SURGICAL ANATOMY OF THE COMMON PERONEAL NERVE IN THE KENYAN POPULATION: A CADAVERIC STUDY

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DECLARATION

Declaration by Candidate

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DEDICATION

This study is dedicated to the Department of Human Anatomy, Moi University School of Medicine.

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ABSTRACT

Background: The common peroneal nerve (CPN) is a branch of the sciatic nerve in the leg, at most risk of injury around the fibular neck as it is almost subcutaneous. With increasing procedures around the knee, there is increasing incidence of possible injuries to the nerve intraoperatively resulting in post operative complications. The nerve has been studied in Caucasian populations and findings published, unlike the case in Kenyan population.

Objective: To describe the surgical anatomy of the CPN in the Kenyan population.

Methods: The study was conducted in the Human Anatomy Laboratory at Moi University, School of Medicine, and using anatomical descriptive cross- sectional study design. Study population of forty three right sided formalin fixed limbs of unascertained origin was dissected, using lateral approach. CPN was identified and tagged. Its distance from the Gerdy's tubercle was plotted at 3 points: ***d I***-(from Gerdy's tubercle to the CPN at the back of the head of the fibula); ***d II***- (from Gerdy's tubercle to the starting point of the superficial branch of the CPN); and ***d III***- (from Gerdy's tubercle to anterior recurrent genicular branch). Its branches were identified. Photographs showing the course of the nerve and its branches were taken. Measurements of ***d I, d II, d III*** and the length of the nerve main trunk were taken and recorded into data collection sheets, and later fed into an electronic database with restricted access. Data analysis was done and results were presented using tables and graphs.

Results: Forty three (32 males, 11 females) cadaveric formalin fixed lower limbs were used. CPN trunk was noted winding around the neck of fibula and disappeared into substance of peroneus longus muscle. The measurements for all cadaveric limbs in mm (Median (IQR)) were***: d I***=58 (54, 62)**;** ***d II***= 54 (47, 58); and ***d III***= 49 (44, 53). The mean radius was 57.6±5.0 mm. The ***d I, d II** and **d III*** for all limbs and even by gender categorization however were all statistically not significant (p> 0.05). The CPN main trunk had median (IQR) lengths in mm of 153 (138, 230) and was statistically significant (Shapiro-Wilk test: W= 0.717; p< 0.001). Photographic findings showed the nerve arose from the sciatic nerve at different locations (2.3% intrapelvic; 9.3% proximal third of the thigh; 18.6% middle third of the thigh and 69.8% distal third of the thigh) and divided into its branches inside the peroneus longus muscle in 91% of limbs, and outside the muscle in 9% of limbs. The branches included: sural communicating; superior, inferior and recurrent genicular; deep and superficial peroneal nerves. The variations in the course of the nerve and the branches were displayed in photographs.

Conclusion: The mean radius for Gerdy's safe zone and the length of the main trunk in Kenyan population were greater than in other studied populations. However, no comparison can be made for the median (IQR) length of main trunk as it lacked in other studies. The number of branches and branching patterns were as in other studies with only in 9% of limbs- division outside the peroneus longus.

Recommendations: Orthopaedics surgeons in Kenya can use the findings of this study to plan and carry out various procedures safely in proximal tibia (Gerdy's safe zone). The exact origin of the limbs could not be ascertained. Therefore further study can be carried out in ascertained different populations for comparison.

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LIST OF ABBREVIATIONS AND ACRONYMS

BMI	Body Mass Index
CPN	Common Peroneal Nerve
CRPS	Complex Regional Pain Syndrome
d I	Distance from Gerdy’s tubercle to common peroneal nerve at the back of the head of fibula
d II	Distance from Gerdy’s tubercle to the superior genicular branch of the CPN
d III	Distance form Gerdy’s tubercle to the anterior recurrent genicular branch of CPN
IREC	Institution Research and Ethics Committee
LHBF	Long Head Biceps Femoris
MT	Main trunk of the common peroneal nerve
MTRH	Moi Teaching and Referral hospital
MUHAL	Moi University Human Anatomy Laboratory
ORIF	Open Reduction and Internal Fixation

LIST OF DEFINED KEY TERMS

Common peroneal nerve- This is one of the branches of the sciatic nerve, also known as common fibular nerve that supplies structures in the leg.

Gerdy's safe zone- This is an arc like area around Gerdy's tubercle with an approximate radius of 45 mm defined by the common peroneal nerve and its anterior recurrent branch (Rubel, et al., 2004).

Gerdy's tubercle- This is a prominence on the lateral aspect of the proximal tibia where the iliotibial tract inserts.

Tibia- This is the larger of the two bones in the leg.

CHAPTER ONE: INTRODUCTION

1.1 Background

Koshi (2017), Sinnatumby (2011), and Standring (2016) described the common peroneal nerve (CPN) as one of the branches of the sciatic nerve. It is also known as the common fibular nerve. It runs downwards and laterally, medial to the biceps tendon. It lies against the lateral side of the fibular neck. At this point, it can be rolled against the fibula in the living. It then disappears into the substance of peroneus longus. It gives off the following branches:

1. The sural communicating nerve- This pierces the roof of popliteal fossa. It then runs downwards in the subcutaneous fat. This nerve joins the sural nerve below the bellies of gastrocnemius.
2. The lateral cutaneous nerve of the calf- It also pierces the roof of popliteal fossa over the lateral head of gastrocnemius. It then supplies the skin over the upper part of the peroneal and extensor compartments of the leg.
3. The superior and inferior genicular nerves- These accompany the arteries of the same name. They supply the knee joint capsule and the lateral ligament.
4. The recurrent genicular nerve-This arises in the substance of peroneus longus, perforates tibialis anterior. It supplies the capsules of the superior tibiofibular and knee joints.

