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Tink, Scott Colin John

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Outcomes of Reconstructive Hip Surgery in Gross Motor Function Classification System Level IV and V Cerebral Palsy Patients



Dr Scott C.J. Tink

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

Johannesburg, 2023

Declaration

I Scott Tink, declare that this research report in the format of a “submissible” paper 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.



Scott Tink

Signed on the 29th of August 2023, in Johannesburg.

Dedication

To my incredible wife Tarryn & our two amazing daughters, Isla & Sienna

Thank you for your unwavering support & encouragement, your love & understanding.

Without you this would not have been possible.

All my love & gratitude.

Presentations arising from the research project

Congress presentations:

1. AusACPDM / IAACD 2022 (Melbourne, Australia; March 2022)
   (Australian Academy of Cerebral Palsy and Developmental Medicine / International Alliance of Academies of Childhood Disabilities)

2. 68th Congress of the South African Orthopaedic Association, Cape Town, September 2022. Top 5 Abstract submission nominee. (Podium presentation)

3. 2nd WITS Orthopaedic Surgery Research Day, Johannesburg, November 2022.

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I would like to acknowledge and thank the study participants and their guardians for their willingness to participate in the study and to share our research findings to improve the healthcare services of children living with cerebral palsy.

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Nomenclature

ADL's	Activities of daily living
AP	Anterior-posterior
AVN	Avascular necrosis
CP	Cerebral palsy
FLACC	Face, Legs, Activity, Cry and Consolability
GMFCS	Gross Motor Function Classification System
HO	Heterotopic ossification
MP	Migration percentage
SPSS	Statistical Package for Social Science
SSI	Surgical site infection
VDRO	Varus de-rotation osteotomy

Outcomes of Reconstructive Hip Surgery in Gross Motor Function Classification System Level IV and V Patients with Cerebral Palsy

Dr. Scott C.J. Tink[1]

MBChB (Pret), B.Sc(Biochem) (Pret), DipPEC(SA), FCOrth(SA)

+27 (11) 717-2048 / 2538

scjt27@gmail.com

Hon. Adj. Prof. Faith M. Bischof[1]

M.Sc Physiotherapy (Wits), Ph.D (Wits)

Adj. Prof. Anthony J.F. Robertson[1]

MBBCh (Wits), M.Med(Orth) (Wits)

Dr. Gregory B. Firth[2]

MBBCh (Wits), FCS(Orth), M.Med(Orth) (Wits)

[1] Charlotte Maxeke Johannesburg Academic Hospital, Department of Orthopaedic Surgery, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand.

Parktown, Johannesburg, 2193.

[2] Royal London Hospital, Department of Orthopaedic Surgery, Barts Health NHS Trust.

Whitechapel Rd, London E1 1BB, United Kingdom.

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Abstract

Background:

Varying degrees of hip displacement have been observed in up to 75% of paediatric patients with cerebral palsy (CP). Conflicting data exists regarding the incidence of significant hip pain associated with displacement, and whether surgical intervention benefits such patients with known high recurrence and complication rates. There is a paucity of evidence regarding the outcomes of reconstructive hip surgery in an African environment.

Study objective: To establish medium-term functional and radiological outcomes of reconstructive hip surgery, in a cohort of non-ambulatory patients with CP, within an African context.

Methods:

This was a single centre, 5-year, retrospective study, reviewing non-ambulant Gross Motor Function Classification System (GMFCS) Level IV and V patients who underwent reconstructive hip surgery, between 2013 – 2017.

Each primary caregiver completed a caretaker questionnaire. Pre- versus post-operative sitting function, hip pain frequency and intensity, activities of daily living (ADL's), radiological outcomes and complications were explored. Descriptive statistics, Wilcoxon signed rank and Spearman Rho non-parametric tests were used to analyse and present the findings.

Results:

Forty-one participants were included, who underwent varus derotation osteotomy (VDRO) and adductor tenotomy, performed on 75 hips. Mean age at surgery was 8.7 years (3.3 – 16.3 years), and mean follow up was 6.3 years, (3.2 – 8.4 years). Surgery was bilateral in 34 cases. Ease of changing diapers and maintaining perineal hygiene was the only ADL to have improved (p=0.027). No improvement in sitting ability was noted. Significant hip pain decreased from 88% pre-operatively, to 32% post-operatively. (p<0.001). Using Reimer's migration percentage (MP), both groups demonstrated significant improvement in hip containment (p=0.029). GMFCS Level V patients experienced more complications (60%), compared to Level IV patients.

