3. Interns who submitted questionnaires that were incomplete or illegible

2.6 Data collection

Approval from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (ethics clearance number: **M190667**) and from each participating hospital's Chief Executive Officer (CEO) or hospital manager to conduct the study was obtained (see Appendices C and D). All data was collected by the primary investigator, Dr M Terreblanche. Data was captured on a Microsoft Excel spreadsheet. The study participants were anonymised.

Basic demographic information (age, gender, race) of the respondents was collected. Other information that related to the intern's undergraduate experience, the field of medicine the intern may wish to specialise in once their internship is completed, and how the intern perceived a personal level of confidence in diagnosing and managing a range of orthopaedic conditions and in performing certain orthopaedic diagnostic or therapeutic procedures was also captured on the questionnaire (see appendix B). The names of the universities the interns attended as undergraduates were captured. These were coded, numerically.

2.7 Data analysis

STATA version 14.0 statistical package was used for data analysis. Descriptive statistics were used to analyse the demographic profile of the study participants; these are reported as frequency and percentages for categorical variables. The mean and standard deviation (SD) or median and interquartile range (IQR) are reported for continuous variables as appropriate.

For inferential statistics:

1. A one-way analysis of variance (ANOVA) test was employed to test the correlation between the medical interns' knowledge with the amount of exposure to orthopaedic surgery the interns received at undergraduate level. An ANOVA test was also employed to determine if medical interns with a future career interest in disciplines which may involve the care of orthopaedic patients performed better than those with a future career interest in disciplines which have no role in the care of orthopaedic patients.
2. Regression analysis was used to assess the relationship of the medical interns' self-perceived confidence in orthopaedic surgery and their scores in the Freedman and Bernstein cognitive examination.
3. A students t-test was applied to determine if medical interns who obtained a previous undergraduate bachelor's degree performed better in the Freedman and Bernstein test or not.

P-values < 0.05, with a confidence interval (CI) of 95%, were considered statistically significant.

Chapter 3: Results

A total of 83 questionnaires were collected. Of these, 78 were suitable for inclusion in this study.

3.1 Study participant demographics

Study participants (medical interns) were recruited from the three academic hospitals in Johannesburg, SA, namely CHBAH, CMJAH and HJH during the course of the year 2019. There were 57 female respondents (73.1%), 20 male respondents (25.6%) and 1 respondent identified as 'other' (1.3%). The median age of the respondents was 26 years (IQR: 2). The racial profile of the study participants was as follows: 41% black (African), 37.2% white (Caucasian), 14.1% Indian, 7.7% mixed race (coloured) and 1.3% Asian. All the interns in this study had obtained their medical qualification from a South African university. There were three (3.9%) respondents from university 1, eight (10.3%) from university 2, seven (9%) from university 3, eleven (14.1%) from university 4, nine (11.5%) from university 5, thirty-four (43.6%) from university 6, two (2.6%) from university 7 and three (3.9%) from university 8. These numbers are reflected in Figures 3.1 – 3.3.

