

Predictors of next day discharge following total hip arthroplasty using the direct anterior approach



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Declaration

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

Signature:.....*R Fernandes*.....

11 October 2024 in Johannesburg, South Africa

**To my nephew and nieces Andrew, Tyla, Jessica and Tatum may you always remain
curious about the world and pursue your dreams.**

Abstract

Total hip arthroplasty widely considered to be the “operation of the 20th century” is projected to increase in number over the coming decades. This is a life changing operation with significant risks and benefits available to the patient should they choose to opt for this course of treatment. The direct anterior approach is fast becoming a popular and sought after approach by surgeons and patients alike due to its propensity for greater soft tissue management and potential to mobilise sooner post-operatively.

The aim of this research dissertation is to determine the predictive factors of next day discharge following total hip arthroplasty using the direct anterior approach. A Cross-sectional retrospective study was performed at a single private practice in Johannesburg, South Africa. The study population included all patients over a six-year period (01 January 2016 – 31 December 2021) who have undergone Direct Anterior Approach (DAA) for Total Hip Arthroplasty (THA) at Morningside Mediclinic.

The data consisted of 700 records and 12 variables namely; next day discharge, age, sex, Body Mass Index (BMI), side of surgery, American Society of Anaesthesiologists (ASA) grade, anaesthetic method, time of surgery, Timed up-and-go (TUG), Risk Assessment and Prediction Tool (RAPT), Harris Hip Scale (HHS), and grip strength. Of a possible 9100 data points there were a total of 396 missing observations.

Of the data analysed the most statistically significant findings were that female patients, who are over the age of 70 years, have had surgery in the afternoon and were exposed to general anaesthetic, are more likely to have longer length of stay. This was confirmed by various pre-operative and validated assessment tools.

Subsequently, an exploratory analysis found that grip strength, which is now widely considered to be the new vital sign of health, could be used as an inexpensive point of care test to predict next day discharge following THA *via* the DAA.

Acknowledgements

I would like to give thanks to my supervisors who have all been extremely supportive and dedicated to assisting me with this body of work;

Dr Botha for allowing me access to the data which he has so carefully collected over so many years which now can be analysed for the benefit of so many and will hopefully make a lasting impression on the practice of arthroplasty

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NOMENCLATURE

ASA	American Society of Anaesthesiologists
AMIS	Anterior Minimally Invasive Surgery
ASIS	Anterior Superior Iliac Spine
BMI	Body Mass Index
CEO	Chief Executive Officer
Covid-19	Coronavirus Disease 2019
DAA	Direct Anterior Approach
ERAS	Enhanced Recovery After Surgery
HHS	Harris Hip Score
LOS	Length of Stay
NHS	National Health Service
PI	Primary Investigator
PJI	Periprosthetic Joint Infection
RAPT	Risk Assessment and Prediction Tool
RF	Rectus Femoris
TFL	Tensor Fascia lata
THA	Total Hip Arthroplasty
TUG	Timed up-and-go
UK	United Kingdom
USA	United States of America

CHAPTER 1

1. INTRODUCTION / BACKGROUND

Globally, the demand for total hip arthroplasty (THA) is growing rapidly and currently, there are over 1 million THA procedures performed each year (1)(2). THA is well considered to be the “operation of the 20th century” with The American Joint Replacement Registry reporting that 92.7% of patients reported meaningful improvement following THA (2)(3). Over the next two decades, THA procedures are expected to double with the United States of America (USA) alone predicting an increase of 284% by 2040 (4). The American Joint Replacement Registry 2021 reported 775,589 total hip arthroplasties and 82,594 hemiarthroplasties between 2012 and 2020 (5). These accounted for 34.6% and 3.7% of total arthroplasty procedures performed over that time (5). In the United Kingdom (UK) the National Joint Registry reported 1,251,164 primary hip arthroplasties between 1st April 2003 and 31st December 2020 (6).

The burden of joint arthroplasty is costly and, in the UK, the average estimated cost of THA is £6000, costing the National Health Service (NHS) approximately £64 million per annum (7). In the USA primary THA accounts for approximately \$15 billion in healthcare costs annually (8). In South Africa (SA) the mean cost of THA is approximately R74,185.25 and is in line with the current global trends (9). The increasing demand for THA will be a universal burden on healthcare resources and finances, which has led to the development of enhanced recovery protocols. These protocols reduce the length of stay to a few days or same day discharge to combat this and have been shown to be successful when compared to the more traditional recovery options (10).

The coronavirus disease 2019 (COVID-19) pandemic has shown us that further demands on our healthcare systems present unique challenges in order to meet the needs of elective arthroplasty. There have been many strategies that are directed at improving patient care and the efficiency of how that care is delivered while distributing the load back to the community services (10). The direct anterior approach (DAA) is gaining popularity because it is associated with less surgical trauma and bleeding, quicker recovery time, faster rehabilitation, potentially better patient outcomes, optimal hardware positioning, and a low dislocation rate. There is a general trend to perform procedures that protect the soft tissue and these are fast becoming the gold standard for THA and generally throughout orthopaedic surgery (12).

Hueter described the anterior approach to the hip joint in 1881 followed by Smith-Petersen in 1917, who then described this approach for hip arthroplasty in 1949 in the USA (13). A shorter vertical anterior approach to perform arthroplasty of the hip as well as the use of an orthopaedic table was first described by the Judet brothers in 1985 (13). The DAA to the hip uses a natural intermuscular and internervous plane in the interval between the tensor fascia lata (TFL) and the sartorius muscle (14). The skin incision is positioned anterolaterally directly over the TFL roughly 2 – 3cm distally and 3cm laterally to the anterior superior iliac spine (ASIS). Fascia covering TFL is incised and intra-facial blunt dissection anterior to the TFL muscle fibers performed to gain access to the medial aponeurosis which is lateral to the sartorius. The rectus femoris (RF) is then retracted medially and the TFL laterally which allows for exposure of the branches which ascend from the lateral circumflex vessels over the anterior hip capsule. These vessels are ligated and the hip joint is exposed *via* capsulotomy. In situ femoral neck osteotomy is done and removal of the femoral head. The acetabular preparation is routinely performed. The femoral preparation is done using a femoral leg positioner which allows external rotation and extension to access the femoral canal (15)(16). The visual representation of DAA can be found in Appendix A.

There are many potential advantages of the DAA however there still remains some controversy of this approach over other approaches to the hip. The DAA is thought to preserve soft tissue around the hip joint due to the inter-muscular interval which it makes use of while preserving hip stability and the abductor musculature. THA with DAA has been associated with a more rapid recovery when measured according to function and activity. These differences were not significant at two months. Patients may be mobilised on the day of the operation with crutches or a walker without any post-operative precautionary measures. The use of opioids is considerably less when compared to other approaches and the length of hospital stay is shorter. Due to the patient's supine positioning, intra-operative fluoroscopy may be used, which may assist in improved component positioning, leg length, and hip offset restoration (11).

There are potential disadvantages to the DAA with conflicting and equivocal scientific data. The steep learning curve is cited widely in literature with between 50 to 100 cases being cited to achieve this and over 100 cases showing a reduction in operative time and fluoroscopy time (11). There are numerous factors which may be considered to predict the length of hospital stay in THA. Sibia et al. looked at various pre-operative patient characteristics comparing a 1 day length of stay (LOS) with a greater than 1 day LOS. Older patients are more likely to have a

longer LOS with patients 70 years old being 1.80 times more likely to have LOS greater than one day. Female gender has been found to be a possible predictor of LOS with a 1.74 times higher rate of LOS greater than 1 day. Effects of body mass index (BMI) on LOS have been studied significantly and an increase of 5kg/m² BMI resulted in increased odds for increased LOS greater than 1 day by 1.40 times. Patients with the American Association of Anaesthesiologists (ASA) grade 3 or grade 4 were 1.84 times more likely to have hospital admission greater than 2 days (17).

Sibia et al. have shown that perioperative surgical variables have also shown an impact on patient LOS. The DAA has been shown to have a shorter length of stay. Patients who were operated on in the afternoon were 2.81 times more likely to have LOS greater than 1-day. DAA is thought to cause less muscle damage when measured with serum creatine kinase levels compared to other approaches and has also shown improvements on the timed up-and-go test. Post-operative rehabilitation and mobilisation on the day of surgery resulted in decreased pain scores and the mean LOS with patients who do not mobilise on the day of surgery to be 3.93 times more likely to have LOS greater than 2 days. Additionally, Sibia et al. have shown that reducing a 2 day LOS down to a 1 day LOS saved approximately \$2900 with 105 bed days saved which totals \$303,688 (17).

In order to attempt to address the burden of LOS and the factors associated with it, the concept of Enhanced Recovery After Surgery (ERAS copyright) was described in 1997 by a Danish surgeon named Henrick Kehlet (18). The concept behind ERAS is to reduce post-operative physical and psychological stress in order to decrease recovery time and financial burden (18). ERAS protocols have been associated with a decrease in blood product transfusions, complication rates, LOS without an increase in mortality, and the 30-day re-admission rate (19). In appropriately selected patients, the 90-day re-admission rates are comparable to the traditional inpatient model of care (20).

Yannick et al. looked at implementing a patient-centered, time-based, fast-track programme with regard to THA. This study found that this protocol can result in a LOS of 24 hours or less with very high patient satisfaction (18). There are a number of elements that contribute to the time-based fast-track protocol. The most important first step is to initiate the concept of a shorter LOS educating the patient that they will go home the next day following surgery. Everyone involved with the patient should be utilised to drive home this message namely the surgeon, physio and administration personnel. There is a standardised general anaesthesia with

added local infiltration and a pre-, peri-, and post-operative standardised pain medication protocol. The operating technique is standardised with a traction table the preferred method depending on the surgeon's choice. There should be no drains or urinary catheter insertion. The patient should be encouraged to mobilise 3 hours post-operatively and opioid medication should only be given during recovery and at home. The patient is started on anti-thrombotic prophylaxis for 10 days. If all of these criteria are met, the patient receives a time-based discharge 24 hours post-operatively. The patient then continues mobilising for 14 days and receives a telephone call on the third day to assess the patient's progress (21).