Conclusion:

Natural sequalae of CP renders these patients susceptible to painful hip instability. Although most patients in this study experienced improved hip abduction with increased ease of perineal hygiene, improved pain relief and better post-operative hip enlocation, the high incidence of complications emphasizes the importance of close follow up of patients living with CP.

Level of evidence: IV – Therapeutic.

Keywords:
Cerebral palsy (CP)
Varus derotation osteotomy (VDRO)
Hip dislocation
Hip reconstruction
Outcomes

Introduction

Most children with CP are born with anatomically normal, functional hips [1,2]. Muscle spasticity worsens with growth and accelerates as skeletal growth rates peak. There is increased hip adductor and flexor tone leading to progressive posterolateral femoral head subluxation, limb scissoring and hip instability [3,4]. Often described as a “silent subluxation” these individuals are frequently asymptomatic, only alluding to pain once hip subluxation is advanced or completely dislocated [4-6].

Varying degrees of hip displacement have been observed in up to 75% of patients with CP [7-11]. However, there is conflicting data to suggest that all displaced hips generate pain. The incidence of significantly painful hip displacement in the short to medium term is reportedly 30 – 50% [12-14]. When analysing the longer-term effects of hip displacement in patients with CP, Wawrzuta et al. reported hip pain in 72% of their participants [15].

Bagg et al. noted that dislocated hips, subluxed hips and hips that had been reduced, all shared a similar level of increased pain. Eithy nine percent of dislocated hips experienced moderate to severe pain, with 45% of subluxed hips experiencing some pain [16].

Bischof and Erken compared operative versus non-operatively managed hips of children with CP. They found no significant difference in pain scores or frequency between the two groups, but rather a deterioration in sitting ability in the operative group [17]. Bischof and Chirwa assessed pain whilst performing common activities of daily living (ADL’s) among non-ambulant adults living with CP with hip dislocations. Pain was reported in one third of patients and was intermittent in nature. [18]. Samilson

et al. described only 6 of their 274 patients with CP as having pain originating from a subluxed hip [19]. Similarly, Pritchett stated that one third of study participants with dislocated hips had mild pain, and 62% had no pain [20].

The success of hip surveillance programs at preventing hip dislocation and its associated pain and morbidity is evidenced by the global decrease in salvage procedures and increase in reconstruction procedures [21-23]. Typically, pelvifemoral osteotomies yield better functional and radiological outcomes compared to femoral varus derotation osteotomies (VDRO) alone [24,25].

From their systematic review regarding interventions for children with CP, Novak et al. stated that up to 40% of interventions had no documented evidence to support their use, and a further 20% of interventions were “ineffectual, unnecessary or even harmful” [26].

Considering the inherent risks and complexity of managing patients with CP, and the conflicting data regarding pain origination, is there justifiable evidence to support the use of reconstructive hip surgeries in this non-ambulant CP population?

The aim of this study was to establish the functional and radiological outcomes of reconstructive hip surgery among non-ambulant patients with CP, managed specifically within our African environment. Study objectives were to assess ADL’s, sitting ability, and hip pain. Further objectives were to assess radiological outcomes and the complications of surgery.

Materials and Methods

This was a retrospective cohort study with prospective recall, analysing medium-term outcomes of non-ambulant, GMFCS Level IV and V children with CP, who underwent a proximal femoral VDRO and adductor tenotomy, at a single tertiary centre in South Africa. The 5-year review period was from January 2013 to December 2017, with a minimum 24 months recovery period before assessment. Institutional ethics clearance was obtained prior to commencing the study.

A database of all patients fulfilling the above criteria was compiled, and 142 participants were included. Primary caregivers were telephonically invited to participate in the study, and a follow-up appointment confirmed.

A questionnaire was compiled to obtain information from the child's primary caregiver. Pre- and post-operative performance of ADL's and perceptions of pain were evaluated.

Pre-operative sitting ability was obtained from the caregiver. Sitting ability at follow-up was classified using the Chailey levels of box sitting [27]. Sitting function was recorded as being able to sit unassisted, able to sit assisted, and unable to sit.