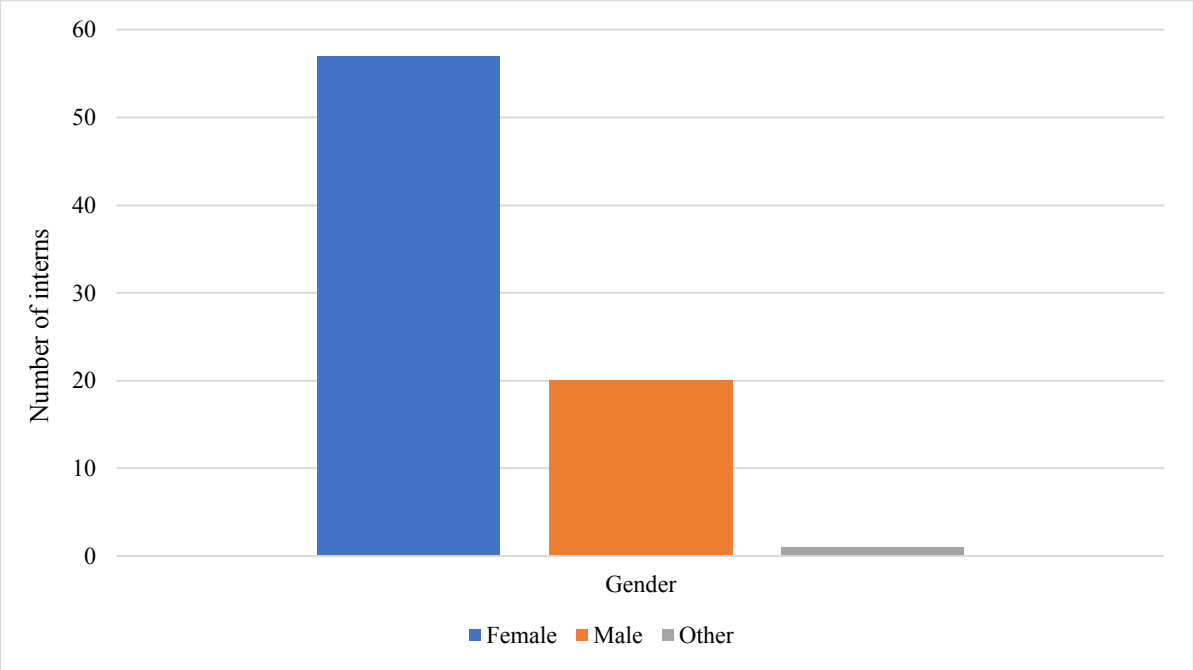


Figure 3.1: Gender of the medical interns

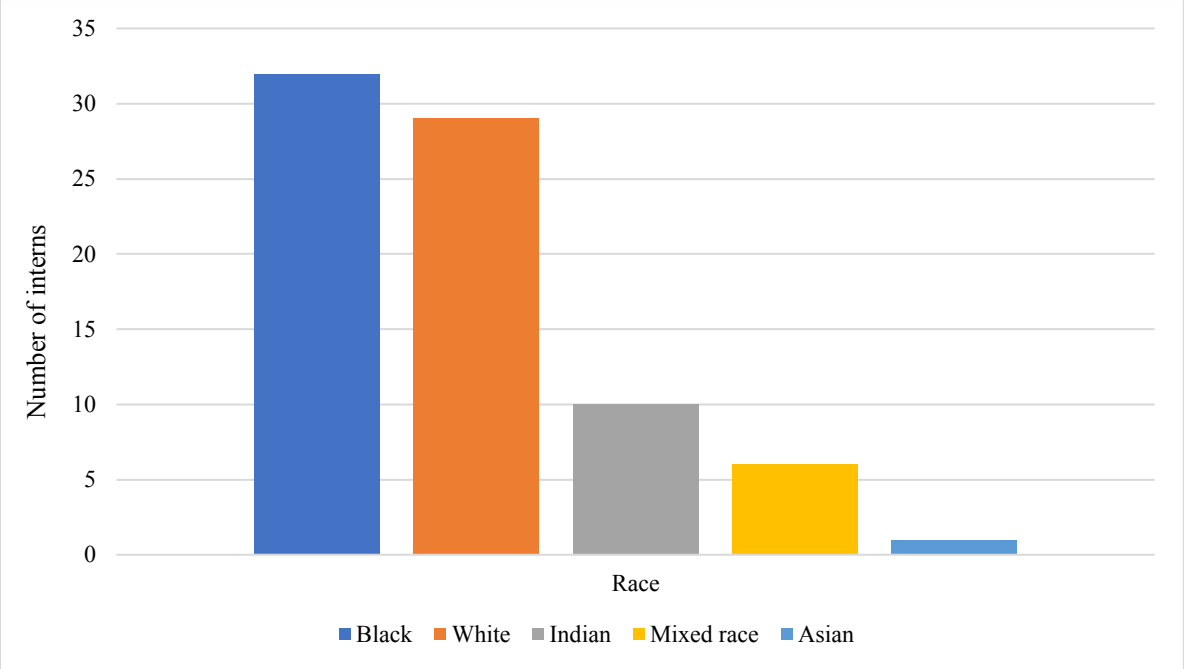


Figure 3.2: Racial profile of the medical interns

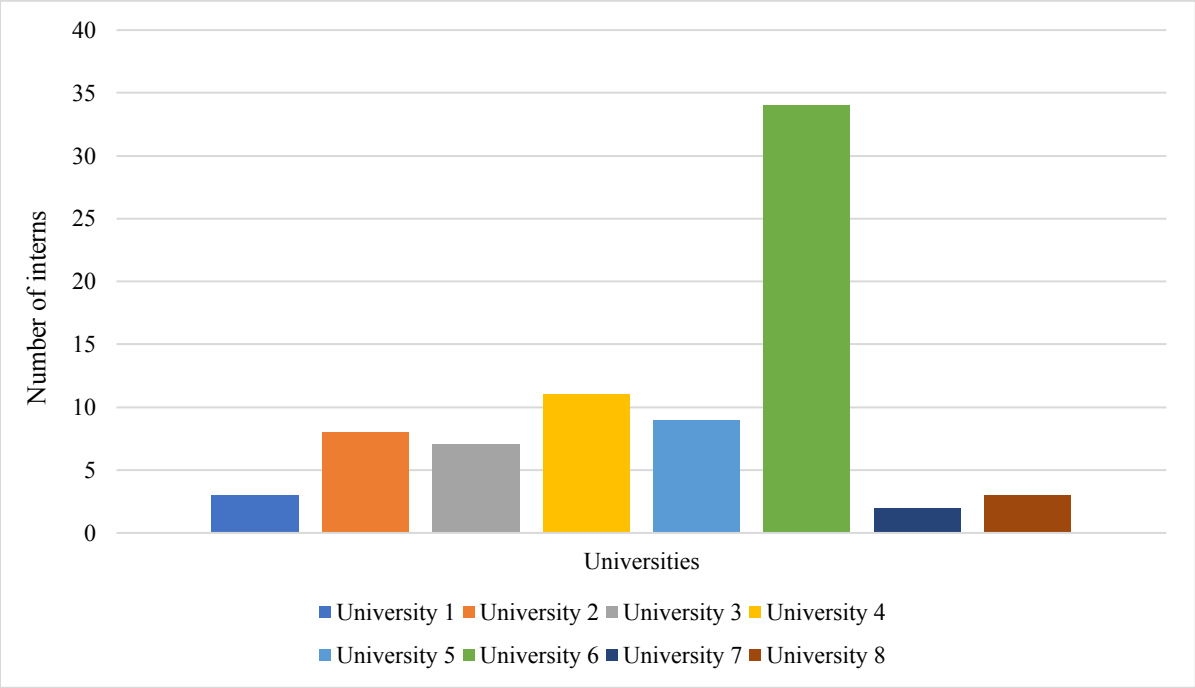


Figure 3.3: University representation amongst the medical interns

3.2 Interns' knowledge of orthopaedic surgery

The interns' mean score on the 25-question theoretical competency examination (Freedman and Bernstein questionnaire) was 40.7% (SD 13.4%) with a range of 17 – 69%.

The pass mark recommended by the 124 orthopaedic residency chairpersons in the Freedman and Bernstein study was 73.1 ± 6.8%. [43] Using this pass mark, three out of the seventy-eight (3.8%) medical interns in this study achieved a mark higher than 73.1 ± 6.8% and thus achieved basic cognitive competency in the examination. Ninety-six percent (n = 75/78) of the interns thus did not achieve basic cognitive competency in the examination.

In only seven of the twenty-five questions, did the interns achieve an overall score of more than 50%; with the interns scoring highest on question 7 (overall intern score of 87.2%) and question 10 (overall score of 83.3%).

A copy of the Freedman and Bernstein questionnaire is provided below with the weight or importance of each question (out of a total of 10, as determined by the 124 chairpersons of orthopaedic residency programs in the Freedman and Bernstein study) [43] shown in the column to the right of the suggested answer for each question. The overall intern score for each question is displayed in the column to the right of the weight or importance of each question. Overall scores from one local study (Dachs *et al.*) [17] and one international study (Al-Nammari *et al.*) [21] are provided alongside the overall scores for each question of this study, for comparison.

Table 3. 1: Freedman and Bernstein questionnaire with the interns' scores for each question [43]

Questions	**Answers**	**Importance score (out of 10)**	**Interns' score (%)**	**Interns' score (Dachs *et al.*)**	**Interns' score (Al-Nammari *et al.*)**
1. What common problem must all	Congenital dislocation of the hip (CDH,	9.1	**53.2%**	80.7%	87.6%

newborns be examined for?	dislocation, subluxation also accepted): 1 point				
2. What is a compartment syndrome?	Increased pressure in a closed fascial space: 1 point	9.0	**52.6%**	71.8%	60.5%
3. Acute septic arthritis of the knee may be differentiated from inflammatory arthritis by which laboratory test?	Any analysis of fluid from aspiration (cell count, Gram stain, culture): 1 point	8.5	**17.9%**	21.8%	51.9%
4. A patient dislocates his knee in a car accident. What structure(s) is/are at risk for injury and therefore must be evaluated?	Must mention popliteal artery: 1 point	8.4	**62.8%**	51.3%	53.8%

5. A patient punches his companion in the face and sustains a fracture of the 5th metacarpal and a 3mm break in the skin over the fracture. What is the correct treatment and why?	Irrigation and debridement; risk of infection: ½ point each	8.4	**39.1%**	32.7%	13.8%
6. A patient comes to the office complaining of low back pain that wakes him up from sleep. What two diagnoses are you concerned about?	Tumour and infection: ½ point each	8.0	**24.4%**	28.2%	56.2%
7. How is compartment syndrome treated?	Fasciotomy (surgery also accepted): 1 point	7.9	**87.2%**	92.3%	68.6%