The CPN ends by dividing in the substance of peroneus longus, into the deep and superficial peroneal nerves (Koshi, 2017; Sinnatumby, 2011; Standring, 2016).

Studies on the nerve have been conducted on the Caucasian population (Rubel et al., 2004), and the genetically diverse Brazilian population (Labronici et al., 2010). Another study on the CPN was done in Egypt (Ramadan, 2006). African studies that mention the CPN were centered on the sciatic nerve (Kukiriza et al., 2010; Ogengo et al., 2011).

Kukiriza et al., (2010) studied the levels of bifurcation of the sciatic nerve in the Ugandan population, while Ogengo et al., (2011) studied variant anatomy of the sciatic nerve in the Kenyan population, and mentioned patterns of its bifurcation into the peroneal and tibial nerves. To our knowledge the only published African study centered specifically on the CPN was done in Egypt on the nerve and its relations to the biceps femoris and peroneus longus tendons (Ramadan, 2006).

The CPN and the branches arising from it are at most risk of injury in their locations as they are mostly subcutaneous (Koshi, 2017; Sinnatumby, 2011; Standring, 2016). With increasing procedures in the leg (percutaneous procedures for example insertion of Steinman pin for skeletal traction, external fixation of open fractures, and other procedures for example as knee arthroscopies), there is increasing incidence of possible injuries to the nerve intraoperatively resulting in post operative complications that would lead to increasing litigation against surgeons by patients. Any form of Injury around this region poses great risk of injury to the CPN and its branches (Standring, 2016). The nerve is not spared from harm due to neoplastic disorders (Takeda et al., 2001). There is paucity of publications on this nerve in this locality. This study is purposefully therefore to fill the current existing knowledge gap.

1.2 Problem statement

The CPN as noted above lies against the fibular neck. This is a superficial position and as such the nerve is predisposed to injury during dislocations and fractures (Standring, 2016), due to other ailments for example tumors (Takeda et al., 2001) or during surgical procedures (Labronici et al., 2010; Rubel et al., 2004). The anatomy and the risk of injuring the CPN globally, regionally and locally in particular have not been adequately studied.

At Moi Teaching and Referral Hospital, in the year 2016 and 2017, there were procedures centered around the knee that would have put the CPN at risk. These included: Total knee arthroplasties; knee arthroscopies; knee spanning external fixators; plating of distal femur, proximal tibia and tibial plateau fractures.

Table 1: Summary of procedures done around the knee at MTRH for the years 2016 and 2017

YEAR	**PROCEDURES (numbers)**				
	Total knee arthroplasties	Knee arthroscopies	Knee spanning external fixators	Miscellaneous procedures	Total number of cases
2016	19	13	17	67	116
2017	18	5	11	54	88

The CPN can also bifurcate from the sciatic nerve in the pelvis. As such, procedures around the hip (Total hip arthroplasties and hemiarthroplasties) can put the nerve at risk of injury. With regards to procedures around the hip that would have predisposed to the CPN to injury, the data was as follows for the years 2016 and 2017 at MTRH.

Table 2: Summary of procedures around the hip that could have affected the CPN done at MTRH for the years 2016 and 2017

YEAR	**PROCEDURES**		
	Total hip Arthroplasties	Hemiarthroplasties	**Total**
2016	16	53	69
2017	19	34	53

In the year 2017, there was the 3 months doctors' strike, and the 3 months nurses' strike. The combined six months, health-practitioners' strikes must have played a part in the reduced number of cases done that year. Despite all this, these numbers indicate that there are quite a number of surgeries done around the knee at MTRH. The procedures carried out at MTRH on the categorized patients could iatrogenically injure the superficially placed nerve in its proximity.

The purpose of this study is to give highlight on the anatomical position of the CPN in relation to bony landmarks in the Kenyan population, in order to understand the risks of damage arising from entrapment ailments, traction injuries due to dislocations and fractures and tumors. When carrying out procedures, this will go a long way in cultivating caution and how to safely handle the cases.

1.3 Justification of the study

There is paucity of publications specifically on the anatomical position of the CPN in relation to bony landmarks in the Kenyan population yet such knowledge is quite crucial in surgical practice as many complications due to the injuries, other ailments and even when performing surgical procedures can be taken care of, prevented and effectively controlled by the Orthopaedics Surgeons and other related practitioners in Orthopaedics field.

Studies done on the CPN are mostly from the Caucasian and Arab populations (Ankolekaret al., 2015; Cao et al., 2018; Labronici et al., 2010; Ramadan et al., 2009; Rubel et al., 2004). To our knowledge, none have been found in the Sub Saharan African (Black) population.

Knowledge and skills involved in the demonstration of position of the CPN in relation to Gerdy's tubercle on the tibia and the proximal fibula, demonstration of different branches and variations in the course of the CPN branches in the African (Black) Kenyan population is quite crucial. This will keep the Orthopaedics Surgeons and other related practitioners in Orthopaedics field updated and cautious in order to handle the problems effectively, thereby preventing complications and thus avoiding the medicolegal issues (see Appendix 7) that may arise.

1.4 Research Question

How is the surgical anatomy of the CPN in the Kenyan population?

1.5 Research Objectives

1.5.1 Broad Objective

To describe the surgical anatomy of the CPN in the Kenyan population.

1.5.2 Specific Objectives

1. To measure the position of the CPN in relation to Gerdy's tubercle on the tibia, by measuring the distances between the nerve and the Gerdy's tubercle at 3 points along the course of the nerve in each limb in the Kenyan population at Moi university Human anatomy laboratory.
2. To measure the length of the CPN in the Kenyan population at the Moi university Human Anatomy laboratory.
3. To demonstrate the different branches arising in the course of the nerve in the Kenyan population at the Moi university Human Anatomy laboratory.
4. To demonstrate variations in the course of the CPN and branches in the Kenyan population at the Moi University Human anatomy laboratory.