The location, intensity and frequency of hip pain were assessed. This was done by performing a single brisk hip abduction movement, and comparing to pre-operative medical records and caregiver recollection. Pain was classified as significant or insignificant. Significant pain was defined as a recurring, reproducible pain

experienced at least several times a week, that occurred with the same movement, position or ADL, causing a sudden increase in irritability, crying, breath holding, muscle tensing, or facial grimacing. Insignificant pain produced the same clinical response, but in a random, non-reproducible manner, or on occasion.

The Faces, Legs, Activity, Cry and Consolability (FLACC) pain scoring tool was used to further assess pain. This scoring system provides a simple 0 – 10 score for qualifying pain behaviours in children unable to verbalise the presence or intensity of their pain [28,29].

Radiographic assessment of Reimer's migration percentage (MP) [30], was performed using a standardized anterior-posterior (AP) pelvic radiograph, as recommended by the Australian Hip Surveillance Guidelines [14]. Pre- and post-operative MP's were compared and each hip was classified as contained (MP ≤ 30%), subluxed (MP 31 – 89%), or dislocated (MP ≥ 90%). Radiological complications were also documented.

Data Analysis:

Due to limited sample sizes the Wilcoxon signed rank and Spearman Rho non-parametric tests were used, along with descriptive statistics. Individually, pre- and post-operative comparisons were made, as well as comparison between both GMFCS groups. Statistical significance was standardised with $p < 0.05$. Data were collected and stored on Microsoft Excel, and analysed by Statistical Package for Social Sciences (SPSS) version 25.

Results

Forty-one of 142 patients were followed-up in the study. Factors contributing to the low patient recall were; patients deceased prior to follow-up (13), caregivers declining participation (11), caregivers untraceable (77). The cohort included 18 females and 23 males. There were 24 GMFCS Level IV and 17 Level V patients. The mean age at time of surgery was 8.7 years old (3.3 – 16.3 years), and the mean follow up period was 6.3 years, (3.2 – 8.4 years). Surgery was bilateral in 34 cases, with a total of 75 hips undergoing VDRO and adductor tenotomy. Eleven hips underwent a simultaneous pelvic osteotomy. Three hips underwent revision surgery, outside of the review period.

Caregivers reporting on ADL's were asked to categorized their answers into one of four choices; with ease, slight challenge but possible, very difficult but possible, or impossible. (Table I). The only statistically significant ADL to improve post-operatively was changing of diapers, (p=0.027). Pre-operatively, changing diapers was categorized as with ease in 8 of the 41 patients (20%), which improved to 35 of 41 (85%) post-operatively. Five of the 41 patients (12%), were described as very difficult but possible pre-operatively, with none in this category post-operatively.

Hip abduction is a primary movement involved in the changing of diapers. Post-operative clinical assessment of hip abduction revealed significant increases in both GMFCS Levels IV and V, (p=0.043 and p=0.018) respectively, with an average increase of 15.2° abduction observed per operated hip. (Table II)

Table I: Activities of daily living

Activities of daily living (n = 41)	With ease		Slight challenge, but possible		Very difficult, but possible		Impossible	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Bathing (Lower limbs)	9	31	26	8	6	2	-	-
Changing diapers / underwear	8	35	28	6	5	-	-	-
Dressing / Undressing lower limbs	17	30	21	9	3	2	-	-
Transferring (In/Out bed)	19	16	22	24	-	1	-	-
Transferring (In/Out chair)	12	13	25	27	4	1	-	-
Ability to stand (with/without assistance)	0	0	2	1	11	12	27	28

* *Pre ~ Pre-operative; Post~ Post-operative*

Table II: Hip abduction

	Pre-Operative	Post-Operative	Improvement
GMFCS IV: (n = 24)	34.2°	44.6°	10.4°
GMFCS V: (n = 17)	25.7°	46.7°	21.0°
Combined groups: (n = 41)	31.1°	45.1°	15.2°

In comparing pre- and post-operative sitting function, (Table III) there was insignificant improvement in the GMFCS Level IV group, (p=0.187) where two of the 24 GMFCS Level IV patients improved from the able to sit with assistance group, to the able to sit, unassisted group. There was no difference in sitting function noted among GMFCS Level V patients.