8. A patient lands on his hand and is tender to palpation in the 'snuff box' (the space between the thumb extensor and abductor tendons). Initial radiographs do not show a fracture. What diagnosis must be considered?	Scaphoid fracture (carpal bone fracture also accepted): 1 point	7.8	**43.6%**	50.0%	72.9%
9. A 25 year old man is involved in a motor vehicle accident. His left limb is in a position of flexion at the knee and the hip, with internal rotation and adduction of the	Hip dislocation: 1 point	7.6	**48.7%**	59.0%	37.6%

hip. What is the most likely diagnosis?					
10. What nerve is compressed in carpal tunnel syndrome?	Median nerve: 1 point	7.4	**83.3%**	87.2%	100%
11. A patient had a disc herniation pressing on the 5th lumbar nerve root. How is motor function of the 5th lumbar nerve root tested?	Dorsiflexion of the great toe (toe extensors also accepted): 1 point	7.2	**1.9%**	9.0%	31.4%
12. How is the motor function of the median nerve tested in the hand?	Any median nerve function (metacarpophalangeal flexion; thumb opposition, flexion or	7.0	**35.2%**	44.2%	60.5%

	abduction): 1 point				
13. A 12 year old boy severely twists his left ankle. Radiographs show only soft tissue swelling. He is tender at the distal aspect of the fibula. What are two possible diagnoses?	Ligament sprain and Salter-Harris I fracture (sprain, fracture also accepted): 1 point	7.0	**26.9%**	41.7%	40.9%
14. A patient presents with new-onset low back pain. Under what conditions are plain radiographs indicated? Please name five (example: history of trauma)	Age > 50 years; neurological deficit; bowel or bladder changes; history of cancer; pregnancy; drug use; or steroid use; systemic symptoms (night pain, fever); paediatric	7.0	**40.1%**	57.1%	36.7%

	population: ¼ point for each				
15. A patient has a displaced fracture near the fibular neck. What structure is at risk for injury?	Common peroneal nerve (peroneal nerve also accepted): 1 point	6.8	**39.7%**	35.9%	68.6%
16. A 20 year-old injured his knee while playing football. You see him on the same day, and he has a knee effusion. An aspiration shows frank blood. What are the three most common diagnoses?	Ligament tear, fracture, peripheral meniscus tear (capsular tear, patellar dislocation also accepted): ½ point each, full credit for two correct responses	6.8	**35.9%**	37.2%	55.2%
17. What are the five most common	Breast, prostate, lung, kidney,	6.7	**63.5%**	63.3%	79.0%

sources of cancer metastases to bone?	thyroid: ¼ point for each, full credit for four correct responses				
18. Name two differences between rheumatoid arthritis and osteo-arthritis?	Any two correct statements (i.e inflammatory vs degenerative, proximal interphalangeal joint vs distal interphalangeal joint, etc): ½ point for each	6.6	**72.4%**	46.8%	48.1%
19. Which malignancy may be present in bone yet typically is not detected with a bone scan?	Myeloma (full credit for haematological malignancies – leukaemia, lymphoma): 1 point	6.4	**29.5%**	38.5%	16.7%

20. What is the function of the normal anterior cruciate ligament of the knee?	To prevent anterior displacement of the tibia on the femur: 1 point	6.2	**20.5%**	24.4%	48.6%
21. What is the difference between osteoporosis and osteomalacia?	Osteoporosis: decreased bone density; osteomalacia: decreased bone mineralisation (any true statement about epidemiology, pathophysiology, e.g. oestrogen vs Vitamin D also accepted): 1 point	5.7	**28.8%**	27.8%	60.5%
22. In elderly patients, displaced fractures of the femoral neck are typically treated	Blood supply to the femoral head (avascular necrosis, non-	5.2	**39.1%**	67.9%	75.2%

with joint replacement, whereas fractures near the trochanter are treated with plates and screws, why?	union also accepted): 1 point				
23. What muscle(s) is/are involved in lateral epicondylitis (tennis elbow)?	Wrist extensors (full credit for any wrist extensor – extensor carpi radialis brevis, extensor carpi radialis longus, extensor digitorum communis): 1 point	5.1	**3.8%**	17.9%	62.4%
24. Rupture of the biceps at the elbow results in weakness of both elbow flexion and … ?	Supination: 1 point	5.1	**28.2%**	28.2%	70.9%

25. What muscle(s) control(s) external rotation of the humerus with the arm at the side?	Infraspinatus or teres minor (full credit for rotator cuff): 1 point	4.6	**37.2%**	14.1%	54.3%

3.2.1 Sub-analysis of the interns' knowledge

Interns' overall scores for the orthopaedic emergencies ('red flag') questions

These were questions 2, 4, 5, 6, 7 and 9 (see Table 3.1). The mean score of the interns for these questions was 52.4%.

Interns' overall scores for the anatomy-related questions

These were questions 8, 10, 11, 12, 15, 20, 22, 23, 24 and 25 (see Table 3.1). The mean score for these questions was 33.2%.

3.3 Interns' self-perceived confidence levels in orthopaedic surgery

The interns' self-perceived levels of confidence in history taking and examination of an individual with a chronic shoulder and chronic knee complaint are displayed in Table 3.2.

Table 3.2: Medical interns' self-perceived confidence levels in history taking and physical examination of an individual with a chronic shoulder complaint and an individual with a chronic knee complaint

	Number of interns (*n*)	**Percentage of total interns (%)**
Confidence in history taking (shoulder complaint)		
Not confident	30	38.4%

Confident	40	51.3%
Highly confident	8	10.3%
Confidence in history taking (knee complaint)		
Not confident	16	20.5%
Confident	35	44.9%
Highly confident	27	34.6%
Confidence in examination (shoulder)		
Not confident	26	33.3%
Confident	41	52.6%
Highly confident	11	14.1%
Confidence in examination (knee)		
Not confident	22	28.2%
Confident	35	44.8%
Highly confident	21	26.9%

The interns' self-perceived levels of confidence in performing various diagnostic and therapeutic procedures pertaining to individuals with musculoskeletal problems are displayed in Table 3.3. The overall self-reported levels of confidence amongst the interns are displayed in Table 3.4.

Table 3.3: Medical interns' self-perceived confidence levels in diagnostic and therapeutic procedures related to individuals with musculoskeletal disorders

	Number of interns (*n*)	**Percentage of total interns (%)**
Confidence in performance of application of plaster of Paris cast		
Not confident	12	15.4%
Confident	42	53.9%
Highly confident	24	30.7%
Confidence in performance of knee joint aspiration		
Not confident	43	55.1%
Confident	23	29.5%
Highly confident	12	15.4%
Confidence in performance of shoulder steroid injection		
Not confident	62	79.5%
Confident	13	16.7%
Highly confident	3	3.8%

Table 3.4: Medical interns' overall self-perceived confidence levels in orthopaedic surgery

Overall level of confidence	Number of interns (*n*)	Percentage of total interns (%)
Not confident	6	7.7%
Confident	53	67.9%
Highly confident	19	24.4%

The interns' overall confidence in orthopaedic surgery (musculoskeletal medicine) was calculated by a summation of the Likert-scale scores the interns selected for the seven questions pertaining to their confidence levels. Considering that a score of 5 was the maximum score an intern could select amongst the self-perceived confidence questions, the maximum obtainable score when ranking the interns' overall confidence in orthopaedic surgery for the seven questions was 35. Since Likert-scale scores of 1 or 2 were considered 'not confident', scores of 3 were considered 'confident' and scores of 4 or 5 were considered 'highly confident'; and since there were seven questions pertaining to the interns' self-perceived confidence levels, overall intern scores of 14 or less were considered 'not confident', overall intern scores of 15 – 21 were considered 'confident' and scores of 22 – 35 were considered 'highly confident'.