We have embarked on pursuing a research protocol based on identifying what factors may be used to predict next day discharge following THA. We have identified an orthopaedic practice that makes use of the DAA technique with an orthopaedic table or leg positioner and employs the concepts mentioned above in the literature review. This practice began collecting data on patients regarding the DAA in 2016 when the protocols of their treatment began to change.

This research project aims to analyse the data collected at this practice over a six-year period (01 January 2016 – 31 December 2021) and to interpret this data to determine if there are any predictive factors of next day discharge following total hip arthroplasty using the direct anterior approach.

1.1. Aim and Objectives

1.1.1 Aim:

To determine the predictive factors of next day discharge following total hip arthroplasty using the direct anterior approach.

1.1.2 Objectives:

- i. To perform a retrospective analysis of the data collected on the Filemaker database following DAA for THA at a private practice at Morningside Mediclinic from 01 January 2016 to 31 December 2021
- ii. To determine the impact of the factors affecting next-day discharge following DAA for THA
- iii. To determine if there are predictive factors from the data that can be considered pre-operatively to predict the likelihood of an overnight discharge

CHAPTER 2

2. METHODOLOGY

2.1. Study design

Cross-sectional retrospective study

2.2. Study site

The study will be conducted within a private practice at Morningside Mediclinic Sandton, Johannesburg, South Africa

2.3. Study population

The study population will include all patients over a six-year period (01 January 2016 – 31 December 2021) who have undergone DAA for THA at Morningside Mediclinic

2.4. Data collection

Data were obtained from the Filemaker database for all patients who underwent DAA for THA from the period, 01 January 2016 – 31 December 2021. Permission to access the Filemaker database was obtained from Dr Botha. The primary investigator (PI), Dr Fernandes reviewed the Filemaker database and the patient files. Variables were retrieved from the Filemaker database and patient files are shown below and in Appendix B. The following data will be collected:

- Age
- Sex
- BMI
- Side of surgery
- ASA grade
- Anaesthetic method
- Time of surgery (AM/PM)
- TUG

- RAPT
- Harris hip score (HSS)
- Grip strength (exploratory analysis – see **Results** chapter)

2.5. Selection criteria

2.4.1. Inclusion criterion:

- i. All patients who have undergone primary THA *via* the DAA at a single private practice in Morningside Mediclinic between 01 January 2016 and 31 December 2021

2.4.2. Exclusion criteria:

- i. Patients who were not independently mobile prior to surgery (with or without walking aid)
- ii. Patients who underwent a post-traumatic total hip arthroplasty
- iii. Patients requiring revision arthroplasty

CHAPTER 3

3. RESULTS

The following will outline the interpretation of the data collected over the stipulated period and following this the data will be interpreted within the discussion section making inferences to possibilities for the findings and the conclusions thereof. The data that was collected was cleaned and checked for missingness in terms of variables that could not be accounted for. Missingness of greater than 30% with regard to a specific variable was removed from the data analysis. A total of seven records were removed from the analysis due to unlikely values. These consisted of the following:

- Days to discharge < 0 days ($n = 1$)
- BMI $< 15 \text{ kg.m}^{-2}$ ($n = 2$)
- TUG = 0s ($n = 4$)

The data consisted of 700 records and 12 variables as mentioned previously namely; next day discharge, age, sex, BMI, side of surgery, ASA grade, anaesthetic method, time of surgery, TUG, RAPT, HHS, and grip strength. This far exceeds the aim of 500 patients. Of a possible 9100 data points there were a total of 396 missing observations as follows:

- Anaesthetic method: $n = 3$
- Next day discharge: $n = 11$
- ASA grade: $n = 30$
- HHS: $n = 93$
- RAPT: $n = 125$
- TUG: $n = 134$

Table 3.1 is the summary of the dataset collected, $n = 700$.

Table 3.1: Original dataset ($n = 700$)

Characteristic	Missing classification, N = 11 ¹	No, N = 263 ¹	Yes, N = 426 ¹
Age (years)	66 (60, 68)	70 (63, 76)	65 (58, 71)
Sex			
Female	4 (36%)	200 (76%)	219 (51%)
Male	7 (64%)	63 (24%)	207 (49%)
BMI (kg.m ⁻²)	28.4 (27.8, 32.4)	27.9 (23.9, 32.3)	27.8 (24.5, 31.7)
Side of surgery			
Left	6 (55%)	112 (43%)	182 (43%)
Right	5 (45%)	151 (57%)	244 (57%)
ASA grade			
I	0 (0%)	9 (3.6%)	34 (8.3%)
II	9 (90%)	202 (81%)	353 (86%)
III	1 (10%)	39 (16%)	23 (5.6%)
Missing	1	13	16
Anaesthetic method			
General	0 (0%)	20 (7.6%)	17 (4.0%)
General, Morphine Spinal	4 (50%)	199 (76%)	299 (70%)

Characteristic	Missing classification, N = 11 ¹	No, N = 263 ¹	Yes, N = 426 ¹
General, Spinal	0 (0%)	1 (0.4%)	5 (1.2%)
Morphine Spinal	4 (50%)	39 (15%)	98 (23%)
Morphine Spinal, Sedation	0 (0%)	4 (1.5%)	7 (1.6%)
Unknown	3	0	0
Surgery time			
AM	5 (45%)	164 (62%)	296 (69%)
PM	6 (55%)	99 (38%)	130 (31%)
Timed up-and-go (s)	10 (9, 19)	12 (9, 19)	9 (8, 11)
Missing	1	70	63
RAPT category			
<6	1 (10%)	38 (19%)	9 (2.5%)
>9	6 (60%)	74 (37%)	266 (73%)
6-9	3 (30%)	87 (44%)	91 (25%)
Missing	1	64	60
Harris Hip Scale	54 (36, 69)	44 (33, 56)	52 (41, 61)
Missing	3	57	33

¹Median (IQR); *n* (%)

Figure 3.1 shows the Missingness pattern for the cleaned dataset. Total sample size, $n = 700$.

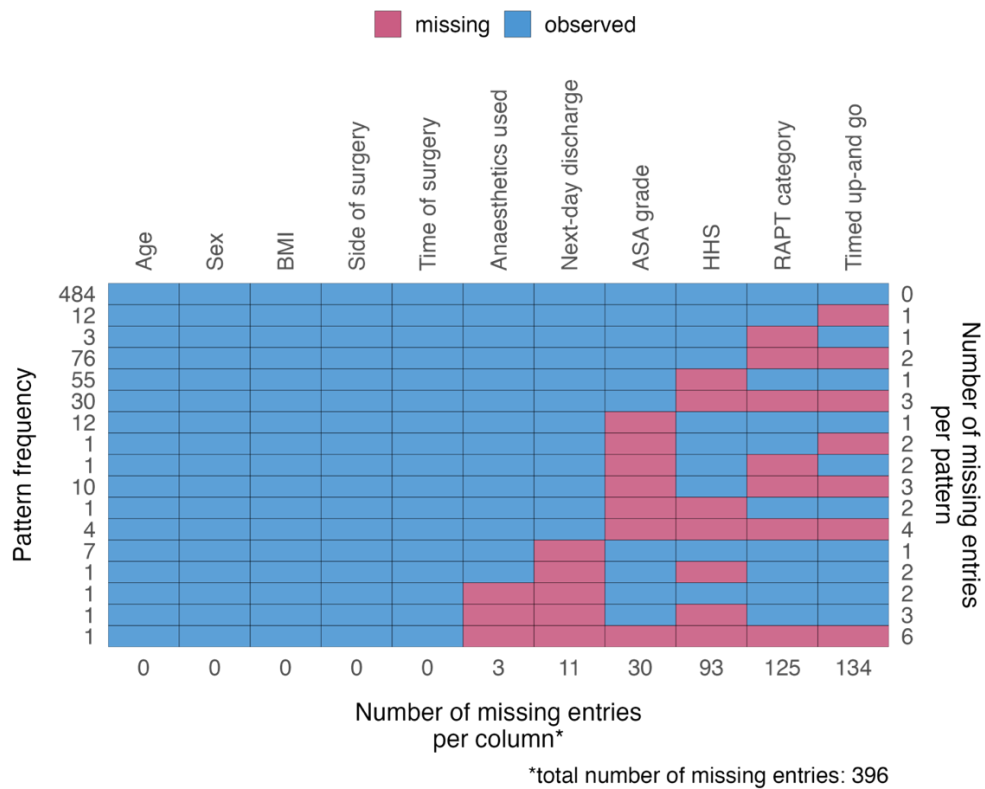


Figure 3.1: Missingness pattern for the cleaned dataset. Next-day discharge is the outcome variable. Total sample size, $n = 700$.

Univariate statistical tests were performed on the dataset between the 12 variables mentioned above and the outcome variable; next-day discharge, using logistic regression and the results were then pooled to yield average estimates.

The independent variables of interest for the multivariable modelling were TUG and HHS, with age, sex, BMI, ASA grade, and time of day of surgery as covariates. Pairwise Spearman's correlations indicated moderate correlations between HHS, TUG, and RAPT for all imputed datasets. Consequently, separate models were built for TUG and HHS, and RAPT was not included as a covariate in any of the models. Like the univariate analysis, logistic regression was used, and the results were pooled to yield average estimates and overall standard error.

3.1 Exploratory analysis

As an exploratory analysis, the subset of the full dataset that had grip strength values was extracted ($n = 402$ records), and missing data were imputed. Multivariable logistic regression was employed to assess the relationship between grip strength and next-day discharge (covariates: RAPT, age, sex, BMI, ASA grade, and time of day of surgery).