Table III: Sitting ability

	Pre-Operative		Post-Operative	
	GMFCS IV	GMFCS V	GMFCS IV	GMFCS V
Able to sit unassisted	10	0	12	0
Able to sit assisted	13	13	11	13
Unable to sit	1	4	1	4

Significant pain was reported in 36 of the 41 patients pre-operatively (88%). This improved to 13 of the 41 patients post-operatively (32%) ($p< 0.001$). Pre-operatively, only 1 of 41 patients (2.4%) had no pain, compared to 15 of 41 patients (37%), post-operatively. Using the post-operative FLACC score 28 patients demonstrated mild to no pain, and 13 demonstrated moderate to severe pain. (Table IV).

Table IV: Hip pain

	Pre-Operative (n=41)	Post-Operative (n=41)
Significant Pain	36	13
Insignificant Pain	4	13
No Pain	1	15
Post-operative FLACC Scores (n=41)		
Mild-No pain (0 – 3 points)		28
Moderate pain (4 – 6 points)		11
Severe pain (7 – 10 points)		2

Radiological assessment revealed that hip containment was significantly improved in both GMFCS groups. In the GMFCS Level IV group, 10 of 44 hips (23%) were contained pre-operatively, compared to 34 of 44 hips (77%), post-operatively, representing a 54% improvement in the number of contained hips. (p=0.006). In the GMFCS Level V group 7 of 31 hips (23%) were contained pre-operatively, which improved to 16 hips (52%) post-operatively; representing a 29% improvement in the number of contained hips. (p=0.037). (Table V). By combining both GMFCS groups, two thirds of all hips operated on were still contained (MP ≤ 30%) at the time of follow-up.

Table V: Hip containment

	Pre-Operative		**Post-Operative**	
	GMFCS IV (n=44)	GMFCS V (n=31)	GMFCS IV (n=44)	GMFCS V (n=31)
Contained Hip	10	7	34	16
Subluxed Hip	23	14	7	9
Dislocated Hip	11	10	3	6

A total of 42 surgical and radiological complications were observed in 34 hips, (Table VI); a complication rate of 45% (34 of 75 hips). Three separate complications occurred in one hip, two complications occurred in 6 hips and a single complication occurred in 27 hips.

Seventeen of the 42 complications (40%) occurred in the GMFCS Level IV group (n=44), affecting 14 patients. This resulted in 32% of GMFCS IV patients experiencing at least one complication. (p=0.033)

Twenty five of the 42 complications (60%) occurred in the GMFCS Level V group (n=31), affecting 20 patients. This resulted in 65% of GMFCS V patients experiencing at least one complication. (p=0.046).

Table VI: Radiological and surgical complications

	GMFCS IV (n=44)		GMFCS V (n=31)		TOTAL:
Femoral vein injury	1	2.3%	0	-	1
Hardware failure	0	-	1	3.2%	1
Pressure sore	1	2.3%	2	6.5%	3
Surgical site infection	2	4.5%	1	3.2%	3
Avascular necrosis	1	2.3%	2	6.5%	3
Heterotopic ossification	4	9.1%	2	6.5%	6
Hip dislocation	2	4.5%	7	22.6%	9
Hip subluxation	6	13.6%	10	32.3%	16
TOTAL:	17	40%	25	60%	42

Discussion

A low patient recall was encountered in this study. Early mortality occurred in 13 of the 41 participants (9,2%) in keeping with the lower life-expectancy of children profoundly affected by CP [31-33].

All primary caregivers agreed that performing ADL's increases in difficulty as the child grows. Pre-operatively, the most difficult ADL to perform and most common pain generators were actions that caused hip abduction or flexion, such as maintaining perineal hygiene and changing diapers. Post-operatively, transferring from chair to toilet, or bed, or into a vehicle was the most difficult ADL. All caregivers reported a subjective improvement in ease of changing diapers and maintaining perineal hygiene post-operatively, as in keeping with published literature [34,35]. Any changes in the reported difficulty of transferring the child from bed to chair or toilet or vehicle, were negligible and insignificant. The ability to stand was the only ADL that worsened at follow-up, but this change was not statistically significant. This reported deterioration was likely due to the child's growth and becoming physically heavier.

Table II highlights a significant improvement in post-operative hip abduction in both GMFCS groups. Similar improvements in hip abduction were reported by De Souza et al., and by Krebs et al. [34,35]

Sitting ability remained unchanged following surgery, except for two patients in the GMFCS IV group who improved. Of note, there was no deterioration in sitting ability, as was previously reported by Bischof & Erken [17].