3.4 Interns' future career interest

Future speciality interest was recorded, in order of descending frequency, as: anaesthesia in 20.5% (*n* = 16/78), paediatrics in 12.8% (*n* = 10/78), internal medicine in 10.3% (*n* = 8/78), orthopaedic surgery in 7.7% (*n* = 6/78), psychiatry in 6.4% (*n* = 5/78), emergency medicine in 5.1% (*n* = 4), neuro-surgery in 5.1% (*n* = 4/78), general practice (GP) in 3.8% (*n* = 3/78), radiology in 3.8% (*n* = 3/78), trauma surgery in 3.8% (*n* = 3/78), ophthalmology in 2.6% (*n* = 2/78), general surgery in 2.6% (*n* = 2/78), pathology in 2.6% (*n* = 2/78), sports medicine (*n* = 2) and plastic surgery in 2.6% (*n* = 2/78). These numbers are reflected in Figure 3.5. A wide range of other speciality interests was recorded in smaller numbers. These choices included: Ear, Nose and Throat (ENT); obstetrics and gynaecology; aviation medicine; public health; chemical pathology; and occupational health. Only one intern selected each of these specialities. These specialty choices have been grouped together under 'other' in Figure 3.4.

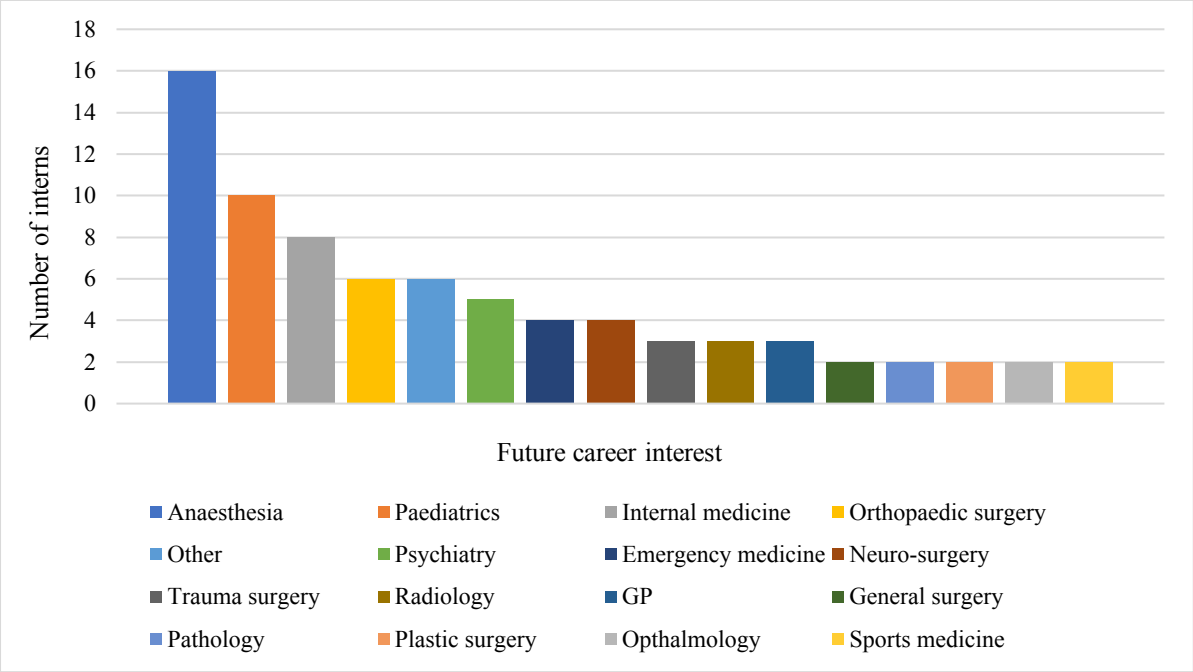


Figure 3.4: Future career interest of the medical interns

Those specialities which have overlap with the assessment and/or care of individuals with musculoskeletal disorders or complaints were grouped as 'related', as in related to the care of orthopaedic patients or 'unrelated', as in specialities which are unrelated to the care of orthopaedic patients or are considered to have very little overlap with the assessment and/or care of individuals with musculoskeletal disorders or complaints.

The 'related' group consisted of career choices such as orthopaedic surgery, anaesthesia, paediatrics, internal medicine, radiology, pathology, trauma surgery, emergency medicine, general practice and sports medicine.

The 'unrelated' group consisted of career choices such as ophthalmology, ENT, obstetrics and gynaecology and psychiatry.

Eighty-four percent (n = 66/78) of the interns indicated a future career interest in one of the specialities deemed to be 'related' to orthopaedic surgery or musculoskeletal medicine. Sixteen percent (n = 12/78) of the interns selected a future career which was deemed unrelated to orthopaedic surgery. This is illustrated in Figure 3.5.