CHAPTER TWO: LITERATURE REVIEW

2.1 Clinical implications of CPN injury

The common peroneal nerve is prone to injuries due to its relatively superficial course as it traverses the lateral condyle of the femur and courses behind the head of the fibula. Due to its anatomical position it can also be injured during operative procedures (Sinnatumby, 2011; Standring, 2016).

Standring, (2016) elucidated that the nerve may become entrapped between the attachments of peroneus longus to the head and shaft of the fibula. Traction lesions can accompany dislocations of the lateral compartment of the knee, and are most likely to occur if the distal attachments of biceps and the ligaments that insert into the fibular head are avulsed, possibly with a small part of the fibular head. The common peroneal nerve is pulled proximally because it is tethered to the bicipital tendon by dense fascia. Patients with such injury present with foot drop, which is usually painless. There is also weakness of ankle dorsiflexion, and eversion of the foot, but inversion and plantar flexion are normal although ankle reflex is preserved. The nerve is relatively unprotected as it traverses the lateral aspect of the neck of the fibula and is easily compressed at this site, by plaster casts or ganglia.

Adolfo et al., (2008) documented that CPN palsy is the most common lower extremity palsy while Weiss et al., (1992) demonstrated palsy in children after casting for femoral fractures.

Standring, (2016) noted that the nerve divides at the fibular neck into the superficial peroneal and deep peroneal nerves. Lesions at this level may damage its main trunk or either of its branches. A lesion of the superficial branch causes weakness of foot eversion with sensory loss on the lateral aspect of the leg, which extends onto the dorsum of the foot.

The Association of Surgical Technologists, (2011) further noted that this nerve was likely to be injured during positioning of the patient for surgical procedures; most common in lithotomy position. They recommended precautions by doing the following: “In lithotomy position, avoid the lower legs resting against the stirrups and by padding the stirrups”.

Recondo et al., (2000) noted that CPN injuries are easy to overlook in cases of injuries to the lateral compartment of the knee, because these are less common. However they are noted to be more disabling. On the other hand, Rupp et al., (1994) determined that the CPN is also at risk during fibular osteotomy at its proximal third.
Immerman et al., (2014) reported that the incidence of injury to the CPN in patients with tibial plateau fractures ranged from 1.2% to 3%. The nerve was also noted to be injured in 75% of multiligamentous knee injury especially after posterolateral knee dislocations. Other risk factors noted included: obesity, male gender and fibular head fracture. There was an association between peroneal nerve injury and vascular injury in knee dislocations, with a nerve rupture rate of about 40%.The nerve was noted to be injured iatrogenically with an incidence of 4.9% in high tibial osteotomies, and an incidence of 0.3%-9.5% in total knee replacement arthroplasties. Immerman et al., (2014) further listed risk factors for iatrogenic injuries which included: “Revision surgery, pre-operative valgus deformity, rheumatoid arthritis, history of previous high tibial osteotomy, prolonged tourniquet time and history of previous laminectomy, foot drop, supination (equinovarus) deformity and lastly a stepping gait was noted to characterize untreated common peroneal nerve injury. These patients were noted to have an incidence of 30%-35% limb disability. In terms of treatment, Immerman et al., (2014) reported that in patients with non- operative treatment, complete recovery was noted up to 30 months after injury. The rate for full recovery of partial peroneal

palsies was noted to be 76%-87%. The rate of spontaneous recovery of complete lesions is 20%-35%. Immerman et al., (2014) reported that neurolysis as a form of treatment showed good recovery in 71%-97% of patients, with 88% rate of functional return. They also reported that direct repair and grafting of the nerve had an 84% and 75% success rate respectively.

In another interesting study, Ribak S., da Silva Filho P. R., et al., (2016) evaluated the clinical results from treating chronic peripheral nerve injuries in the upper limbs using the superficial peroneal nerve as a graft donor source. They used in 11 patients who had sustained ulnar and median nerve injuries (ulnar nerve was injured in eight cases and the median nerve in six; there were three cases of injury to both nerves). There was no motor deficit in the donor area. A sensitive deficit in the lateral dorsal region of the ankle and the dorsal region of the foot was observed. None of the patients presented complaints in relation to walking. They concluded that use of the superficial peroneal nerve as a graft source for treating peripheral nerve injuries is safe and provides good clinical results similar to those from other nerve graft sources.

2.2 Surgical approaches

Alpert et al., (2008) noted that injuries to the posterolateral corner of the knee were rare. As such, many Orthopedic Residents and practicing Orthopedic Surgeons may be unfamiliar with the posterolateral surgical approach to the knee. These practitioners may not be comfortable doing procedures needing this approach. They also noted that posterolateral knee injuries may injure the CPN. They recommended a surgical approach in which one created a fascial window oriented parallel to the CPN and posterior to the long head of biceps. This fascial window is to be used to identify and mobilize the nerve intra-operatively. This allows retraction of the long head biceps femoris (LHBF) anteriorly. It also allows one to palpate the posterior fossa of the head of fibula safely. This is especially important when doing posterolateral reconstruction using a drill through the head of fibula.

Medvecky and Noyes, (2005) outlined indications for posterior surgical approach to the knee to include:"Posterior collateral ligament tibial inlay reconstruction, inside out meniscal repair, repair with or without augmentation of acute traumatic medial or lateral ligamentous injuries, open reduction internal fixation (ORIF) of tibial plateau fractures, ORIF of posterior collateral ligament tibial avulsion fractures, Baker's cyst excision and posterior capsular releases for arthrofibrosis and tumor/mass excision." The posterolateral and posteromedial approaches to the knee were noted by team of Medvecky and Noyes, (2005) to be important and a useful skill for Specialists in Knee Surgery and Sports Medicine, and also General Orthopedic Surgeons. The posterolateral approach was noted to endanger the CPN in either cases of straying posteriorly in superficial dissection to biceps tendon or straying posteriorly in the deeper dissection to lateral gastrocnemius head. His team stressed the importance of knowing that it is easier to injure the CPN with the posterolateral surgical approach to the knee.