Post-operative significant hip pain was reduced in both GMFCS groups by 56% and 53%, respectively. Pre-operatively 36 patients reported significant hip pain, compared

to 13 patients post-operatively (Table IV). Of these 13 patients, 12 were reportedly painful pre-operatively, and one had no pain pre-operatively. The FLACC pain scoring tool is a validated pain scoring instrument that was used as an additional, independent measure of pain [28,29]. There was a correlation between the FLACC scoring and the descriptive pain scoring. FLACC recorded 28 patients in the mild to no pain category, in keeping with the 15 patients with no pain and the 13 patients with insignificant pain. Combining the moderate and severe pain categories of the FLACC score, these 13 patients correlated directly with the 13 patients classified with significant hip pain according to the descriptive pain scoring.

Reimer's MP is considered by many authors as the most accurate, single radiographic measure of hip instability in children with CP [3,22]. Radiological assessment (Table V) revealed a 54% improvement in the number of contained hips (MP ≤ 30%) in the GMFCS IV group, and a 29% improvement in the GMFCS Level V group, at follow-up. By combining both GMFCS groups (n=75), the number of contained hips increased from 17 pre-operatively, to 50 post-operatively. This produced a post-operative hip containment rate of 67%, which is in keeping with recent literature. Hip containment following VDRO was reported as 84% by Chang et al. [36], 63% by Shore et al. [37], and 52% by Ruzbarsky et al. [11]. Of note among the GMFCS IV patients, all 10 hips that were contained pre-operatively, remained contained at time of follow-up. Among the GMFCS level V group, of the 7 pre-operative contained hips only 5 were still contained at follow-up.

The number of subluxed hips decreased from 37 pre-operatively to 16 post-operatively; a 57% reduction. The number of dislocated hips decreased from 21 pre-

operatively to 9 post-operatively; a 57% reduction. This was corroborated clinically by the improved hip abduction scores and subjectively by the reported greater ease of perineal care.

There was a high complication rate in this cohort of patients, with seven hips having multiple complications. Complication rates reported for non-ambulatory children with CP undergoing hip reconstruction vary widely with rates up to 92% [11,15,38]. Failure to maintain hip containment accounted for 60% of all complications in this study.
A greater number of overall complications occurred in the GMFCS Level V group (27 complications) compared to the Level IV group (15 complications), also noted by Bayusentono et al. [39].

Heterotopic ossification (HO), occurred in 6 of the 75 hips (6%) post-operatively, none of which warranted surgical resection. Post-operative HO formation has a reported 2.3% – 53% occurrence [40-43]. Avascular necrosis (AVN) occurred in 3 of the 75 hips (4%). AVN secondary to VDRO is reportedly 2 – 10% in the literature [11,36].

The single case of iatrogenic femoral vein injury was explored and repaired by a vascular surgeon at the time of index surgery. The child made a full recovery. The single case of hardware failure progressed to re-dislocation. Revision surgery was performed outside of the study review period.

Most complications encountered did not cause significant morbidity nor require further surgical interventions. All complications noted were in keeping with published literature [11,15,38,40-44].

Study Limitations:

Study limitations include the use of retrospective data. The total number of study participants was low, with a participation rate of 29%. There was reliance on caregiver recall, which may have resulted in inaccurate reporting of pre-operative ADL's, function, and pain. There was a potential for bias from primary caregivers who may have over-emphasised any improvements or benefits experienced by the child.

Conclusion

After reviewing the individual aims of the study, the only ADL to have shown improvement was the changing of diapers; which is integral to maintaining perineal hygiene and patient comfort. Post-operative hip abduction improved with reported increased ease of patient care. No improvement in sitting ability was observed. Significant hip pain was reduced in this cohort. However, 32% still experienced significant pain at follow up. Hip enlocation was improved post-operatively, however hip instability persisted in one third of participants and was the most common complication noted. All complications observed were in keeping with published literature, most of which did not require further intervention. The overall complication rate following VDRO and adductor tenotomy remains high, with more complications noted among GMFCS Level V patients.

This data may be used in counselling parents and caregivers, and for healthcare providers caring for children with CP within the African environment. Although 68% of patients in this cohort experienced improved hip abduction, 56% improved pain relief and 44% improved post-operative hip enlocation, the high incidence of complications emphasizes the importance of close follow up of patients living with CP.