3.2 Univariate analyses

3.2.1 Age

The median age of patients discharged within one day of surgery was younger than those who were not discharged the next day. Patients who did not have next day discharge ($n = 263$) had a median age of 70 years old and patients who were discharged the next day ($n = 426$) had a median age of 65 years old (see Figure 3.2). This is consistent with the literature review which found older patients are more likely to have a longer LOS with patients 70 years old being 1.80 times more likely to have LOS greater than one day (17). It can, therefore, be inferred from this data and the consistency with this dataset and the literature review that patients 70 years old and older may require more intense pre-operative preparation in terms of physiotherapy and administrative support in terms of planning for their operative day. This greater focus on this age group, in particular, may assist in decreasing the duration of stay and help the patient mentally prepare for the post-operative expectations and reality.

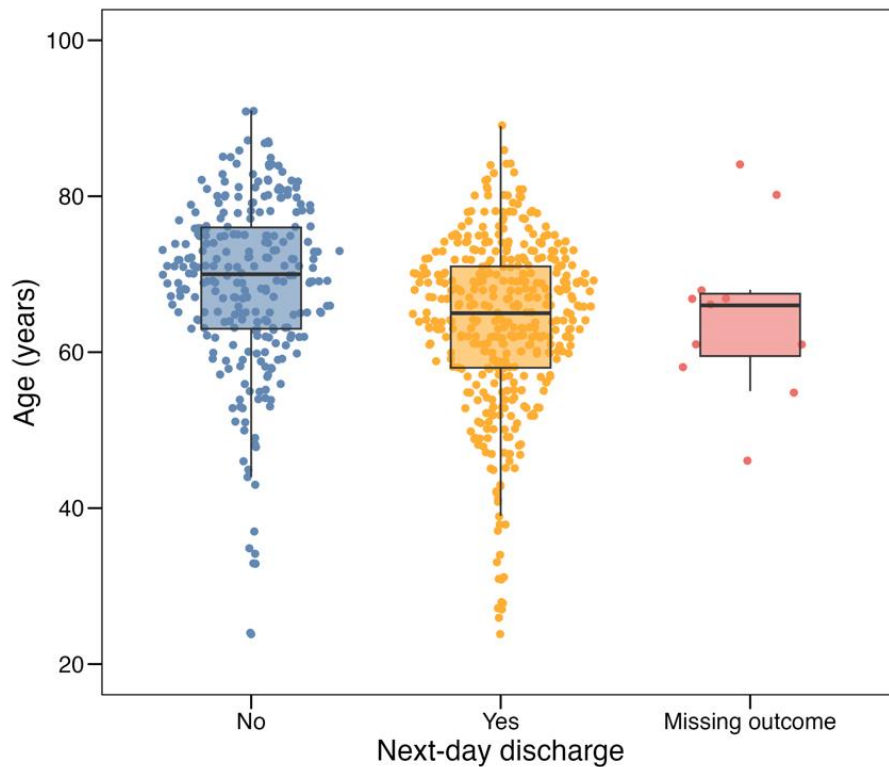


Figure 3.2: Tukey box-and-whisker plots overlaid on individual data points scattered according to density for age (years) by next-day discharge. The number of missing observations for next-day discharge = 11 (pink), and there were no missing observations for age in the original dataset.

3.2.2 Sex

A greater percentage of males (~50%) to females (~25%) experienced next day discharge within this dataset (see Figure 3.3). The odds of next-day discharge in males was 3.01 *versus* the odds for females. The effect was robust, and fairly consistent (95% CI of the odds ratio: 2.14 to 4.23, $p = 0.001$). In the literature review, it was found that the female sex was 1.74 times more likely to have a greater than 1 day length of stay (17). Self-administered questionnaires which assessed pre-operative functional status revealed in the literature that female participants had greater functional impairments than their male counterparts before surgery and this was related to presenting for surgery later in life with more advanced disease (17). More needs to be done to understand this phenomenon in the literature and data. Patients who seek to undergo THA with ERAS protocol for next-day discharge should be made aware of this discrepancy amongst the different sexes as this has a significant impact on the cost of treatment and it can be inferred that the cost of treatment for a female patient may be greater

than the cost of a male patient who is ~50% likely to have next day discharge following THA *via* the DAA.

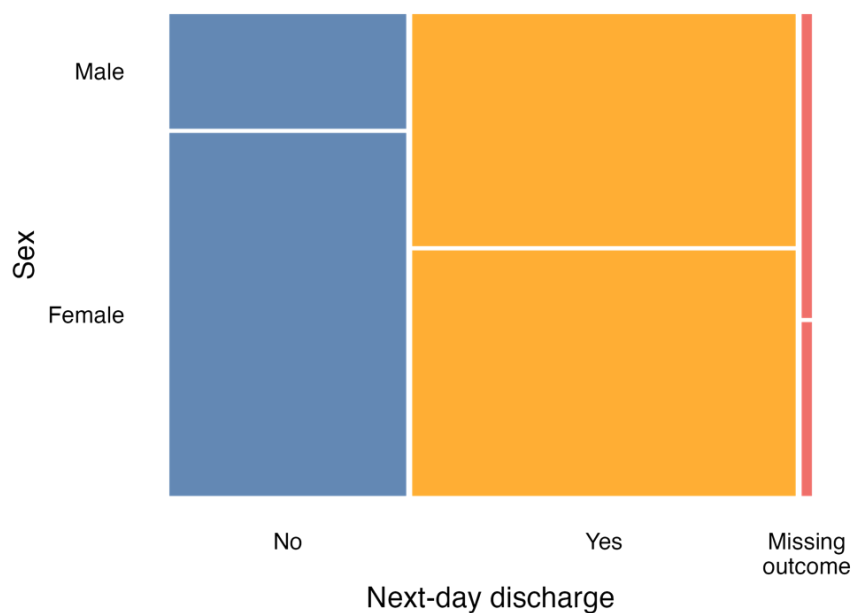


Figure 3.3: Mosaic plot (showing proportions) for sex by next-day discharge in the original dataset. The number of missing observations for next-day discharge = 11 (pink), and there were no missing observations for sex in the original dataset.

3.2.3 BMI

Within this dataset, the median BMI of patients who had next-day discharge *versus* patients who had a longer LOS were similar - BMI ~ 28kg.m⁻² (see Figure 3.4). The odds of next day discharge were 0.99 that of longer discharge times for every kilogram per metre squared of BMI. Therefore, this data does not seem to support the assertion in the literature that increased BMI leads to longer discharge times with significant predictability. This may be in part due to the nature of the setup in Dr Botha's practice. Dr Botha exclusively does the DAA for THA, and this limited difference between the two groups could be due to experience and technique.

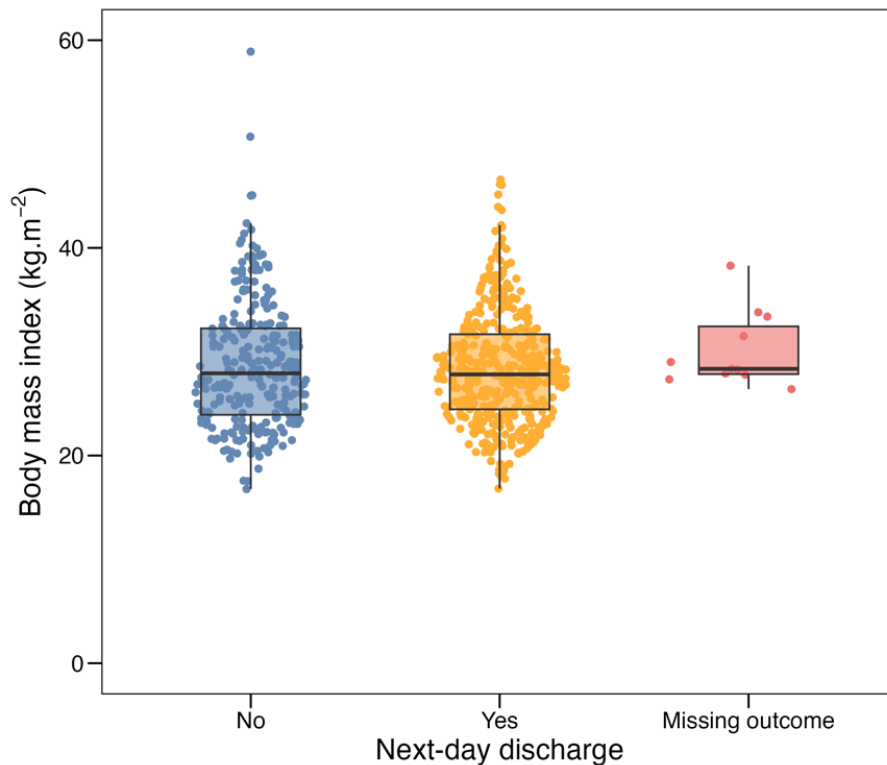


Figure 3.4: Tukey box-and-whisker plots overlaid on individual data points scattered according to density for body mass index (BMI) by next-day discharge. The number of missing observations for next-day discharge = 11 (pink), and there were no missing observations in the original BMI dataset.

3.2.4 Side of surgery

The data showed that 60% of surgery occurred on the right hip and 40% occurred on the left hip in both the early and late discharge groups. There appeared to be no correlation between the side of surgery and early discharge, however the estimate may be imprecise ($p = 0.9$). It may be an interesting assessment to compare surgery on the dominant *versus* the non-dominant leg in subsequent analysis to determine if there may be any correlation.

3.2.5 Time of surgery

A greater percentage of morning surgeries compared to afternoon surgeries were discharged within one day of surgery (see Figure 3.5). While this difference was not statistically significant (Odds ratio = 0.74, $p = 0.066$) there may be value practically with rehabilitation services having less time to undertake post-operative rehab on the day of afternoon surgery and therefore

delaying the mobilisation time. This may also be attributed to the anaesthetic method with patients operated on in the afternoon likely to have a resolution of anaesthetic later in the day again predisposing them to less therapy time and less time to gain confidence in mobilisation.