Stanton et al., (2010) noted that the surgical incisions most likely to injure the CPN were the lateral approach and posterior approaches. They further outlined indications for the lateral approach which included exploration of the lateral collateral ligament and getting access to the anterior and posterior intra-articular structures. For the posterior approach, they outlined the indications as exploration of the popliteal fossa and neurovascular structures, repair of posterior collateral ligament avulsion fracture, and excision of popliteal cysts.

Allum, (2002) reviewed articles on complications of knee arthroscopies and noted that in a series done by Small, (1986) , 229 (0.06% incidence) nerve injuries were noted in

375,069 knee arthroscopies. The individual nerve injuries included: 42% cases the saphenous nerve, 5% the peroneal nerve, 3% the femoral nerve and 3% the sciatic nerve. The mechanisms of injury to the nerve included "direct trauma to the nerve, pressure due to compartment syndrome resulting from extravasation of fluid, damage related to the use of a tourniquet and dysfunction due to the ill understood condition of complex regional pain syndrome (CRPS). He established that temporary paresis may occur after prolonged inflation of the tourniquet, and also in older patients. The CPN was more likely to be damaged in knee arthroscopy to the lateral side during meniscal repair and lateral meniscectomy. He further added that flexion of the knee during procedures allowed the nerve to drop back posteriorly which made the nerve less vulnerable. Allum, (2002) thus concluded that the safe area for knee arthroscopy laterally lay between the posterior edge of the iliotibial band/tract and the biceps preferably deep to the lateral head of gastrocnemius.

In surgical approaches to the knee, it is imperative to know the course of the nerve and all possible variations especially as procedures for example total knee replacement arthroplasties and knee arthroscopies become more common. The CPN can be injured in total knee replacement arthroplasties either by direct or indirect injury. Clarke et al., (2004) noted that direct injury could occur when doing Pie crust lateral soft tissue release in valgus knee. This was also supported by Jia et al., (2012) who conducted a study on anatomic proximity of the peroneal nerve to the posterolateral corner of the knee determined by magnetic resonance imaging.

It is important to know the variations of the nerve as it is easy to damage the proximal portion of the nerve during knee arthroscopy. Asp et al., (2014) carried out a review on studies and noted that in a study carried out by Deutsch et al., (1999) in10% of legs the CPN divides into deep and superficial branches proximal to the knee joint. In 30%

of specimens, a separate cutaneous branch emanated from the CPN trunk, a branch that had not previously been described in the literature. It was demonstrated that during arthroscopically assisted inside-out lateral meniscus repair in fresh frozen cadavers, the risk of injuring the peroneal nerve or one of its branches was as high as 20% from insertion of meniscal sutures when a posterior retractor was not used.

Kramer et al., (2006) noted that during creation of a posterolateral accessory portal in knee arthroscopy, there is risk of injury to the CPN. The team also quoted the same percentages as Deutsch et al (1999) with regards to the branching of the CPN into deep and superficial branches, and also the previously unrecognized cutaneous branch in 30% of specimens emanating from the common peroneal nerve.

2.3 Radiological studies

Van den Bergh et al., (2013) conducted MRI studies on the knee in both normal and pathologic states. The team listed the following features contributing to peroneal neuropathy.

1. Paucity of epineural tissue which predisposes CPN to compression.
2. Variations of the biceps femoris tunnel where a more distal extension of the long head of biceps femoris tendon predisposes to compression.
3. The bifurcation level of the CPN, where a more proximal bifurcation (10% of cases it bifurcates above the joint line), predisposes the nerve to injury.
4. The nerve has a superficial course around the fibula. This predisposes it to injury through, compression, stretching and also intraoperatively.
5. The fibular tunnel, where it is prone to entrapment.
6. Its additional nerve branches.

Van den Bergh et al., (2013) also noted that diabetics were more prone to injury due to lower microvascular threshold; hence they develop entrapment neuropathies more commonly than other patient populations. This team described how the nerve looks like in MRIs and divided the injury phases into early, subacute and end stage denervation. In the early period after injury, MRI will show edema, after 7 days the MRI will show the nerve undergoing atrophy. In the end stage of injury, fatty replacement is seen.

The causes of pathology to the nerve included:

1. Trauma- due to fractures or surgery
2. Traction injuries
3. Contusions
4. Penetrating injury
5. Compression from intraneural lesions (intraneural ganglions, peripheral nerve sheath tumors) and extraneural lesions (osteochondromas, extraneural ganglia).

In an MRI study on the anatomy of the knee Yin et al., (2014) noted that the course of the CPN is variable and depends on the patient's weight. This is especially important when planning for inside out meniscal tear repairs. Yin et al., (2014) concluded that the proximity of the peroneal nerve to suture tracks is highly predicted by BMI." As such, this team recommended that in the case of inside out lateral meniscus repairs on non-obese patients, a posterior incision should be done.

2.4 Cadaveric studies in fetuses

Leishiwon et al., (2015) studied the sciatic nerve in fetuses in the Indian population and established that the sciatic nerve divided in the popliteal fossa in 86% of specimens.

Kurtoglu et al., (2006) studied the bifurcation of the sciatic nerve in fetuses (Turkish population) in relation to the popliteal crease. They found that the bifurcation occurred above the popliteal crease in majority of cases (85%). Their team also established that with regards to branching, the superficial fibular nerve in fetuses became superficial at higher levels when compared to the adult population.