Declarations & Ethics statement

Author contributions:

1. Dr Scott Tink – This author was involved with study design, questionnaire design, literature review, protocol compilation, ethics application, compilation of patient database, communicating with patients and arranging follow-up consultations, examination of patients, data capturing, data analysis, Biostatistician consultation, report drafting, congress presentations, and compilation and submission of final research report.

2. Prof. Faith Bischof – This author was involved with study design, questionnaire design, literature review, protocol compilation, ethics application, examination of patients, data capturing, data analysis, congress presentations, and approval of final research report.

3. Prof. Anthony Robertson – This author was involved with study design, questionnaire design, protocol compilation, ethics application, data analysis, congress presentations, and approval of final research report.

4. Dr. Gregory Firth – This author was involved with literature review, protocol compilation, compilation of patient database, data analysis, and preparation for congress presentations.

Ethics approval and consent to participate:

- Ethics approval was obtained from Human Research Ethics Committee (Medical), University of the Witwatersrand: **M191025**
- Informed Consent was obtained by the legal guardians for every study participant.

Consent for publication:

- Signed consent obtained from each legal guardian. No individual names, identification numbers or other personal identifiers to be published.

Availability of data and materials:

- Data were collected from multiple sources belonging to the Chris Hani Baragwanath Academic Hospital (CHBAH), with consent of the CHBAH Ethics Committee and hospital management. All information is regarded as highly confidential and is stored as encrypted and data protected.
- Data sharing is possible with applicable approval from the CHBAH Medical Ethics Committee and hospital management approval.

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- All funding was solely provided by the primary author.

Competing interests:

- The authors declare that they have no competing interests.

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Appendix A: Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr SCJ Tink

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M191025

NAME: (Principal Investigator)	Dr SCJ Tink
DEPARTMENT:	School of Clinical Medicine Department of Surgery Division of Orthopaedic Surgery Chris Hani Baragwanath Academic hospital
PROJECT TITLE:	Outcomes of reconstructive hip surgery in Gross Motor Function Classification System IV & V Cerebral Palsy patients
DATE CONSIDERED:	2019/10/25
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Professor A Robertson
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/03/11

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 **October** and will therefore reports and re-certification will be due early in the month of **October** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

16/03/2020
Date

PLEASE QUOTE THE CLEARANCE CERTIFICATE NUMBER IN ALL ENQUIRIES

Appendix B: Letter of Permission – CHBAH Medical Advisory Committee

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date:17th July2019

TITLE OF PROJECT:

Outcomes of recosntructive hip surgery in GMFCS Level IV and V cerebral palsy patients at CHBAH

UNIVERSITY: Witwatersrand

Principal Investigator:Scott Tink

Department:Paediatric Orthopaedics

Supervisor :Professor Anthony Robertson, Professor Faith Bischof

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)
17th July 2019

.....
Approved/~~Not Approved~~
Hospital ManagementDate:
Date: 18/07/2019

Appendix C: Letter of Permission – CHBAH Department of Orthopaedics (Pg 1)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | FACULTY OF HEALTH SCIENCES

16th May 2019

LETTER OF PERMISSION TO CONDUCT RESEARCH FOR M.MED (ORTH)

Dept of Orthopaedic Surgery: Prof. S.K. Magobotha

Researcher: Dr Scott C. J. Tink

Purpose of Study: To conduct research within the department of Orthopaedic surgery at Chris Hani Baragwanath Academic Hospital (CHBAH), in the form of a retrospective cohort study with prospective recall, in order to fulfil the requirements of Masters of Medicine (M.Med Orth) degree.

Study Topic & Aim: Assessing the outcomes of Reconstructive Hip Surgery in non-ambulatory patients with cerebral palsy at CHBAH. The specific review period will be from the beginning of January 2013 to the end of December 2017.

Study objectives:

1. To establish the frequency and intensity of hip pain in these patients post-operatively.
2. To establish their sitting level, posture and tolerance.
3. To establish the functional outcomes in terms of other relevant activities of daily living, such as washing, dressing and transferring.
4. To perform a radiological assessment and analysis of hip reduction.

Cerebral palsy patients make up a large portion of the paediatric orthopaedic clinic patient load, presenting with an array of conditions that may require surgical intervention. The CHBAH paediatric orthopaedic unit adheres to the Australian Hip Surveillance guidelines for monitoring these patients and when indicated, reconstructive hip surgeries have been performed. In the aforementioned review period, January 2013 to December 2017, an estimated 146 non-ambulatory children and young adolescents with cerebral palsy underwent proximal femoral varus de-rotational osteotomies (VDRO), and adductor muscle release. A minority of these patients also received a pelvic osteotomy.