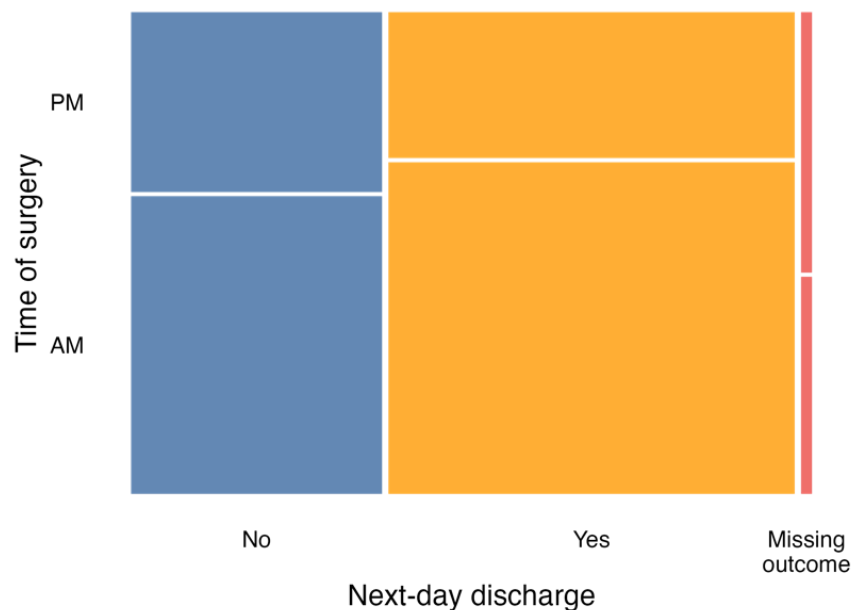


Figure 3.5: Mosaic plot (showing proportions) for time of surgery (AM/PM) by next-day discharge in the original and imputed datasets. The number of missing observations for next-day discharge = 11 (pink), and there were no missing observations for sex in the original dataset.

3.2.6 ASA grade

When looking at the data, by far, the greatest number of patients were ASA II regardless of next day discharge *versus* longer LOS (see Figure 3.6). When compared to ASA I patients, the next-day discharge group had lower odds of being in grade II or grade III compared to the longer than one day admissions. The point estimates indicated large (ASA grade II odds ratio: 0.43) to very large effects (ASA grade III odds ratio: 0.16), but the precision of the estimate for ASA grade II was very low, with the upper limit being close to 1, therefore no effect (ASA grade II 95% CI of the odds ratio: 0.22 to 0.98, $p < 0.045$). Similarly, the precision of the ASA grade III estimate was low, but in this case, it was always of a large magnitude (ASA grade III 95% CI of the odds ratio: 0.06 to 0.40, $p < 0.001$).

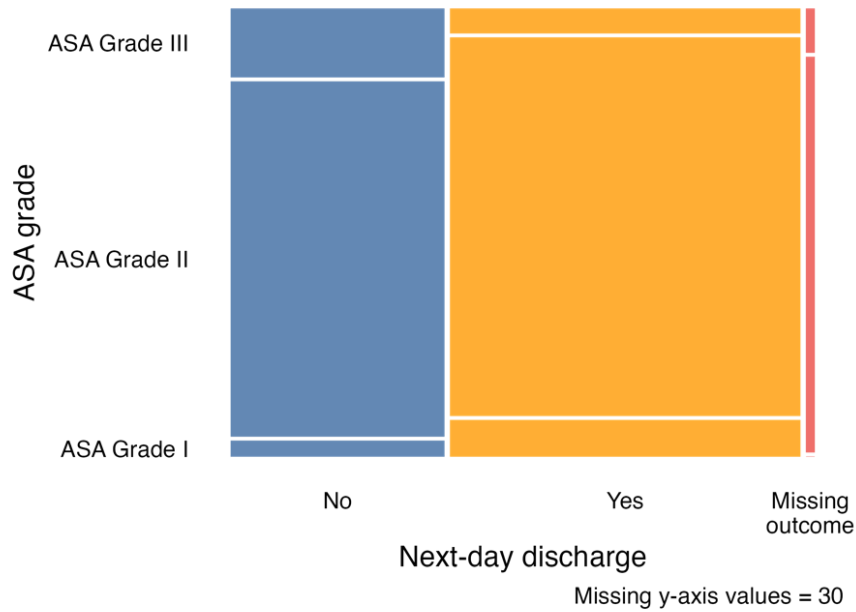


Figure 3.6: Mosaic plot (showing proportions) for ASA grade by next-day discharge in the original and imputed datasets. The number of missing observations for next-day discharge = 11 (pink), and the number of missing data points for ASA grade = 30.

3.2.7 Anaesthetic method

General anaesthetic and spinal with intrathecal morphine was found in the data to be the most common anaesthetic method used (~73%). Following this, the next most common anaesthetic method used was spinal with intrathecal morphine and sedation (~22%). General anaesthesia alone accounted for a small number of anaesthetics administered (~5%). However, there were differences between the next-day discharge and longer stays (see Figure 3.7), with next-day discharge having a greater proportion of patients who had spinal with intrathecal morphine, and sedation than those patients with longer stays (~25% *versus* ~17%).

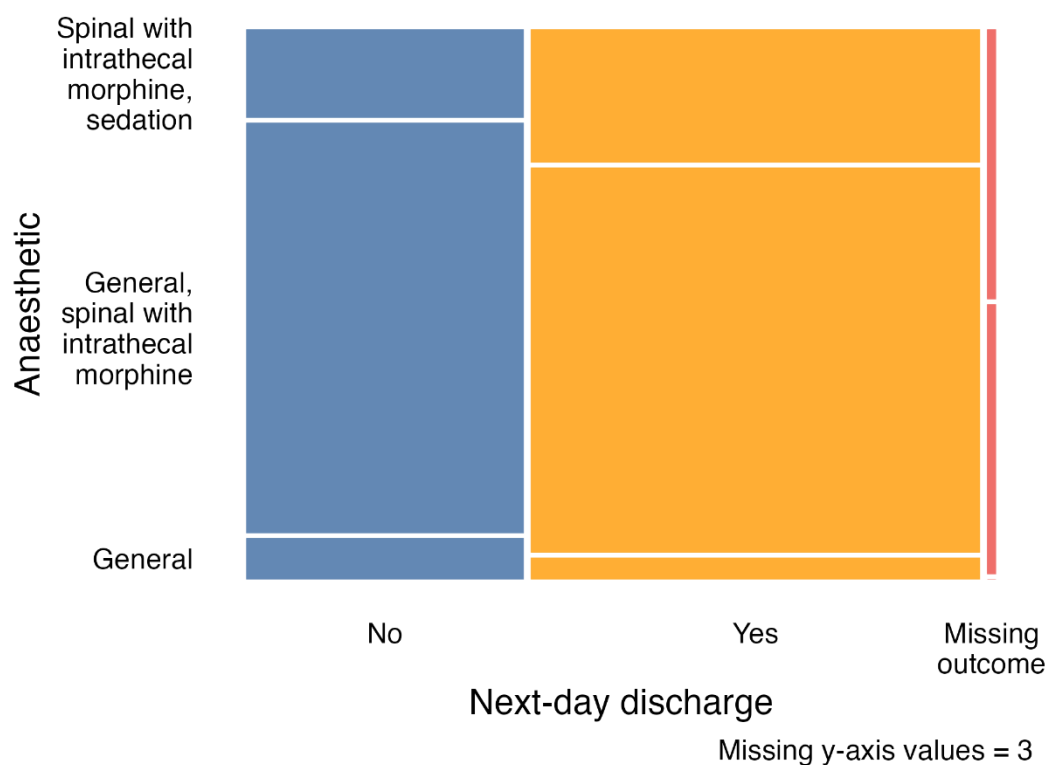


Figure 3.7. Mosaic plot (showing proportions) for anaesthetic method used by next-day discharge in the original and imputed datasets. The number of missing observations for next-day discharge = 11 (pink), and the number of missing datapoints for anaesthetic method = 3.

With the increase in use of spinal with intrathecal morphine, and sedation anaesthesia in the next-day discharge group, there was a concomitant decrease in the use of general anaesthesia and spinal with intrathecal morphine, and general anaesthesia alone in this group. These shifts in the use of anaesthetic methods were statistically significant (see Table 3.2), with next-day discharge being significantly associated with an increase in odds of using spinal with intrathecal morphine, and sedation compared to the odds of using general anaesthesia and spinal with intrathecal morphine (odds ratio: 1.58, $p = 0.02$). However, the interpretation of this finding is complicated by the low precision of the estimate (wide confidence interval) and the lower limit of the confidence interval being consistent with a small effect (95% confidence interval: 1.06 to 2.36).

Overall, the surgeon and anaesthetic team began initially using general anaesthetic and spinal with intrathecal morphine but as experience was gained over the years of data collection the team gradually began to use spinal with intrathecal morphine alone.

Table 3.2. Pooled estimates for the logistic regression of anaesthetic method *versus* next-day discharge.

Characteristic	OR ¹	95% CI ¹	p-value
Anaesthetic method			
General, spinal with intrathecal morphine	—	—	
General	0.56	0.29, 1.09	0.089
Spinal with intrathecal morphine, sedation	1.58	1.06, 2.36	0.024

¹OR = Odds Ratio, CI = Confidence Interval

3.2.8 Timed up and go

The median TUG test was 3 seconds lower for patients who underwent next-day discharge compared to patients with a longer LOS; 9 *versus* 12 seconds (see Figure 3.8). The data showed to be statistically significant ($p < 0.001$) and had good precision (95% confidence interval: 0.87 to 0.92). This is an expected result and had good reliability in the data.