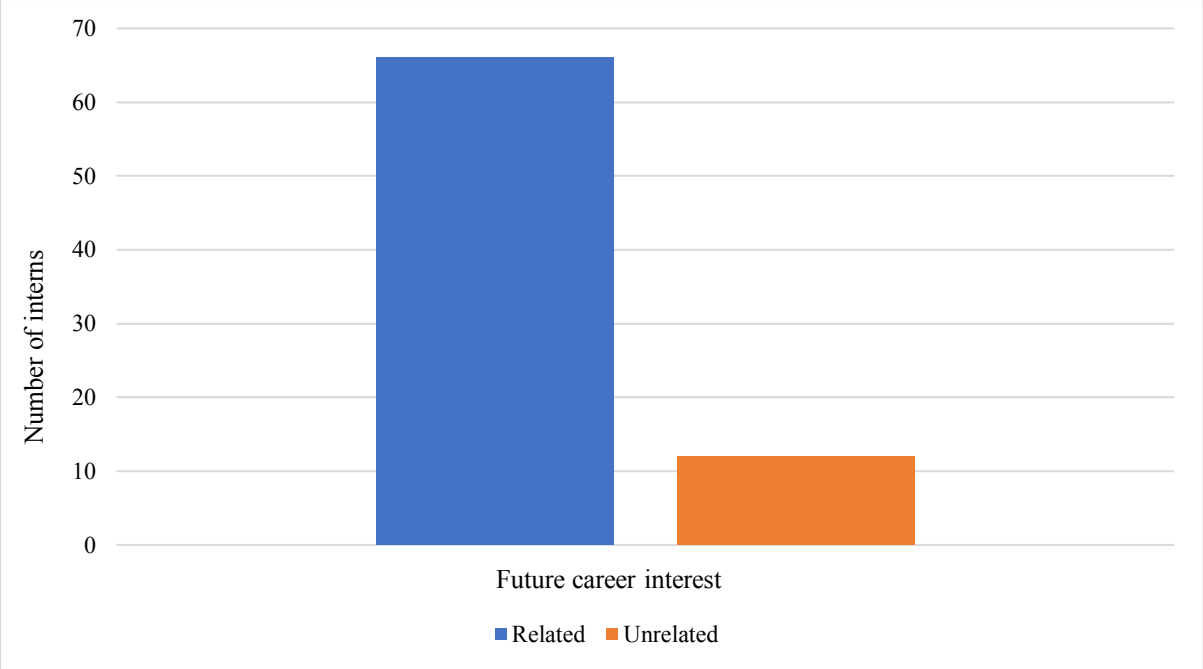


Figure 3.5: Future career interest of the medical interns grouped into career choices considered related or unrelated to orthopaedic surgery

3.5 Relationship of interns' future career interest and knowledge of orthopaedic surgery

Table 3.5 demonstrates the interns' mean scores in the Freedman and Bernstein examination when interns' future career interest was grouped into those specialities considered related to orthopaedic surgery and those considered unrelated to orthopaedic surgery.

Table 3.5: Relationship of the medical interns' future career interest, when grouped into career choices considered related to orthopaedic surgery and career choices considered unrelated to orthopaedic surgery, and their knowledge of orthopaedic surgery

Group	**Number of interns (*n*)**	**Mean Freedman & Bernstein score**	**SD**	**CI (95%)**	***P*-value**
Career interest unrelated to orthopaedic surgery	12	40.8%	11.9%	33.2 – 48.3	0.7457

Career interest related to orthopaedic surgery	66	42.2%	13.5%	38.8 – 45.5	
Combined	78	41.9%	13.2%	39.0 – 44.9	

No statistically significant difference in the interns' Freedman and Bernstein examination scores was detected when medical interns with a future career interest in specialities which are unrelated to orthopaedic surgery were compared to those with a future career interest in specialities which are related to orthopaedic surgery ($p = 0.7457$).

When future career interest of the interns was grouped into orthopaedic surgery, surgical disciplines, non-surgical disciplines, and general practice (GP), the mean score of the interns in the orthopaedic surgery group was 43.6% (SD 16.2%), the mean score in the surgical group was 39% (SD 12.7%), the mean score of the interns in the non-surgical group was 41.8% (SD 13.5%) while for the GP group the mean score of the interns was 35.6% (SD 15.0%), as illustrated in Table 3.6.

Table 3.6: Relationship of the medical interns' future career interest, when grouped into orthopaedic surgery, surgical specialties, non-surgical specialties and general practice, and their knowledge of orthopaedic surgery

Future career choice	**Number of interns (*n*)**	**Mean Freedman & Bernstein score**	**SD**	***P*-value**
Orthopaedic surgery	6	43.6%	16.2%	0.4099
Surgical specialities	15	38.8%	10.8%	
Non-surgical specialities	54	43.1%	13.4%	
General practice	3	32.4%	16.6%	

No statistically significant difference in the interns' Freedman and Bernstein examination scores was detected comparing interns with a future career interest in surgical disciplines to those with a future career interest in non-surgical disciplines or general practice ($p = 0.4099$).

The future career interests of the three interns who passed the Freedman and Bernstein questionnaire were: plastic surgery (n = 1) and anaesthesia (n = 2). None of the interns who chose orthopaedic surgery as their future speciality passed the Freedman and Bernstein questionnaire in this study. Similarly, none of the interns who selected GP or family practice as their future career choice passed the examination.

Chapter 4: Discussion

The results of this study provide insight into the knowledge and self-perceived confidence in orthopaedic surgery and musculoskeletal medicine that South African medical interns retain from their undergraduate curriculum. Essentially the findings of this study provide the reader with an understanding of how South African health sciences faculties prepare their newly qualified medical doctors to diagnose and treat disorders of the musculoskeletal system.

4.1 Demographic profile of the interns

The demographics of this cohort reflect a diverse group of recent medical graduates, from all universities in South Africa (see Figures 3.1 – 3.3).

4.2 Knowledge of orthopaedic surgery amongst South African medical interns

The primary aim of this study was to determine the knowledge and self-reported confidence levels in orthopaedic surgery amongst South African medical interns. The findings of this study are in keeping with the findings of previous studies on this topic conducted in SA; and with studies conducted internationally. [17 – 31] This study confirms that South African junior doctors' knowledge of musculoskeletal medicine is inadequate, with 96.1% (n = 75/78) of the interns in this study failing the basic competency examination in musculoskeletal medicine designed by Freedman and Bernstein, and the interns achieving a mean score of 40.6%.

Importantly, this study demonstrates that there has not been an improvement in basic musculoskeletal knowledge of junior doctors a decade after the first studies conducted on medical interns' musculoskeletal competence was performed in SA. [17 – 19] On the contrary, this study demonstrated that South African medical interns' knowledge has in fact worsened since the initial studies on intern knowledge and competence in orthopaedic surgery in SA were performed; a finding confirmed by Coetzee *et al*. in a recently published study on the same subject matter. [20]

4.2.1 Local comparisons

With specific reference to local research on this subject matter, Dachs *et al*. [17] showed that 91% of interns that they surveyed at the start of their orthopaedic rotation in the Western Cape province of SA failed the basic cognitive competency examination, with an average score of 45.3%. They suggested greater time be devoted to orthopaedic training, the content of the

curriculum be revised and more time be devoted to the teaching of anatomy in particular, since interns scored lowest on the anatomy-based questions. Robertson and Lukhele, in 2010, demonstrated an 89% failure rate amongst interns who completed the same questionnaire, with an average score of 51%. [19] More recently, in the study conducted by Coetzee *et al*., the largest study of interns' competence in orthopaedic surgery in SA, showed that the interns they studied with the Freedman and Bernstein questionnaire had a 94% failure rate, with a mean cognitive score of 46%. [20]

4.2.2 International comparisons and recommendations

Internationally, the original study by Freedman and Bernstein, published in 1998, showed a failure rate of 82% amongst first year residents in the USA, with an average score of 59.6%. [43] Skelley *et al.* showed mean scores of 59% amongst medical students who were given the Freedman and Bernstein examination at the end of their fourth and final academic year. [23] Day *et al.*, using the Freedman and Bernstein questionnaire as their assessment tool, showed a failure rate of 74% amongst final year medical students in the USA. [24] Similarly low cognitive competency amongst final year medical students or medical interns have been shown in the West Indies, Nepal, Australia, India and Hawaii. [25 – 30] In an Australian study, the failure rate amongst 66 interns was 60.6% and the mean score was 69.4%. [29] More recently, Al-Nammari *et al*. found that 79% of the newly qualified doctors in the UK they studied failed the Freedman and Bernstein cognitive examination with an average score of 56.5%. [21]

This demonstrates that the overall scores in the Freedman and Bernstein questionnaire amongst international junior doctors or final year medical students are higher than newly qualified South African doctors; and that their failure rates are lower.