Sinha et al., (2014) studied the sciatic nerve in fetuses (Indian population) and evaluated the levels of bifurcation, and the diameter of the sciatic nerve at certain levels. They documented the level of the bifurcation in relation to the lateral condyle of the femur, whether it was above or below it. In 66% of cases, the nerve in fetuses was seen to divide at or within a distance of 11mm from the lateral condyle of the femur, the cases increased to 75% of cases within a distance of 13mm and to 100% within a distance of 21mm from the lateral condyle. This particular research team postulated that they may have gotten the nerve bifurcating more distally because they had a higher population of smaller fetuses in their study. The study was meant to provide dimensions of the nerve that would have been useful in cases that needed grafting and also in tumor diagnosis. The dimensions would also provide a basis for radiological studies in children.

Chetty et al., (2014) studied the nerve on Caucasian fetuses and studied the length of the main trunk of the common peroneal nerve and the branching pattern of the CPN. They noted variations in the lengths between Right lower limbs- 16.03 (SD 3.53) mm (11.07-22.77mm) and Left lower limbs- 16.69 (SD 3.90) mm (10.65-24.14mm)."

Chetty et al., (2014) did a study on the CPN on fetuses and documented whether CPN branched before reaching the tuberculum of the fibula, or at the tuberculum of the fibula. It was noted that majority of the nerves branched at the tuberculum of the fibula. The team established that in the fetal subjects, the CPN divided at the tuberculum in 67.5% of the right limbs, and 70% in the left. The nerve divided above the tuberculum of the fibula in 25% of the right limbs and 12.5% in the left limbs. One has to keep in mind the study in adults where in 10% of specimens the nerve divided into its deep and superficial branches proximal to the knee joint.

Cadaveric studies in fetuses alert one to the fact that as in all cases of embryology, there are always changes as structures develop in the human body and as such one has to keep this in mind when operating in patients in the pediatric population, that the anatomy might be slightly different when compared to adults.

2.5 Cadaveric studies in adults

2.5.1 The position of the Common Peroneal Nerve

2.5.1.1The position of CPN with regards to the bifurcation from the Sciatic nerve

With reference to variations in the course and branching, variations could occur at the beginning of the bifurcation of the sciatic nerve as it branches into the tibial and CPN. This knowledge is important in patients with sciatica, peroneal syndrome or piriformis syndrome.

Ogengo et al., (2011) noted that the nerve had a variable origin from the sciatic nerve. In the Kenyan population they found that in 20.1% of cases the bifurcation was pelvic as opposed to 79.9%, which were extrapelvic. In the pelvic division, it was noted that the tibial nerve was always infrapiriformic. As for the CPN, 9.8% of cases passed below the piriformis, 7.9% pierced the piriformis and 2.4% passed above the piriformis. As for the two nerves bifurcating in the pelvic region, in 11.6% of cases the nerves continued separately, 4.9% of cases the nerves reunited and in 3.7% of cases the nerves were connected by a communicating branch. In the extra-pelvic division, 67.1% bifurcated in the popliteal fossa, 10.4% in the middle of the thigh and 2.4% were in the gluteal region.

In the Ugandan population, in a descriptive cross sectional cadaveric study Kukiriza et al., (2010) noted that the sciatic nerve bifurcated into the peroneal and tibial nerves in the pelvis in 22.5% of cases, and in the gluteal and posterior thigh regions in 77.5% of cases.

In a review done by Ibrahim et al., (2013), it was noted that 83.9% of cases on CPN split from the sciatic nerve between the lower border of the piriformis and the knee joint. An early origin proximal to the piriformis was noted in 11.7% of cases and a delayed origin was noted in 4.4% of cases. The CPN arose in the pelvis in 92.8% of the cases, and then passed below the piriformis. In 7.2% of cases, the CPN did not pass below the piriformis: 1.9% pierced the piriformis, 0.6 % passed above the piriformis, while 4.7% passed between a double piriformis. When the CPN is compressed the patient suffers from common peroneal nerve syndrome, which causes the following: superficial (lateral compartment) and deep peroneal syndromes, characterized by wasting of the anterior and lateral compartment muscles of the leg. The patient is unable to achieve dorsiflexion and eversion of the foot, and extension of his toes. Loss of sensation is noted on the anterolateral aspect of the leg, and also the dorsum of the foot.

In a study of the sciatic nerve in the Ethiopian population, Berihu and Debeb, (2015) found some had bifurcations while others had trifurcations. In the ones with bifurcations the sciatic nerve bifurcated into the tibial nerve and the CPN. They found 3 limbs with trifurcations. In 2 out of 3 limbs sciatic nerve divided into the tibial nerve, the CPN and an unusual trunk which divided into the lateral cutaneous nerve of the leg and peroneal communicating branch. In the last limb the sciatic nerve divided into the tibial nerve and also superficial peroneal and deep peroneal nerves. From this study, it is noted that there is a possibility of the main trunk of the common peroneal nerve being absent in part of the population.

Adibatti and Sangeetha, (2014) did a study on the Indian population and found that the sciatic nerve divided into its branches, Tibial and common peroneal nerves at the angle of the popliteal fossa.

Kumar et al., (2011) also studied the Indian population and noted that the peroneal division of the sciatic nerve is at more risk of injury during injections and hip fractures as it is positioned more posteriorly. They also documented that in 32% of the cases, the sciatic nerve divided in the popliteal fossa. On the contrary, Okrazewska et al., (2002), Caucasian population- 62%; Prakash et al., (2010), Indian population- 35%; and Ugrevonić et al., (2005) Caucasian population - 72%; in the majority of the cases, the nerve emerged undivided.

Another review of studies done by Brown et al., (2008) noted that there is a reported incidence of variation in the sciatic nerve of about 15%-30%. The most common variation noted was division of the nerve into tibial and peroneal nerves above the piriformis muscle. In this division, one branch travelled through the muscle and another travelled superior to the muscle. They reported that the CPN is more likely to be injured because of the following two reasons: Terminal branches are tethered distally, also there is a superficial fibular arcade noted at the knee, and the nerve has fewer but larger caliber nerve bundles with less interposed connective tissue hence it is at more risk of compression. The incidence of peroneal nerve injury is noted to be 0.3%-2.1% in cases of total hip replacement arthroplasties.