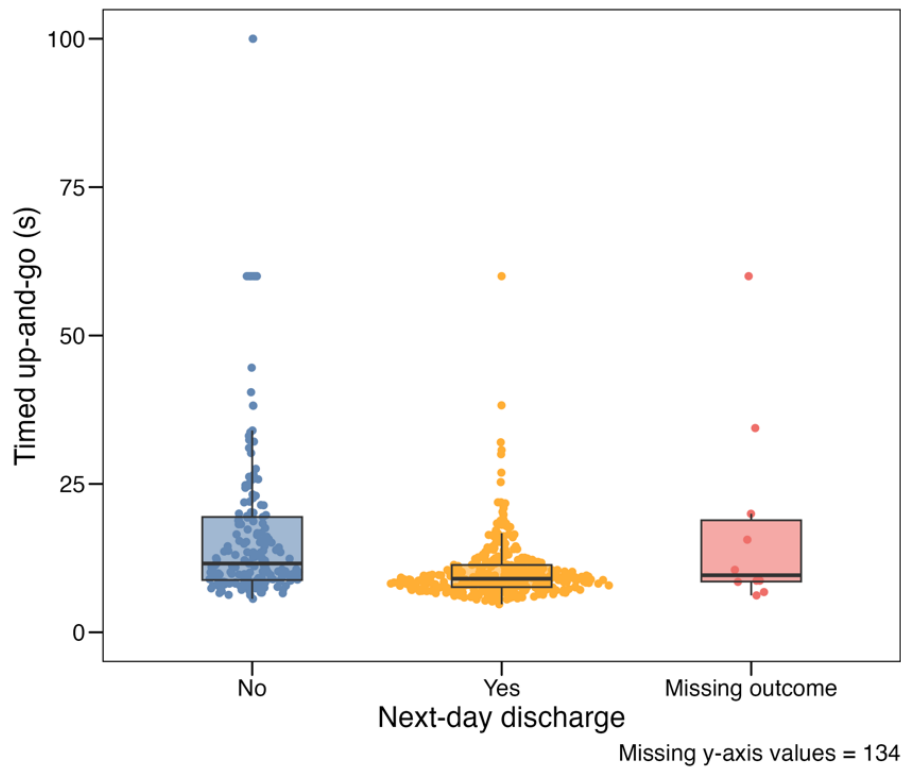


Figure 3.8: Tukey box-and-whisker plots overlaid on individual data points scattered according to density for Timed up-and-go (TUG) by next-day discharge. The number of missing observations for next-day discharge = 11 (pink), and there were 134 missing observations in the original TUG dataset.

3.2.9 Risk Assessment and Prediction Tool (RAPT)

The RAPT was developed as a tool to determine patients who have a likelihood of early discharge. The data collected confirmed the intended performance of the tool. There was a statistically significant association, with large effect sizes, between the group (next-day discharge *versus* longer admission time) and being in the > 9 (high probability of early discharge, odds ratio: 14.6, $p < 0.001$) and the 6 – 9 (intermediate probability of early discharge, odds ratio: 4.43, $p < 0.001$) (see Figure 3.9). In both cases, the level of precision of the estimate was poor, but in both cases, the lower limit of the plausible values was large (> 9 RAPT lower 95% confidence value: 6.99; 6 – 9 RAPT lower 95% confidence value: 2.05).

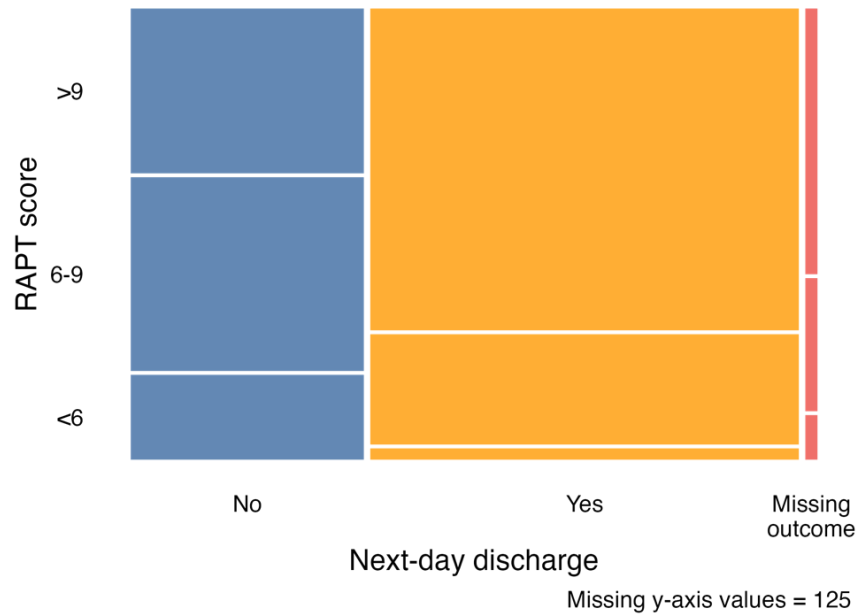


Figure 3.9: Mosaic plot (showing proportions) for Risk Assessment and Prediction Tool category (RAPT) score by next-day discharge in the original dataset. The number of missing observations for next-day discharge = 11 (pink), and the number of missing data points for RAPT = 125.

3.2.10 Harris hip score

The median HHS was 9 points greater in those patients who were discharged within one day of surgery compared to those with longer admission times (53 *versus* 44) (see Figure 3.10). The odds ratio was statistically significant ($p < 0.001$), but the effect size was very small, and likely not of any practical significance (odds ratio: 1.02, 95% confidence interval: 1.01 to 1.03).

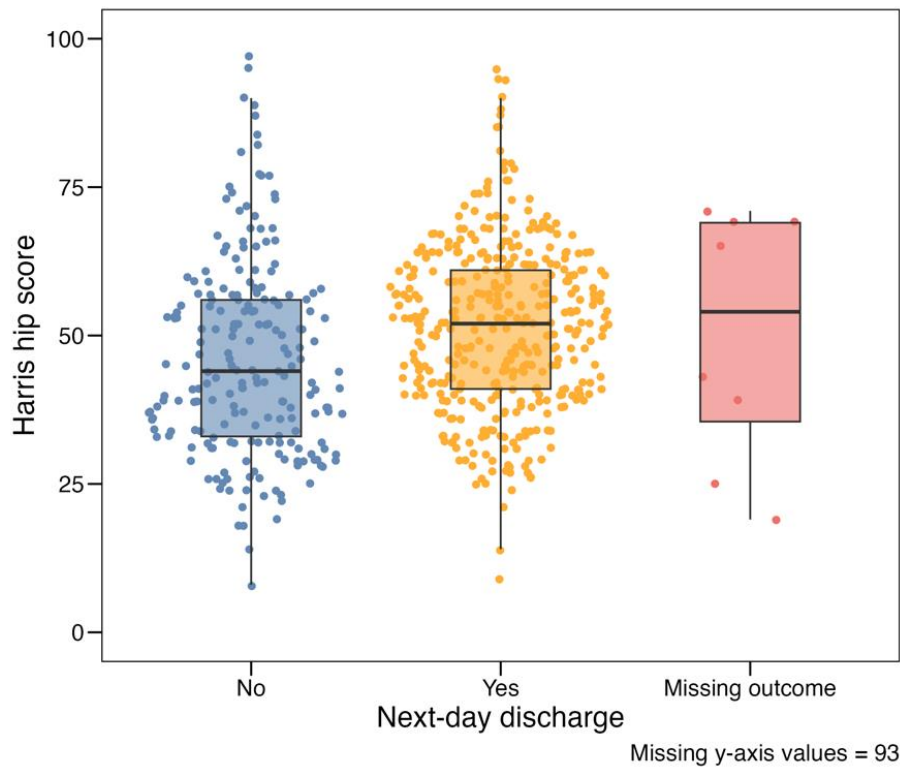


Figure 3.10: Tukey box-and-whisker plots overlaid on individual data points scattered according to density for Harris Hip Scale (HHS) by next-day discharge. The number of missing observations for next-day discharge = 11, and there were 93 missing observations in the original HHS dataset.

3.3 Multivariable analyses

3.3.1 Model 1 (timed up-and-go, TUG)

Table 3.3 shows the pooled estimates (reported as an odds ratio) for the logistic regression analysis of the five imputed datasets for TUG *versus* next-day discharge while controlling for age, sex, BMI, ASA grade, and time of surgery. After controlling for the aforementioned covariates, a statistically significant association was detected between TUG score and next-day discharge, such that lower TUG values were associated with next-day discharge. The effect size was small, but the precision of the estimate was good.

Table 3.3: Pooled estimates for the multivariable logistic regression of TUG *versus* next-day discharge.

Characteristic	O R ¹	95% CI ¹	p- value
TUG	0.9 1	0.89, 0.94	<0.001

¹OR = Odds Ratio, CI = Confidence Interval,

Covariates: age, sex, BMI, ASA grade, and time of surgery

3.3.2 Model 2 (Harris Hip Score)

Table 3.4 shows the pooled estimates (reported as an odds ratio) for the logistic regression analysis of the five imputed datasets for HHS *versus* next-day discharge while controlling for age, sex, BMI, ASA grade, and time of surgery. After controlling for the aforementioned covariates, a statistically significant association was detected between HHS score and next-day discharge, such that greater HHS values were associated with next-day discharge. However, the effect size was extremely small, (but with good precision), and thus I suggest that the role of HHS in predicting next-day discharge is very low.

Table 3.4: Pooled estimates for the multivariable logistic regression of HHS *versus* next-day discharge.