These studies all called for greater quantity but also improved quality of musculoskeletal education at undergraduate level; similarly they recommended nationally commissioned investigations into the deficiency in knowledge pertaining to musculoskeletal medicine. One study advocated for inter-disciplinary teaching of musculoskeletal medicine since the care of musculoskeletal disorders is provided for by doctors working in different disciplines, and this would not only serve to reinforce knowledge already gained previously, but would provide unique insights into care of musculoskeletal disorders from the various disciplines.

4.3 Self-perceived confidence levels in orthopaedic surgery amongst medical interns

In contrast to other studies, this study found that interns have mixed levels of self-perceived confidence in their abilities to diagnose, investigate and treat common musculoskeletal disorders. [21, 23, 24]

The overall self-reported confidence levels amongst the interns in this study were high, with 24.3% (*n* = 19/78) feeling 'highly confident'; 67.9% (*n* = 53/78) of the interns feeling 'confident' in musculoskeletal medicine, and only 7.7% (*n* = 6/78) rating themselves as 'not confident'.

The majority of interns in this study felt confident or highly confident with regards to history taking and physical examination (as illustrated in Table 3.2).

The results of the interns' knowledge of basic anatomy of the knee and shoulder joint conflict with these high levels of self-perceived confidence. Only 20.5% (*n* = 16/78) of the interns had knowledge of the function of the anterior cruciate ligament and only 37.2% (*n* = 29/78) of the interns had knowledge of which muscles are responsible for external rotation of the shoulder.

The findings of this study contrast with the international literature. Skelley *et al*. found low scores of self-reported confidence levels in assessing musculoskeletal disorders, amongst USA medical students. [23] Day *et al*. similarly demonstrated that medical students in their final year of study at Harvard medical school had low self-rated confidence levels in the examination of the musculoskeletal system, compared to their confidence in examination of the respiratory system. [24] Al-Nammari *et al*. [21], in the UK, reported that only 40% (*n* = 83/210) of their study cohort felt confident in musculoskeletal medicine. These authors recommended greater exposure to musculoskeletal medicine at undergraduate level to improve confidence levels.

In contrast to their high confidence scores related to history taking and physical examination, the interns in this study showed lower scores of self-reported confidence in performing basic diagnostic and therapeutic procedures. Although the majority of the interns felt confident at being able to apply a plaster of Paris cast for a fracture, the majority of them lacked confidence in the performance of aspiration of the knee joint and the performance of a steroid injection of the shoulder (as shown in Table 3.3). Skills teaching could thus be a potential area to target in the future training of medical graduates in South Africa.

4.4 Future career interest of medical interns

This study demonstrated that South African graduates' career ambitions have no significant bearing on their knowledge of orthopaedic surgery, as illustrated in Tables 3.5 and 3.6.

This contrasts to other studies which showed a significantly greater knowledge of orthopaedic surgery amongst those who wished to enter into a career in musculoskeletal medicine than interns who selected other career choices. Skelley *et al*. showed that medical students who wished to enter into disciplines related to musculoskeletal medicine performed better, with an average score of 67.5%, than students who wished to enter into careers unrelated to musculoskeletal medicine, with an average score of 43.9%. [23] Similarly, Al-Nammari *et al*. found that 52% of their cohort who had a future interest in musculoskeletal specialities passed the Freedman and Bernstein examination while only 38% of those with an interest in surgical disciplines passed the examination. [21] In contrast, they found that only 9% of those with an interest in internal medicine passed the examination and none of the respondents with an interest in general practice passed. [21]

None of the interns in the current study who selected general practice or family practice as their future speciality of choice passed the Freedman and Bernstein questionnaire. This is concerning as a substantial proportion of a general practitioner's workload will be individuals with musculoskeletal complaints or injuries.

4.5 Limitations of the study

The findings of this study may be limited by the validity of the Freedman and Bernstein questionnaire in the South African context. Furthermore, the Likert scale in this study has not been validated. There may have been a selection bias introduced due to medical interns being recruited from only three hospitals in one province. This resulted in an overwhelming representation from one university. Lastly, it could be argued that the subjects did not take the examination seriously as there was no consequence to underperformance.

4.6 Recommendations

The current study has highlighted a deficiency in undergraduate teaching of orthopaedic surgery in South Africa. This has resulted in poor knowledge and inappropriate levels of confidence in orthopaedics amongst recent medical graduates. Therefore, this study highlights a need for curricula to be revised again and for the duration of time spent in orthopaedic training

to be reconsidered. Methods of teaching should be reviewed, and teaching objectives in the South African context more clearly defined. An appropriate assessment tool to evaluate knowledge of orthopaedic surgery, validated for the South African setting, needs to be developed.

Chapter 5: Conclusion

This study has shown that the effectiveness of South African undergraduate training of orthopaedic surgery is deficient. Recent medical graduates' knowledge of orthopaedic surgery, using the Freedman and Bernstein questionnaire, is inadequate, with a mean score of 40.7% and only 3.8% of interns passing the examination. This is similar to other local and international literature. The recent medical graduates in this study demonstrated inappropriate confidence in orthopaedic surgery with only 7.7% acknowledging a lack of confidence. The interns lacked confidence in the performance of various skills related to musculoskeletal pathologies, skills that all general practitioners should be well versed in. Interns' future career interest was not found to have a significant association with orthopaedic knowledge. This is in contrast to international literature. Graduates with a career choice related to orthopaedic surgery achieved an overall score of 42.2% in the Freedman and Bernstein examination versus an overall score of 40.8% in those who chose a career unrelated to orthopaedic surgery. This study suggests that in South Africa orthopaedic undergraduate training needs improvement.

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Appendices

Appendix A: Informed consent document

Informed consent

Study Title: Evaluation of medical interns' knowledge and confidence in orthopaedic surgery at the University of the Witwatersrand's academic hospital complex in Johannesburg, South Africa

Good day,

My name is Dr Michael Terreblanche and I am a registrar working in the department of orthopaedic surgery at the University of the Witwatersrand. I am conducting research in the form of a survey/questionnaire to understand the level of knowledge and confidence in orthopaedic surgery of medical interns working and training at hospitals affiliated to the University of the Witwatersrand. This research will contribute towards my Masters degree in medicine, which is a requirement for one to become a specialist orthopaedic surgeon in South Africa.

I would like to invite you to consider participating in the study I am conducting entitled: "Evaluation of medical interns' knowledge and confidence in orthopaedic surgery at the University of the Witwatersrand's academic hospital complex in Johannesburg, South Africa"

Before agreeing to participate, it is important that you read and understand the following explanation of the purpose of the study, the study procedures, benefits, and your right to withdraw from the study at any time.

The information provided in this consent form is to help you to decide if you would like to participate.