Brown et al., (2008) further noted that injury to the common peroneal nerve may occur at the level of fibular head due to peri-operative compression. It may also be due to a more proximal injury to the peroneal division of the sciatic nerve.

2.5.1.2 The position of CPN in relation to the fibula bone

Ribak S., Fonseca J. R., et al., (2016) evaluated the anatomical and morphological characteristics of the superficial peroneal nerve. As regards the bifurcation of superficial nerves, 80% of the terminal branches were distal to the point of emergence from the fascia, while in 90% of the limbs, two sensory branches were distal to bifurcation. The fascial emergence point had mean distance of 24.6 cm from the fibular head, and nerve thickness was 0.3 cm. The mean distances were 4.68 cm. and 29.3 cm. between the lateral malleolus and the ankle, and to peroneus brevis for the main nerve trunk and the motor branch respectively. Morphometric analyses revealed an average of five nerve bundles at the broadest nerve diameter (2.6 mm). They concluded that the nerve may be a safe and useful donor for autologous graft treatment of peripheral nerve injuries.

Stitgen et al., (1992) determined in a study (Caucasian population) that “a safe zone is located anterior to the palpable portion of fibular head and up to 2 cm distal to the tip of fibular head”.

Watt et al., (2014) conducted a study on branching patterns and localization of the common fibular nerve to get an anatomical basis to plan safe surgical approaches in the Caucasian population. The team dissected the CPN from its point of emergence from the fibular tunnel to its three main branches namely the anterior tibial recurrent nerve, the superficial fibular nerve and the deep fibular nerve. They found that fibular (bone) length correlated to distance from the tip of the fibula to the deep fibular nerve and anterior tibial recurrent nerve. They also found a correlation between fibular (bone) length and distance from tibial tuberosity to the three major nerves. They established that the thickness of the tendon of the biceps femoris muscle correlated significantly with BMI. This study showed that the anatomy of the CPN can also vary with the characteristics of individual patient.

Dearden et al., (2015) conducted a cadaveric study where their team wanted to relate the trajectory of the CPN to the placement of a lateral insertion fibula head transfixion wire in the Caucasian population. Ilizarov wires (standard 1.8mm) were placed into the head of fibula. They used 10 unembalmed cadaveric knees. This was a percutaneous procedure. Afterwards they dissected the knees to establish the course of the CPN. A mean distance of 24.5 mm (14.2 mm-37mm) was found between the CPN from the anterior aspect of the broadest point of head of fibula. The team established that the nerve crossed the neck of fibula at a distance of 34.8mm from the tip of the fibula. The range of this distance was 21.5-44.3mm. The team concluded that, a safe zone should be observed in the anterior half of the proximal 20mm of the fibula head, to avoid injury to the nerve.

Hildebrand et al., (2015), noted in the Caucasian population that with the knee in 90 degrees of flexion, the CPN center crosses the long head of the Biceps Femoris (LHBF) tendon 45.3 mm from the posterior border of the fibula, where the direct arm of the Biceps Femoris inserts, and the posterior border of the fibula 21.9 mm from the tip of the fibular styloid. These relationships were important in identifying the CPN in procedures involving the posterolateral corner of the knee.

Takeda et al., (2001) did a study on the Japanese population and found that in the case of tumors in the proximal fibula, the peroneal nerve shifts posteriorly and distally in the operative field.

2.5.1.3 The position of CPN in relation to the proximal tibia

Jones et al., (2007) conducted a cadaveric study (Caucasian population) on the placement of proximal oblique locking screws in intramedullary tibial nailing. The team did this on 10 paired cadavers (7 females, 3 males). The tibia had intramedullary nailing done, with placement of the proximal oblique locking screws done in a medial to lateral direction. After which dissection using a lateral approach was done in the specimens to see if the CPN was affected. They demonstrated in their study that the CPN was vulnerable to injury in a commonly performed procedure, which involved drilling a 45 degree oblique locking screw from medial to lateral. They recommended in their study that designs of hardware should take into account the bony anatomy and the anatomy of the surrounding areas to avoid injury of CPN during procedures.

2.5.1.4 The position of CPN in relation to the proximal tibia- Gerdy's tubercle (Gerdy's safe zone)

Gerdy's tubercle is defined as a triangular facet on the anterolateral aspect of the proximal tibia. Kalra et al., (2014) conducted a study on tibias to study this tubercle and found that it had different shapes. This would be of great importance when planning for surgery. People would also know at the back of their mind that certain tubercles are more prone to injury due to their shape.

Rubel et al., (2004) noted that most studies on the CPN had been done in relation to the neck of fibula. They noted that most of these studies were done in a two dimensional manner and as such the spatial relationship between the nerve and bony landmarks were difficult to understand. The team therefore set out to define the anatomic relationship of the CPN and its branches in a three dimensional manner, and to identify an anatomical landmark in the tibial surface that would enable one to study the course of the nerve as it entered the anterior and lateral compartments of the leg.