Characteristic	O R ¹	95% CI ¹	p- value
HHS score	1.0 2	1.01, 1.03	0.006

¹OR = Odds Ratio, CI = Confidence Interval,

Covariates: age, sex, BMI, ASA grade, and time of surgery

While analysing the data, an exploratory analysis was done regarding the data collected on grip strength as a surrogate marker to look at the potential between greater grip strength and time to discharge. This was not part of the primary analysis, but the interpretation of the data collected did show some interesting potentially beneficial results.

3.3.3 Grip strength

Table 3.5 shows the pooled estimates (reported as an odds ratio) for the logistic regression analysis of the five imputed datasets for grip strength *versus* next-day discharge while controlling for age, sex, BMI, ASA grade, and time of surgery. After controlling for the aforementioned covariates, a statistically significant association was detected between grip strength and next-day discharge, such that greater grip strength values were associated with next-day discharge. However, the effect size was extremely small, (but with fairly good precision), and thus I suggest that the role of grip strength in predicting next-day discharge is very low.

Table 3.5: Pooled estimates for the multivariable logistic regression of grip strength *versus* next-day discharge.

Characteristic	O R ¹	95% CI ¹	<i>p</i> - value
Grip strength (Kg)	1.0 6	1.02, 1.11	0.002

¹OR = Odds Ratio, CI = Confidence Interval,

Covariates: age, sex, BMI, ASA grade, and time of surgery

CHAPTER 4

4. DISCUSSION

A significant amount of data were collected during the specified time frame as outlined from 01 January 2016 to 31 December 2021. There were 700 patient details analysed and the data were rigorously cleaned and missing data identified and accounted for. From the analyses, we can see that there are in fact a number of data points that can be used pre-operatively to reliably predict which patients may be fit to plan for an enhanced recovery after surgery protocol. These data points correlate with the literature review conducted and this supports the data further.

The age of a patient has proven to be a significant predictor of next-day discharge. Patients who are greater than 70 years old should be counselled on the likelihood that they may not have a next-day discharge following THA *via* the DAA (see Figure 3.2). From the literature review we can see that the demand for THA is only going to increase and with an ageing population this is going to be and is currently a massive burden on the healthcare system (4). The increase of LOS related to age greater than 70 years old found in the data analysis and literature review will require novel approaches to the approach in the management of the elderly patient for THA (17).

These patients may benefit from enhanced pre-operative rehabilitation in order to increase the likelihood of an enhanced recovery time. This information is extremely beneficial for the patient and the family with regard to preparation for surgery and can reliably predict that these patients will have a longer duration of stay. This may assist patients and their families in preparing adequately for post-surgical rehabilitation as well as financially for surgery. The scope of this review did not look at step down facilities. One option for older patients (> 70) could be to prepare for a step down facility discharge on the same day or next day following surgery.

Female sex is a factor which has been shown to reliably come up in the literature as a predictor of a greater length of stay (17). Female sex has been shown to be a possible predictor of increased LOS up to 1.74 times. In the authors data analysis approximately 50% males and 25% females experienced next-day discharge (see Figure 3.3). Although some factors have been postulated as to the cause of this it seems there is no definite answer as to why this may perhaps be the case. The author suggests that a review of sex alone should be conducted and

possibly validated self-reporting questionnaires directed at the female sex should be used to determine why this variable is so significantly affected with regard to length of stay.

Patients must be made aware of this fact and female patients should be counselled that a greater length of stay is a possibility. Therefore, once again, resources such as a greater prehabilitation programme should be directed to the female sex in order to attempt to alleviate the risk of greater length of stay. More focused rehabilitation and a greater understanding of the home environment and support environment of the female patient should be undertaken to ensure a holistic approach to ensure a reduced stay is a possible outcome. The author suspects that female patients may not receive the same caregiver support that their male counterparts may receive similar to literature which suggests that female patients present with more advanced disease (17).

It came as a surprise to the author that BMI did not correlate more significantly as a risk factor for greater length of stay (see Figure 3.4). A Patient should always be encouraged to have optimal health prior to any elective procedure. It is possible that a review to look at the optimal BMI for THA using the ERAS protocol may be considered. The literature review found that an increase of 5kg/m^2 in BMI increased the odds for increased LOS greater than one day by 1.40 times (17). This was not replicated in the authors findings however. This may in part be due to the fact that surgeons who perform THA *via* the DAA have overcome the steep learning curve identified in the literature (11). Dr Botha in his practice has made use of the traction table in order to assist in positioning of the operated limb as well as to provide traction and access to the limb being addressed.

Although this review looked at next-day discharge following THA it would be of interest to determine what the effect of BMI may have on the 90-day re-admission rate as an independent risk factor.

The data showed that 60% of surgery occurred on the right hip and 40% occurred on the left hip in both the early and late discharge groups. There appeared to be no correlation between side of surgery and early discharge however the estimate may be imprecise ($p = 0.993$). It may be an interesting assessment to compare surgery on the dominant *versus* the non-dominant leg in subsequent analysis to determine if there may be any correlation. However, this was not the scope of this analysis.

When an early discharge expectation is required, elective surgery should be planned for the morning of the planned surgical date. The literature review clearly display that next day discharge following THA *via* the DAA is 2.81 times more likely if surgery is performed in the morning (17). The data analysis showed that a greater percentage of patients in Dr Bothas practice operated in the morning were discharged within one day of surgery however this result was not found to be statistically significant and not replicated as in the literature review (see table 3.5). One of the reasons to account for this discrepancy may be that an undetermined number of patients were transferred to a step down facility and discharged from the hospital if they were found to not be sufficiently ready to go home. However a separate analysis of this was not possible.

However the author does believe that every effort should be made to arrange the surgical list so as to accommodate arthroplasty patients undergoing THA *via* the DAA in the morning. The effect is significant as per the literature and the logistics to achieve this are reasonable, inexpensive, time and cost saving.

Patients can reliably be told to reasonably expect a next-day discharge should they meet the ASA 1 criteria (see Figure 3.6). ASA II/III patients can be counselled significantly on their risk of a greater length of stay. This finding correlates with the literature review which found that patients with a greater ASA grade were 1.84 times more likely to have a LOS greater than two days (17).

Planning of the surgery with the anaesthetic team and rehabilitation team should include measures to mitigate the risk of increased LOS such as various anaesthetics techniques that are less invasive and therefore carry less risk for the patient. In order to optimise patients pre-operatively the author suggests that patients be made aware of their risk and identify any modifiable risk factors that can be controlled with regard to surgery.

In the literature, the preferred method of anaesthesia has been shown to be spinal anaesthesia (Heavy Bupivacaine or Prilocaine) without intrathecal morphine and using a combination of sedation such as propofol and fentanyl as an adjunct opioid. If general anaesthesia is required short active drugs are advised. Multimodal analgesia which includes Non-Steroidal Anti-inflammatory Drugs (NSAIDs) is recommended to be started in recovery (10). However within this dataset, spinal with intrathecal morphine has been used to effect to ensure next-day

discharge and this has come with trial and error and a nuanced approach to each patient. This is a potential avenue for further investigation.

The data analysis shows that the hip assessment tools that have been used in the data collection namely, TUG, HHS, and RAPT, were reliable tools to use. These are simple and inexpensive tools to use pre-operatively and can be reliably used to discuss the possible course of treatment for the patients. There is a need to plan hospital discharge more efficiently and appropriately and to develop patient-specific care pathways in order to achieve this (22). These assessment tools can be used to determine this.

In the analysis of the TUG test, it was found that the median TUG was 3s lower in those patients who underwent next-day discharge (see Figure 3.7). The author suggests that the TUG can be used multiple times in the prehabilitation period to monitor the progress of the patient leading up to the date of the planned surgery. This would be an objective and tangible test for the patient to prepare for multiple times and appreciate the progression and this in itself could work as a motivating factor in preparation for surgery. This could ensure patient ownership and buy in to ensure the patient is invested in the operative planning course and takes ownership of their treatment.

The RAPT (see Figure 3.8) is an assessment tool designed to predict the destination for discharge as well as LOS (22). The RAPT has been validated in many countries and the data collected in this review has affirmed the exact use of the tool as it has been described. Therefore, the continued use of the RAPT as one of the assessment tools to determine next day discharge should be continued to be used and provide feedback to the patient.

The data analysis revealed that the median HHS of patients discharged the next day was 9 points higher than those with a prolonged length of stay. While the conclusion drawn from the data may not be definitive, it suggests that patients with higher HHS scores exhibit more severe pathology and less functional capacity. Thus, it may be inferred that these patients may experience improved outcomes compared to individuals with lower HHS scores, as their main source of pain could be relieved by the operation and movement, making it simpler for them to adapt. Further investigation is required. The HHS is a useful tool for comparing pre-operative and post-operative conditions. It can help motivate patients to objectively evaluate their progress after surgery during their period of recovery.

An exploratory analysis was done on grip strength as a predictor of next-day discharge (see Table 3.5). This data was limited in comparison to other data variables as this data was only collected from 01 January 2019 onwards as it was added to the pre-operative assessment in the practice at that time. Hand grip strength has since been described as a possible new vital sign of health (23). Sarcopenia, or an age-related decline in muscle mass, muscle strength, and muscle function, is an important concept in determining overall physical capability in the ageing population (23). The Hand grip strength in the data collected underwent a multivariable analysis which suggested that greater grip strength is associated with a greater chance of next-day discharge following THA *via* the DAA. The effect size was small but with good precision.

Grip strength is one of the surprise results of this analysis and the author believes that this is an exciting and inexpensive point-of-care test that can easily be performed in the consultation room and provide not only information on possible sarcopenia but also correlates with various other conditions, overall mortality and quality of life (23).

The current limitations of this research protocol are that it is based at a single Private practice in Johannesburg, South Africa. All procedures were performed by a single Orthopaedic surgeon with a team that has been well trained with regards to this specific protocol in that setting.