Local and international research has shown that medical undergraduates do not receive sufficient exposure to and training within orthopaedic surgery. Furthermore, studies have shown that, globally, junior doctors' knowledge of orthopaedic surgery is low. This is concerning because musculoskeletal conditions are common and patients with musculoskeletal problems present frequently to both emergency centres and to general/family practitioners. Musculoskeletal conditions and disorders can have a significant impact on individuals in terms of disability and chronic pain, especially if managed sub-optimally; and also on society (time away from work, loss of productivity, permanent disability etc.). The treatment of musculoskeletal injuries and disorders consumes a large portion of health care budgets, and even more so if treatment or management is delayed or sub-optimal when extensive and/or expensive reconstructive surgical procedures are often required to treat problems as a result of inadequate initial care of the individual.

There is a shortage of orthopaedic surgeons working in state health care facilities in South Africa, so it is becoming necessary for non-orthopaedic specialists to become proficient in managing orthopaedic conditions. The low level of knowledge of orthopaedic surgery among junior doctors is particularly alarming in South Africa where relatively inexperienced doctors undertaking their mandatory year of community service often have to manage orthopaedic conditions in rural hospitals without the direct supervision of an orthopaedic specialist. Some of the other knock on effects of inadequate knowledge and confidence in orthopaedic surgery among junior doctors are that it impacts on registrar training of orthopaedics as more and more trauma cases are referred to academic/university hospitals where more elective (non-trauma) orthopaedic surgical procedures should be carried out. This has the added consequence of orthopaedic consultants becoming demotivated and uninspired to remain working in state

health care facilities (where registrar training takes place) as they do not get the opportunities to develop their surgical skill in elective (non-trauma) orthopaedic procedures, as most of their time is spent operating on trauma cases. Registrar training is thus further impacted as more and more consultants leave state health care facilities to pursue career development in the private health care sector.

In the context of the information presented above, the purpose of this research is to determine the knowledge and confidence in orthopaedic surgery of South African junior doctors (medical interns) and if it is found that South African junior doctors are inadequately prepared to care for individuals with musculoskeletal injuries or disorders, this might provide co-ordinators with an opportunity to improve undergraduate and/or postgraduate orthopaedic training in South Africa.

In this questionnaire, you will be asked to provide basic demographic details such as your age, gender and race; and you will be asked questions relating to your potential choice of future career interest. You will be asked questions pertaining to the orthopaedic teaching/training you received at undergraduate level. You will be asked questions relating to how confident you feel you are at managing and diagnosing certain orthopaedic conditions. You will also be asked a set of questions to assess your knowledge of orthopaedic surgery.

Your participation in this research is completely voluntary and your responses to the questions in the questionnaire will be completely anonymous. Your participation in, or decision not to participate in this research and your answers to the questions in this survey will not influence your assessment at the end of your orthopaedic rotation in any way.

If you are willing to take part in this research, kindly tick the check box next to where it says "voluntarily agree to participate" at the bottom of this page. If you would not like to participate

in this research, kindly tick the check box at the bottom of this page next to where it says "voluntarily disagree to participate".

I have been informed of the content of, and the purpose of this research questionnaire and I:

Voluntarily agree to participate in this research questionnaire ☐

Voluntarily disagree to participate in this research questionnaire ☐

Thank you for your time.

Dr M Terreblanche

Appendix B: Study questionnaire

Undergraduate experience

Where did you obtain your medical degree?

South Africa ☐

Outside of South Africa ☐

Did you undertake an elective in orthopaedic surgery as a medical student (whether part of your curriculum or on your own accord) or receive any additional teaching or training in orthopaedic surgery outside of the official teaching set aside for orthopaedic surgery as a medical student? _____

If you answered 'yes' to the question above, or if you have ever seen or completed the Freedman and Bernstein questionnaire you do not need to complete the remainder of this questionnaire.

If you answered 'no' to the question above, and if you wish to participate in this study/research, kindly complete the remainder of the questionnaire.

What was the duration of your orthopaedic training at undergraduate level (in weeks)?

_____

Were you required to partake in after-hours duties (e.g. “calls”) in orthopaedic surgery as a medical student?

Yes ☐

No ☐

If you answered yes to the above question, what did your after-hours duties consist of?

Limited “calls” (e.g. until 22h00 or similar) ☐

24 hour “calls” ☐

Did you achieve an undergraduate bachelor’s degree prior to achieving your medical degree (MBChB, MBBCh or equivalent)?

Yes ☐

No ☐

Demographic information

Please indicate your:

Age (years) _____

Gender

Male ☐

Female ☐

Other ☐

Race

African (black) ☐

Asian (Indian) ☐

Asian (Oriental ancestry) ☐

Caucasian (white) ☐

Mixed race (coloured) ☐

Other ☐

Future career interest:

Please select one of the following options:

General practice/family practice ☐

Internal medicine ☐

Anaesthesia/pain management ☐

Sports medicine ☐

Emergency medicine ☐

Orthopaedic surgery ☐

Paediatrics ☐

Occupational health ☐

Trauma surgery ☐

General surgery ☐

Rheumatology ☐

Other ☐

Please specify _____

Rating your confidence in orthopaedic surgery

On a scale of 1 – 5 (1 = none, 2 = low, 3 = adequate, 4 = high, 5 = complete), how would you rate your confidence in taking a history to help you to formulate a differential diagnosis (e.g. coming up with five diagnostic possibilities) for:

A patient with a shoulder complaint (e.g. chronic shoulder pain)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

A patient with a knee complaint (e.g. chronic knee pain):

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Using the same scale (1 – 5), how would you rate your confidence in:

Performing an examination of the shoulder in order to formulate a differential diagnosis in a patient with a shoulder complaint (e.g. chronic shoulder pain):

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Performing an examination of the knee in order to formulate a differential diagnosis in a patient with a knee complaint (e.g. chronic knee pain):

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Using the same scale (1 – 5), how would you rate your confidence in:

Applying a plaster of Paris cast for a fracture:

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Performing a diagnostic aspiration (arthrocentesis) of a knee joint in an adult patient with a knee effusion of unknown cause:

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Performing a local anaesthetic steroid injection (LASI) for an adult patient with gleno-humeral (shoulder) joint osteo-arthritis or supraspinatus tendonitis:

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Freedman and Bernstein questionnaire:

Questions	**Answers**
1. What common problem must all newborns be examined for?	Congenital dislocation of the hip (CDH, dislocation, subluxation also accepted): 1 point
2. What is a compartment syndrome?	Increased pressure in a closed fascial space: 1 point
3. Acute septic arthritis of the knee may be differentiated from inflammatory arthritis by which laboratory test?	Any analysis of fluid from aspiration (cell count, Gram stain, culture): 1 point
4. A patient dislocates his knee in a car accident. What structure(s) is/are at risk for injury and therefore must be evaluated?	Must mention popliteal artery: 1 point
5. A patient punches his companion in the face and sustains a fracture of the 5^{th} metacarpal and a 3mm break in the skin over the fracture. What is the correct treatment and why?	Irrigation and debridement; risk of infection: ½ point each