The 3 distances from Gerdy's tubercle as described by Rubel et al., (2004), as shown in Figure 1, were then measured:

1. Distance d I -distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula
2. Distance d II- distance from the most prominent aspect of Gerdy's tubercle to the starting point of the superior genicular branch of the CPN
3. Distance d III- the distance from the most prominent aspect of Gerdy's tubercle to the anterior recurrent branch of the nerve

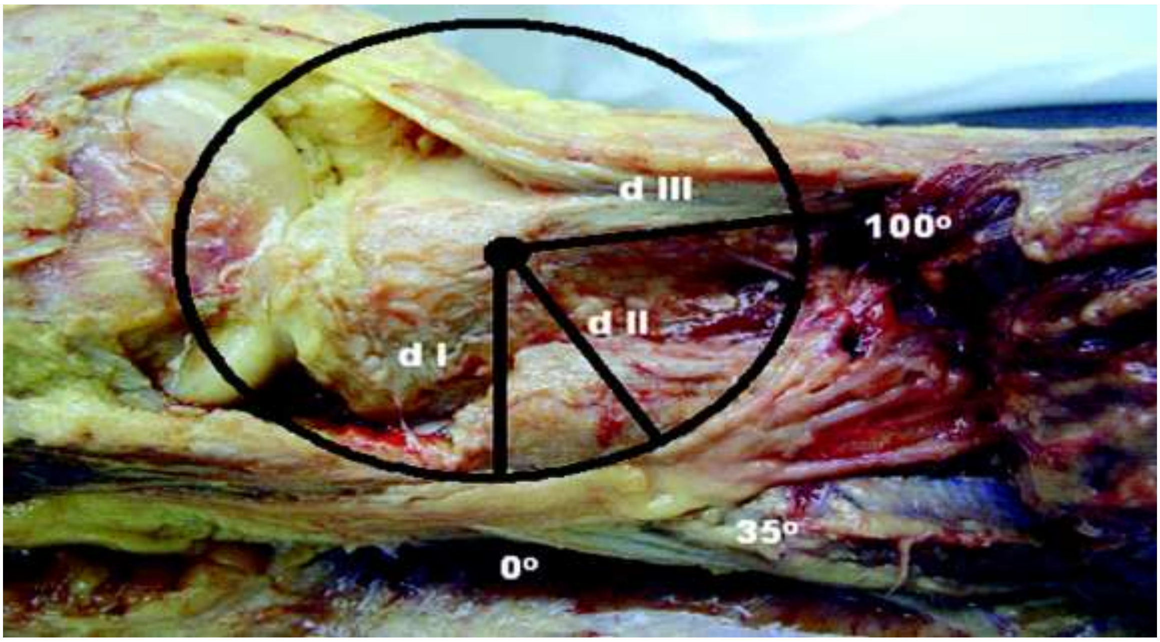


Figure 1: Photograph showing d I, d II and d III as dissected by Rubel et al., 2004

The team conducted a cadaveric study on the CPN in the Caucasian population and noted that the CPN and its anterior recurrent branch had a circular trajectory centered at Gerdy's tubercle with an average radius of 45.32 (SD 2.6) mm (range of 41-49 mm). The team concluded that with this knowledge in the background, one could mark a circular trajectory with Gerdy's tubercle at the centre preoperatively for purposes of placement of instrumentation and thus avoid the CPN and its branches intraoperatively. The nerve is at increased risk as percutaneous procedures at the tibia gain preference.

Labronici et al., (2010) also based their study on study by Rubel et al., (2004); their team went on further to determine if there was a difference in the dimensions prior to dissection in the Brazilian population, so as to help with pre-operative planning. They established that the dimensions increased after dissection.

Figure 2. Gerdy's safe zone marked and measured before dissection by Labronici et al.,

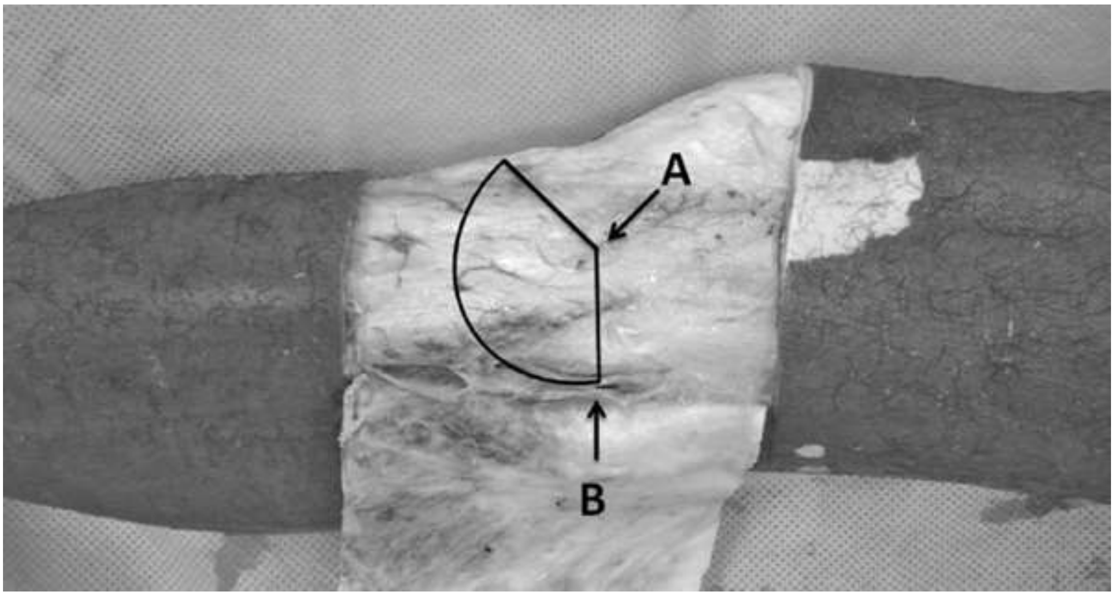


Figure 3. Photograph of the area demonstrating Gerdy's safe zone in a cadaveric specimen. A) Gerdy's tubercle. B) Common peroneal (fibular) nerve as per Labronici et al., (2010)

Labronici et al., (2010) carried out measurements on 50 limbs and got the following values:

1**. d I** before dissection- mean 41.7 (SD 5.8) mm (20-52mm), median of 42mm.

2. d I after dissection- mean 44.3 (SD 4.2)mm (37-55mm), median of 44.5 mm.

3. **d II**- mean 47.1 (SD 5) mm (38-55mm), median of 46 mm.

4. **d III**- mean 44.5 (SD 5.2) mm (35-55mm), median of 44mm.