However, the strength of this research is that this the surgeon has developed a rigorous protocol and has kept meticulous data which allows for this protocol to be replicated in other centers that perform high volume arthroplasty surgery. This data can then be compared to the data presented above and further conclusions and refinement of the use of the DAA in THA in an ERAS protocol can be achieved which ultimately will benefit patient outcomes and reduce the cost of healthcare.

Comparison of this data along in different clinical setting such as the Government healthcare setting can then be compared to the private healthcare setting which may highlight any biases that may be unintentionally held with this particular set of data.

CHAPTER 5

5. CONCLUSION

It is essential to identify factors that can predict a patient's readiness for discharge the day after undergoing major surgery such as total hip arthroplasty (THA) using the direct anterior approach (DAA). THA operations entail considerable expenses and place a notable strain on patients. Thus, it is crucial to discover inventive and economical solutions to reduce the difficulties linked to this surgery, commonly known as the "operation of the 20th century (2)(3)."

The data collected and analysed in this analysis have confirmed much of what is known with regard to the literature review and current knowledge about the ERAS protocol for THA.

This review is unique in that it specifically identifies factors that can be used to determine next-day discharge following THA *via* the DAA.

Of the data analysed the most statistically significant findings were that female patients, who are over the age of 70 years, have had surgery in the afternoon and were exposed to general anaesthetic, are more likely to have longer length of stay.

Subsequently, an exploratory analysis found that grip strength, which is now widely considered to be the new vital sign of health, could be used as an inexpensive point of care test to predict next day discharge following THA *via* the DAA. This opens the door to subsequent research with regard to this exciting, simple and cheap point of care test that may provide extensive insight into a patient's fitness for surgery and potential expected outcomes

This review has looked at real world, inexpensive solutions in order to maximise the benefit of life-changing surgery such as THA *via* the DAA. It has provided a framework for subsequent data to be collected in various clinical settings in an inexpensive and precise way.

THA is here to stay and we need concrete solutions to take to all stakeholders in terms of providing care to our patients that are inexpensive and reliable and most importantly, help the patient take ownership of their role in the management of their disease which ultimately will bring them, as well as us the service provider's great joy.

REFERENCES

1. Issa K, Pivec R, Kapadia BH, Banerjee S, Mont MA, Mont v M A. Osteonecrosis of the femoral head: the total hip replacement solution. *Bone Joint J.* 2013; 95-B(11 Supp A): 46-50.
2. Zagra L. Advances in hip arthroplasty surgery: What is justified? *EFORT Open Reviews.* 2017; 2(5):171–8.
3. American Joint Replacement Registry (AJRR): 2019 Annual Report. Rosemont, IL: American Academy of Orthopaedic Surgeons (AAOS), 2019. Available from: <https://www.aaos.org/globalassets/about/annual-report---year-in-review/aaos-2019-annual-report.pdf>. [Date Accessed: 12 April 2024].
4. Singh JA, Yu S, Chen L, Cleveland JD. Rates of total joint replacement in the United States: Future projections to 2020-2040 using the national inpatient sample. *J Rheumatol.* 2019; 46(9):1134–40.
5. American Joint Replacement Registry (AJRR): 2021 Annual Report. Rosemont, IL: American Academy of Orthopaedic Surgeons (AAOS), 2021. Available from: <https://www.aaos.org/globalassets/registries/ajrr-2021-annual-report-preview.pdf>. [Date Accessed: 12 April 2024].
6. Brittain R, Howard P, Lawrence S, Stonadge J, Wilkinson M, Wilton T, et al. NJR statistical analysis, support and associated services. Vol. 3, National Joint Registry. 18th Annual Report. Available from: www.njrcentre.org.uk [Date Accessed: 12 April 2024].
7. Pulikottil-Jacob R, Connock M, Kandala NB, Mistry H, Grove A, Freeman K, et al. cost effectiveness of total hip arthroplasty in osteoarthritis: comparison of devices with differing bearing surfaces and modes of fixation. *Bone Joint J.* 2015; 97-B(4): 449–57.
8. Miller LE, Martinson MS, Gondusky JS, Kamath AF, Boettner F, Bhattacharyya SK. Ninety-day postoperative cost in primary total hip arthroplasty: An economic model comparing surgical approaches. *Clinicoecon Outcomes Res.* 2019; 11:145–9.
9. Sekeitto AR, Aden AA. Costing total hip arthroplasty in a South African state tertiary hospital. *S Afr Med J.* 2021; 111(3):250–4.
10. Thompson JW, Wignadasan W, Ibrahim M, Beasley L, Konan S, Plastow R, et al. Day-case total hip arthroplasty: a literature review and development of a hospital pathway. *Bone Jt Open.* 2021; 2(2): 93–102.

11. Flevas DA, Tsantes AG, Mavrogenis AF. Direct Anterior Approach Total Hip Arthroplasty Revisited. *JBJS reviews* 2020; 8(4):e0144
12. Foissey C, Fauvernier M, Fary C, Servien E, Lustig S, Batailler C. Total hip arthroplasty performed by direct anterior approach - Does experience influence the learning curve? *SICOT J.* 2020; 6:15.
13. Aggarwal VK, Iorio R, Zuckerman JD, Long WJ. Surgical Approaches for Primary Total Hip Arthroplasty from Charnley to Now: The Quest for the Best Approach. *JBJS reviews.* 2020; 8(1): e0058.
14. Galakatos GR. Direct anterior total hip arthroplasty. *Mo Med.* 2018; 115(6): 537–41.
15. Goldberg TD, Kreuzer S, Randelli F, Macheras GA. Direct anterior approach total hip arthroplasty with an orthopedic traction table. *Vol. 33, Oper Orthop Traumatol.* 2021: 331–40.
16. Moretti VM, Post ZP. Surgical approaches for total hip arthroplasty. *Indian J Orth.* 2017; 51(4): 368–76.
17. Sibia US, MacDonald JH, King PJ. Predictors of Hospital Length of Stay in an Enhanced Recovery After Surgery Program for Primary Total Hip Arthroplasty. *J Arthroplasty.* 2016; 31(10):2119–23.
18. Kaye AD, Urman RD, Cornett EM, Hart BM, Chami A, Gayle JA, et al. Enhanced recovery pathways in orthopedic surgery. *J Anaesthesiol Clin Pharmacol.* 2019; 35:S35–9
19. Ripollés-Melchor J, Abad-Motos A, Díez-Remesal Y, Aseguinolaza-Pagola M, Padin-Barreiro L, Sánchez-Martín R, et al. Association between Use of Enhanced Recovery after Surgery Protocol and Postoperative Complications in Total Hip and Knee Arthroplasty in the Postoperative Outcomes Within Enhanced Recovery after Surgery Protocol in Elective Total Hip and Knee Arthroplasty Study (POWER2). *JAMA Surg.* 2020; 155(4):e196024.
20. Rosinsky PJ, Chen SL, Yelton MJ, Lall AC, Maldonado DR, Shapira J, et al. Outpatient vs. inpatient hip arthroplasty: A matched case-control study on a 90-day complication rate and 2-year patient-reported outcomes. *J Orthop Surg Res.* 2020;15(1).
21. van den Eeden YNT, de Turck BJG, van den Eeden FMC. 24 hours stay after hip replacement: Implementation of a patient-centered time-based fast-track program. *Acta Orthop.* 2017; 88(1):24–8.

22. Sconza, C., Respizzi, S., Grappiolo, G., & Monticone, M. The risk assessment and prediction tool (Rapt) after hip and knee replacement: A systematic review. *Joints*. 2019; 7:41–45
23. Vaishya R, Misra A, Vaish A, Ursino N, and D'Ambrosi R. Hand grip strength as a proposed new vital sign of health: a narrative review of evidences. *J Health Pop Nut*. 2024; 43:7