6. A patient comes to the office complaining of low back pain that wakes him up from sleep. What two diagnoses are you concerned about?	Tumour and infection: ½ point each
7. How is compartment syndrome treated?	Fasciotomy (surgery also accepted): 1 point
8. A patient lands on his hand and is tender to palpation in the 'snuff box' (the space between the thumb extensor and abductor tendons). Initial radiographs do not show a fracture. What diagnosis must be considered?	Scaphoid fracture (carpal bone fracture also accepted): 1 point
9. A 25 year old man is involved in a motor vehicle accident. His left limb is in a position of flexion at the knee and the hip, with internal rotation and adduction of the hip. What is the most likely diagnosis?	Hip dislocation: 1 point
10. What nerve is compressed in carpal tunnel syndrome?	Median nerve: 1 point

11. A patient had a disc herniation pressing on the 5th lumbar nerve root. How is motor function of the 5th lumbar nerve root tested?	Dorsiflexion of the great toe (toe extensors also accepted): 1 point
12. How is the motor function of the median nerve tested in the hand?	Any median nerve function (metacarpophalangeal flexion; thumb opposition, flexion or abduction): 1 point
13. A 12 year old boy severely twists his left ankle. Radiographs show only soft tissue swelling. He is tender at the distal aspect of the fibula. What are two possible diagnoses?	Ligament sprain and Salter-Harris I fracture (sprain, fracture also accepted): 1 point
14. A patient presents with new-onset low back pain. Under what conditions are plain radiographs indicated? Please name five (example: history of trauma)	Age > 50 years; neurological deficit; bowel or bladder changes; history of cancer; pregnancy; drug use; or steroid use; systemic symptoms (night pain, fever); paediatric population: ¼ point for each
15. A patient has a displaced fracture near the fibular neck. What structure is at risk for injury?	Common peroneal nerve (peroneal nerve also accepted): 1 point
16. A 20 year-old injured his knee while playing football. You see him on the same	Ligament tear, fracture, peripheral meniscus tear (capsular tear, patellar dislocation also

day, and he has a knee effusion. An aspiration shows frank blood. What are the three most common diagnoses?	accepted): ½ point each, full credit for two correct responses
17. What are the five most common sources of cancer metastases to bone?	Breast, prostate, lung, kidney, thyroid: ¼ point for each, full credit for four correct responses
18. Name two differences between rheumatoid arthritis and osteo-arthritis?	Any two correct statements (i.e. inflammatory vs degenerative, proximal interphalangeal joint vs distal interphalangeal joint, etc): ½ point for each
19. Which malignancy may be present in bone yet typically is not detected with a bone scan?	Myeloma (full credit for haematological malignancies – leukaemia, lymphoma): 1 point
20. What is the function of the normal anterior cruciate ligament of the knee?	To prevent anterior displacement of the tibia on the femur: 1 point
21. What is the difference between osteoporosis and osteomalacia?	Osteoporosis: decreased bone density; osteomalacia: decreased bone mineralisation (any true statement about epidemiology, pathophysiology, e.g. oestrogen vs Vitamin D also accepted): 1 point

22. In elderly patients, displaced fractures of the femoral neck are typically treated with joint replacement, whereas fractures near the trochanter are treated with plates and screws, why?	Blood supply to the femoral head (avascular necrosis, non-union also accepted): 1 point
23. What muscle(s) is/are involved in lateral epicondylitis (tennis elbow)?	Wrist extensors (full credit for any wrist extensor – extensor carpi radialis brevis, extensor carpi radialis longus, extensor digitorum communis): 1 point
24. Rupture of the biceps at the elbow results in weakness of both elbow flexion and … ?	Supination: 1 point
25. What muscle(s) control(s) external rotation of the humerus with the arm at the side?	Infraspinatus or teres minor (full credit for rotator cuff): 1 point

Appendix C: Human Research Ethics Committee (Medical) Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr M Terreblanche

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M190667

NAME: (Principal Investigator)	Dr M Terreblanche
DEPARTMENT:	School of Clinical Medicine Department of Surgery Division of Orthopaedic Surgery Charlotte Maxeke Johannesburg Academic Hospital
PROJECT TITLE:	Evaluation of medical interns' knowledge and confidence in orthopaedic surgery at the University of the Witwatersrand's academic hospital complex in Johannesburg, South Africa
DATE CONSIDERED:	2019/06/28
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr SA Khan
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2019/10/08

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

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 submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **June** and will therefore reports and re-certification will be due early in the month of **June** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

10. 10. 2019.
Date

PLEASE QUOTE THE CLEARANCE CERTIFICATE NUMBER IN ALL ENQUIRIES

Appendix D: Hospital CEO permission letters

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Gauteng Department of Health
Helen Joseph Hospital
Enquiries: Dr. M. Mukansi
Research Committee: Chairperson
Tel :(011) 489-0306/1087
Fax :(011) 489 1038
E mail:Murimisi.mukansi@wits.ac.za

02 April 2019

To whom it may concern

Subject: HELEN JOSEPH HOSPITAL RESEARCH COMMITTEE APPLICATION

PROTOCOL TITLE: Evaluation of medical interns knowledge and confidence in Orthopeadic Surgery at the University of Witwatersrand Academic Hospital in Johannesburg South Africa.

Protocol Ref No: Dr Michael Terreblanche

Ethic Clearance: Pending

Principal investigator: Dr Michael Terreblanche

Department: Orthopeadic Surgery

Committee Recommendations
The Committee is giving you Conditional access while awaiting the final ethical clearance certificate from the University of Witwatersrand HREC.

It is the duty of the researcher to collect the data to the relevant department after the Research Committee approved the study.

Dr. M. Mukansi
Chairperson of HJH Ethic and Research Committee

GAUTENG PROVINCE

REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 27th February 2019

TITLE OF PROJECT:

Evaluation of medical interns' knowledge and confidence in orthopaedic surgery at the University of Witwatersrand's academic hospital complex in Johannesburg, South Africa.

UNIVERSITY: Witswatersrand

Principal Investigator: Dr M Terreblanche

Department: Orthopaedics

Supervisor : Dr S A Khan

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: 27/02/2019

.....
Approved/~~Not Approved~~
Hospital Management
Date: 28/02/2019

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. N. Mzila
Office of the Clinical Director
Email:Nolwazi.Mzila@gauteng.gov.za
Tell: (011): 488-4812
03 March 2019

Dear Dr. M. Terreblanche

STUDY TITLE: Evaluation of medical interns Knowledge and confidence in Orthopaedic surgery at the wits academic complex in Johannesburg, South Africa.

Permission to conduct the above mentioned study is provisional approved. Your study can only commence once Ethics approval is obtained. Please forward a copy of your Ethics Clearance Certificate as soon as the study is approved by the Ethics Committee for the CEO's office to give you the final approval to conduct the study.

Supported / ~~not supported~~

Dr. M.I. Mofokeng
Clinical Director
DATE: 5/03/2019

Approved / not approved

Ms. G. Bogoshi
Chief Executive Officer
DATE: 05.03.2019