In a 2013 systematic review of high-level evidence articles regarding interventions for children with cerebral palsy, Novak and colleagues stated that up to forty percent of interventions had no documented evidence to support their use, and a further twenty percent of interventions were *"ineffectual, unnecessary or even harmful"*. Therefore, appreciating that such surgical interventions are invasive,

Appendix C: Letter of Permission – CHBAH Department of Orthopaedics (Pg 2)

anatomically disruptive, may require revision, increase family stress in addition to the emotional burden of granting consent, and carry an array of potential complications, the purpose of this study would be to analyse our results, successes, operative failures and complications, to ultimately determine whether these surgeries are truly benefiting our patients.

To date, countless publications of the various aspects of cerebral palsy have been published. However, research focusing specifically on short to medium term post-operative outcomes of hip reconstruction in non-ambulatory children with cerebral palsy, within the African context are limited to only a few older studies with relatively small sample sizes. Majority of the existing research comes from European, American and Australasian studies.

With this letter and explanation, I seek the permission of the Head of Department of Orthopaedic Surgery at CHBAH, to conduct this research. I promise to maintain patient confidentially and integrity to the highest ethical standard throughout the research and publication process. In the event that this research is published in a peer-reviewed journal, the University of the Witwatersrand shall be recognized, as well as the contributing colleagues.

Permission granted: _____

Permission granted by: Prof S. K. Magobotha

Permission granted on date: 16th May 2019

Conditional granting of permission: As detailed in the text above.

Appendix D: Journal of Pediatric Orthopaedics, publication guidelines

Manuscript preparation & publication criteria (Obtained from https://edmgr.ovid.com/jpo/accounts/ifauth.htm)

Ethical / Legal considerations:

A submitted manuscript must be an original contribution not previously published, must not be under consideration for publication elsewhere, and, if accepted, must not be published elsewhere in similar form, in any language, without the consent of Lippincott Williams & Wilkins.

Each person listed as an author is expected to have participated in the study to a significant extent.

Patient Anonymity and Informed Consent:

It is the author's responsibility to ensure that a patient's anonymity be carefully protected and to verify that any experimental investigation with human subjects reported in the manuscript was performed with informed consent and following all the guidelines for experimental investigation with human subjects required by the institution(s) with which all the authors are affiliated.

Authors should remove patients' names and other identifying information from figures. If any identifying details appear in text, tables, and/or figures, the author must provide proof of informed consent obtained from the patient. Photographs with bars placed over eyes of patients should not be used in publication. If they are used, permission from the patient is required.

Authorship Requirements:

Each person listed as an author is expected to fulfill the criteria for authorship established by the International Committee of Medical Journal Editors in their 2007 statement on Uniform Requirements for Manuscripts Submitted to Biomedical Journals (www.icmje.org). More specifically, according to the ICMJE, authorship credit should be based on several requirements. Please create a list assigning a person's name against the following roles or tasks:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; and
- Drafting the work or revising it critically for important intellectual content; and
- Final approval of the version to be published; and
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Authorship qualification requires that each of the above criteria be satisfied. The cover letter must provide assurance that each author fulfills each of these requirements.

Authors retain copyright

Authors grant Wolters Kluwer an exclusive license to publish the article and the article is made available under the terms of a Creative Commons user license. Please visit the ‘Open Access Publication Process’ page for more information.

Conflicts of interest

For the timespan covering the work being presented, authors are required to disclose all possible conflicts of interest in the manuscript, including financial, consultant, institutional and other relationships that might lead to bias or a conflict of interest. If there is no conflict of interest, this should also be explicitly stated as none declared. All sources of funding should be acknowledged in the manuscript. All relevant conflicts of interest and sources of funding should be included on the title page of the manuscript with the heading “Conflicts of Interest and Source of Funding”. Each author

Permissions

Authors must submit written permission from the copyright owner (usually the publisher) to use direct quotations, tables, or illustrations that have appeared in copyrighted form elsewhere, along with complete details about the source. Any permissions fees that might be required by the copyright owner are the responsibility of the authors requesting use of the borrowed material, not the responsibility of Lippincott Williams & Wilkins.