APPENDICES

Appendix A: Overview of DAA exposure

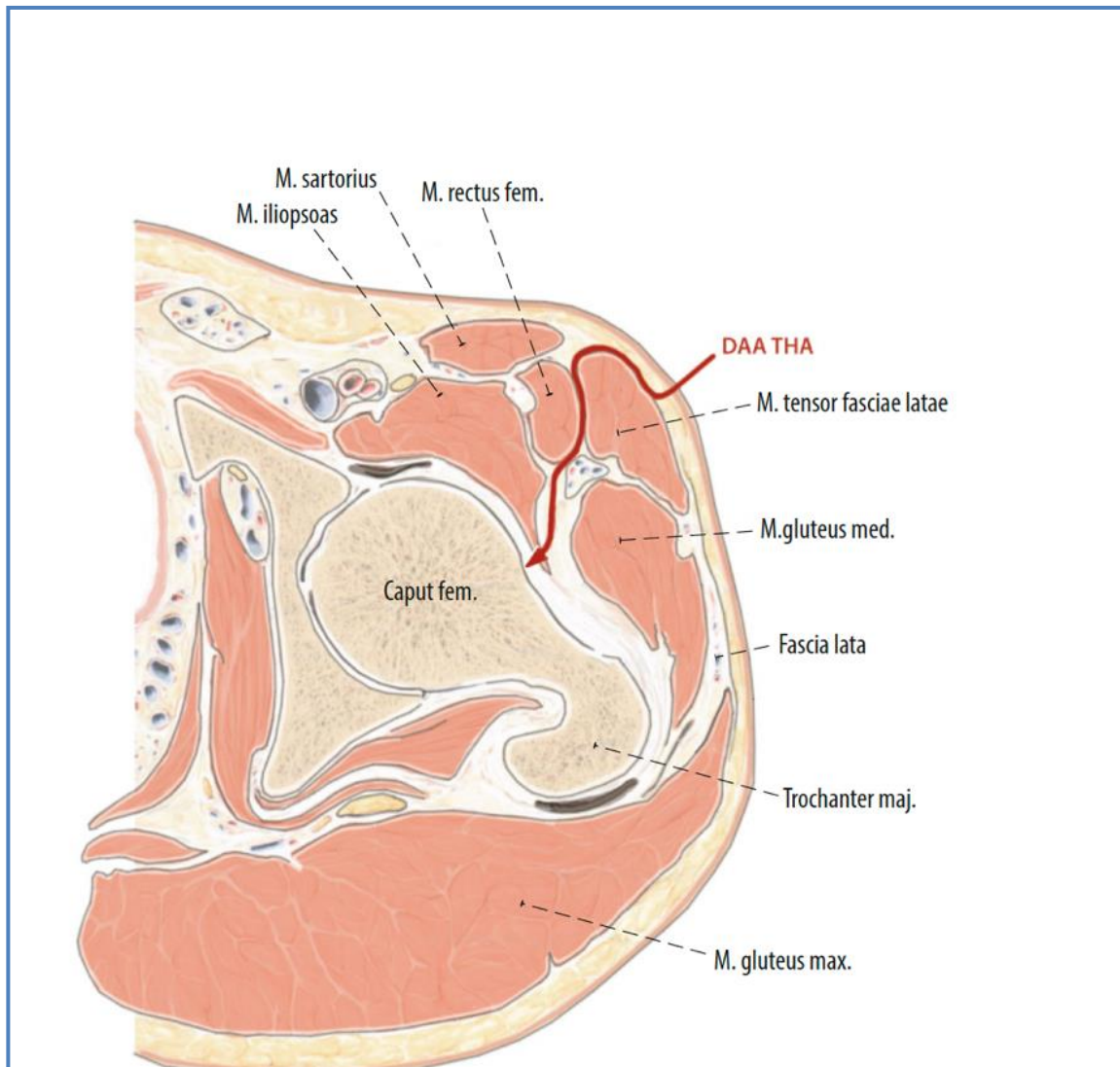
Appendix B: Data Collection sheet

Appendix C: RAPT

Appendix D: Harris Hip Score

Appendix E: Ethics Clearance certificate

Appendix A: Overview of DAA exposure (15)



Appendix B: Data Collection sheet

Data collection sheet:				
Participant number:				
DAA for THA				
Circle appropriate				
Age				
Sex	M	F		
BMI	<30	30-35	35-40	>40
Diagnosis	OA	RA	Other	
Malignancy	Remission	Active		
Side	Left	Right		
ASA grade	I	II	III	IV
Anaesthetic technique	GA	Regional		
Catheter	yes	no		
Time of surgery	Before 12:00	After 12:00		
Grip strength				
TUG				
RAPT	RAPT <6	RAPT 6 - 9	RAPT >9	
HHS				
WOMAC				
Forgotten joint score				
HOOS short form				
Assistive devices	Crutches	Walker	both	
Haematological	Hb <10	HB 10-15	Hb >15	
Complications	yes	No		
Previous surgery	Major	Minor		
Stepdown	Yes	No		
Administrative delay	Yes	No		
Discharge delay	Yes	No		

Appendix C: RAPT

Risk Assessment and Prediction Tool (RAPT)

Instructions for use

The RAPT form is completed by the patient.

Take the RAPT form when you:

- Visit your orthopaedic surgeon
- Attend the Pre-admission Clinic
- The form can be stored in your hospital medical record

8

Risk Assessment and Prediction Tool (RAPT)

Background

Developed by Dr. Leonie Oldmeadow at the Alfred Hospital in Victoria in 2001 to predict the discharge destination of patients undergoing elective hip and knee arthroplasty surgery.

Predictions based on objective factors provide confidence in decision making regarding discharge for patients and staff.

Purpose of the tool

- The ability to indicate before surgery, the most likely discharge destination after surgery, which allows appropriate patients to prepare themselves and their families for their return home.
- Assists in aligning patient's expectations about what is needed following surgery.
- Allows the acute hospital to commence early discharge planning for discharge destination goal
- RAPT helps to identify patients who will need the most help after discharge;
- Score <6—Admit to overnight rehabilitation program
- Score 6-9—Additional intervention to discharge directly home (e.g. Rehabilitation in the Home)
- Score >9—Discharge directly home.

To be completed by the patients undergoing elective Hip or Knee replacement surgery prior to discussion with your orthopaedic surgeon or attending Pre-admission Clinic

Name.....

DOB.....

Address.....

Surgeon.....

	Value	Score
1. What is your age group?	50-65 years 66-75 years >75 years	=2 =1 =0
2. Gender?	Male Female	=2 =1
3. How far on average can you walk? (a block is 200 metres)	Two blocks or more (+/-rest) 1-2 blocks (+/-rest) Housebound (most of time)	=2 =1 =0
4. Which gait aid do you use? (more often than not)	None Single-point stick Crutches/frame	=2 =1 =0
5. Do you use community supports? (home help, meals on wheels, district nursing)	None or one per week Two or more per week	=1 =0
6. Will you live with someone who can care for you after your operation?	Yes No	=3 =0
Your score (out of 12)		

Key: Destination at discharge from acute care predicted by score.

- Scores <6 — extended inpatient rehabilitation
- Score 6-9 — additional intervention to discharge directly home (e.g. *Rehabilitation in the Home*)
- Score >9 — directly home.

Patient's preference	Prediction Score	Agreed destination
.....		
Patient Signature:	Date:	
.....	 / /	

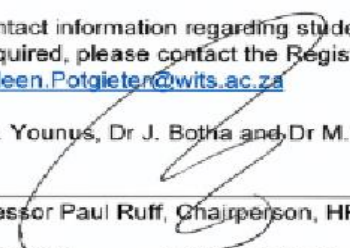
Appendix D: Harris Hip Score

Harris Hip Score	Hip ID: Study Hip: ☐ Left ☐ Right Examination Date (MM/DD/YY): / / Subject Initials: Medical Record Number:
--	---

Interval: _____

Harris Hip Score	
Pain (check one) ☐ None or ignores it (44) ☐ Slight, occasional, no compromise in activities (40) ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30) ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20) ☐ Marked pain, serious limitation of activities (10) ☐ Totally disabled, crippled, pain in bed, bedridden (0)	Stairs ☐ Normally without using a railing (4) ☐ Normally using a railing (2) ☐ In any manner (1) ☐ Unable to do stairs (0)
Limp ☐ None (11) ☐ Slight (8) ☐ Moderate (5) ☐ Severe (0)	Put on Shoes and Socks ☐ With ease (4) ☐ With difficulty (2) ☐ Unable (0)
Support ☐ None (11) ☐ Cane for long walks (7) ☐ Cane most of time (5) ☐ One crutch (3) ☐ Two canes (2) ☐ Two crutches or not able to walk (0)	Absence of Deformity (All yes = 4; Less than 4 = 0) Less than 30° fixed flexion contracture ☐ Yes ☐ No Less than 10° fixed abduction ☐ Yes ☐ No Less than 10° fixed internal rotation in extension ☐ Yes ☐ No Limb length discrepancy less than 3.2 cm ☐ Yes ☐ No
Distance Walked ☐ Unlimited (11) ☐ Six blocks (8) ☐ Two or three blocks (5) ☐ Indoors only (2) ☐ Bed and chair only (0)	Range of Motion (*indicates normal) Flexion (*140°) _____ Abduction (*40°) _____ Adduction (*40°) _____ External Rotation (*40°) _____ Internal Rotation (*40°) _____
Sitting ☐ Comfortably in ordinary chair for one hour (5) ☐ On a high chair for 30 minutes (3) ☐ Unable to sit comfortably in any chair (0)	Range of Motion Scale 211° - 300° (5) 61° - 100 (2) 161° - 210° (4) 31° - 60° (1) 101° - 160° (3) 0° - 30° (0)
Enter public transportation ☐ Yes (1) ☐ No (0)	Range of Motion Score _____ Total Harris Hip Score _____

Appendix E: Ethics Clearance certificate

 UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG	
R14/49 Dr Robert Martins Fernandes	
HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)	
<u>CLEARANCE CERTIFICATE NO. M230605 MED23-01-089</u>	
<u>NAME:</u> <u>(Principal Investigator)</u>	Dr Robert Martins Fernandes
<u>DEPARTMENT:</u>	Health Sciences Morningside Mediclinic
<u>DEGREE:</u>	Master of Medicine in Orthopaedic Surgery
<u>PROJECT TITLE:</u>	<i>Predictors of next day discharge following total hip arthroplasty using the direct anterior approach</i>
<u>DATE CONSIDERED:</u>	30/06/2023
<u>DECISION:</u>	Approved unconditionally
<u>CONDITIONS:</u>	
<u>NOTE:</u>	If contact information regarding student study participants is required, please contact the Registrar's office - Nicoleen.Potgieter@wits.ac.za
<u>SUPERVISOR:</u>	Dr A. Younus, Dr J. Botha and Dr M. Jingo
<u>APPROVED BY:</u>	 _____ Professor Paul Ruff, Chairperson, HREC (Medical)
<u>DATE OF APPROVAL:</u>	18/12/2023
<u>EXPIRY DATE:</u>	18/12/2028
This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.	
<u>DECLARATION OF INVESTIGATORS</u>	
I/we fully understand the conditions under which I am/we are authorized to carry out the above mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. <u>I agree to submit a yearly progress report</u> in the month date of convened meeting each year until study is closed. Failure to submit annual report will result in ethics clearance certificate suspension. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. Unreported changes to the application may invalidate the clearance given by the HREC (Medical). Login to upload signed copy of this ethics clearance certificate prior to commencing with the study https://www.witsethics.co.za/login.aspx . Email a signed copy of ethics clearance certificate to HREC-Medical.ResearchOffice@wits.ac.za	
 _____ Principal Investigator Signature	<u>17/01/24</u> _____ Date
PLEASE QUOTE THE CLEARANCE CERTIFICATE NUMBER IN ALL ENQUIRIES	