Preparation of Manuscript:

Original Articles – Should not exceed 2,500 words.

Cover Letter – Must contain assurance that each of the listed authors meets each of the authorship requirements as stated explicit in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (www.icmje.org).

Title Page – Must be submitted as a separate file. It must include on the title page, (a) the complete manuscript title, (b) the authors' full names, highest academic degrees, and affiliations, (c) the name and address for correspondence, including fax number, telephone number, and e-mail address, (d) the address for reprints if different from that of corresponding author, and (e) all sources of support, including pharmaceutical and industry support, that require acknowledgment.

The title page must also include disclosure of funding received for this work from any of the following organizations: National Institutes of Health (NIH); Wellcome Trust; Howard Hughes Medical Institute (HHMI); and other(s).

Structured Abstract and Levels of Evidence – Should consist of:

- Maximum 325 words, consisting of five paragraphs, with the headings; *Background*, which states the primary research question, *Methods*, *Results*, *Conclusions*, and *Level of Evidence*.
- Limit the use of abbreviations and acronyms.
- For the Level of Evidence section, describe the study type and assign a level-of-evidence rating to the primary research question, according to the criteria in the table found at this address, under ‘Instructions to Authors’: https://edmgr.ovid.com/jpo/accounts/ifauth.htm

Text – Each manuscript page must be numbered clearly and use double-spacing structure, with line numbers continuing throughout. Organize the manuscript into four main headings: Introduction, Materials and Methods, Results, and Discussion. Define abbreviations at first mention in text and in each table and figure.

References – The authors are responsible for the accuracy of the references. Present the references (double-spaced) at the end of the manuscript, cited in their order of appearance. If there are more than three authors, name only the first three authors and then use et al.

Figure Legends – Required for all figures, they should be brief and specific, and should appear beneath the figure itself. There should be a separate manuscript page after the references.

Tables – Cite tables consecutively in the text, and number them in that order. Table names should appear on top of each table, and include the table title, appropriate column heads, and explanatory legends, including definitions of any abbreviations used.

Style – Pattern manuscript style after the *American Medical Association Manual of Style* (9th edition). *Stedman's Medical Dictionary* (27th edition) and *Merriam Webster's Collegiate Dictionary* (10th edition) should be used as standard references.

Appendix E: Student's contribution to the research and writing of the "submissible" paper.

Division of Orthopaedic Surgery

Faculty of Health Sciences, 4M Room 12, Wits Medical School, 7 York Road, Parktown 2193
• Tel: +27 11 717-2638 • Fax: +27 11 717-2651

14th February 2023

Faculty of Health Sciences, University of the Witwatersrand

RE: SCOTT TINK's CONTRIBUTION TO THE RESEARCH AND WRITING OF THE "SUBMISSIBLE" PAPER

To whom it may concern,

This letter serves to confirm that the co-authors of the "submissible" research paper have agreed to its use by Scott Tink, student number, 2288265, as part of his MMed research report. Scott Tink made a substantial contribution to conducting the research study and writing the manuscript.

Yours sincerely,

.....

Prof. FM. Bischof
Primary co-supervisor

.....

Prof. AJF. Robertson
Co-supervisor

.....

Dr Scott CJ Tink
MMed Candidate

Appendix F: Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Scott C. J. Tink (Student number: 2288265) am a student registered for the degree of Masters of Medicine - Orthopaedic Surgery in the academic year 2023.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature:  Date: 31st May 2023.

Appendix G: Turnitin report acknowledgement letter

Division of Orthopaedic Surgery

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

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Faculty of Health Sciences, University of the Witwatersrand 30/05/2023

RE: TURN-IT-IN REPORT ACKNOWLEDGEMENT LETTER

To whom it may concern,

Please accept Dr Scott C. J. Tink's (student number: 2288265) Turn-it-in report for his MMed Research Report entitled "*Outcomes of Reconstructive Hip Surgery in GMFCS Level IV and V Cerebral Palsy patients*". The similarity index is 16%. All the source matches are 1% and less with the exception of source match 1 (mainly Wits formatting) and match 2 (terminology pertaining to the study). The report does not appear to be plagiarised.

Yours sincerely,



Dr Brenda Milner

Associate Researcher

Email: Brenda.Milner@wits.ac.za

Cell: 083 468 2145