Cao et al., (2018), studied Vietnamese population and determined that Gerdy's safe zone was defined by a radius of 45 mm.

Labronici et al., (2010) (Brazilian population) and Rubel et al., (2004) (Caucasian population) pointed out that the common peroneal nerve has been studied in a two dimensional way, making it difficult to plan for surgery. Surgeries in the region that might injure the nerve include: proximal tibial osteotomies to correct varus deformities of the tibia, treatment of fractures using external fixators, fasciotomy in cases of compartment syndrome of the leg, osteotomies and biopsies of the proximal portion of the fibula.

Labronici et al., (2010) opined that the Gerdy's safe zone is arrived at by using the distance between Gerdy's tubercle and the head of fibula as a radius of a circle and thus trace a circle which encloses the zone. Gerdy's safe zone is determined by a radius from Gerdy's tubercle, to the head of the fibula (measurement d I). In this zone it is highly unlikely to find branches of the nerve.

The d I is a distance therefore between two bones (Tibia and fibula). As such, it is known that there have been documented differences in dimensions of bone in the different races. Putman et al., (2013) conducted a study in African and Caucasian women where they investigated skeletal microarchitecture and strength in the radii and tibias of the participants. They found that African Americans had denser and larger bones when compared to the Caucasian women.

Mahfouz et al., (2012) found that males had larger dimensions of distal femur and proximal tibia as compared to women. His team found that the medial lateral length measurements of proximal tibia were larger in African American males when compared to Asian males. However they found that their measurements were larger in Caucasian males as compared to African American males. This finding in their study differed with earlier studies that they quoted in which African males had larger dimensions when compared to Caucasians.

Rubel et al., (2004) conducted their study on the Caucasian population. Labronici et al., (2010) conducted their study on a Brazilian population. The Brazilian population is known to be genetically diverse as the people have a mix of Caucasian and African ancestry in their genetic makeup. Further studies reviewed by Vanderlei and Santos,

(2014) pointed out that their population had three formative stocks namely, Portuguese, African and Amerindians. In the 19^{th} and 20^{th} century, other races migrated to the region- Caucasians from other countries, Arabs and Asians leading to racial mixing through intermarriages. Kent and Wade, (2015) also point out that the Brazilian population is genetically diverse.

With the studies on the genetic make-up of the Brazilian population, then the studies on bony architecture done by Putman et al., (2013), and Mahfouz et al., (2012), one comes to the conclusion that slightly different results would be expected in study by Labronici et al., (2010) on Brazilian population compared to those by Rubel et al., (2004) on Caucasian population since the Brazilian population is documented to have African ancestry. This might explain why the dimensions in study by Labronici et al., (2010) are slightly larger as compared to the measurements that Rubel et al., (2004) took. With that information at the back of one's mind, what do researchers expect to find in the Kenyan population? This study gives the required information.

2.5.2 Studies on the length of the CPN

Ankolekar et al., (2015) studied the common peroneal nerve in the Indian population. They set out to determine the mean length of the main trunk of the common peroneal nerve in the Indian population, in both right and left lower limbs. They found a shorter mean length in the right lower limb as compared to the left lower limb; length of CPN in the right lower limbs had a mean of 17.7(SD 7) cm (or 177 (SD 70) mm) while in the left lower limbs, they found the CPN had a mean of 19.1(SD 7.1) cm (or 191 (SD 71) mm).

Cao et al., (2018) studied the CPN and found that the main trunk measured 120.6mm in length. The team also found that the CPN had a diameter of 3.7mm.

2.5.3. Studies on the different branches arising in the course of CPN

Takeda et al., (2001) established `that in the Japanese population the CPN runs in a posterolateral to anteromedial direction and then divides into 3 major branches, namely the recurrent anterior genicular branch(branch to the tibialis anterior muscle), the deep and superficial peroneal branches.

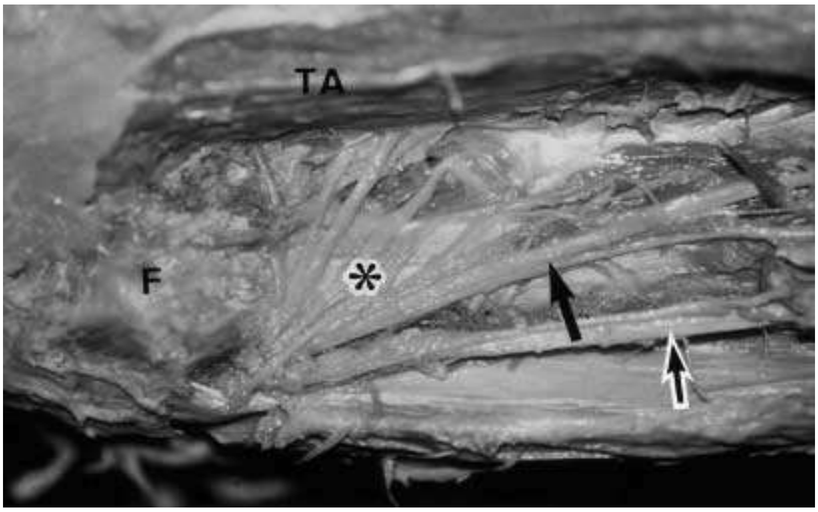


Figure 4. Photograph of peroneal nerves (*F* head of fibula, * proximal muscular branches to the tibialis anterior muscle, *black arrow* deep peroneal nerve, *white arrow* superficial peroneal nerve, *TA* tibialis anterior muscle) as per Takeda et al., (2001)

Labronici et al., (2010) found a mean of 3.14 (SD 0.7) number of branches, with a minimum of 2 and a maximum of 5 branches.

2.5.4 Studies on the variations in the course of the CPN and branches

Asp et al., (2014) carried out a review on studies and noted that in a study carried out by Deutsch et al., (1999) in10% of legs the CPN divides into deep and superficial branches proximal to the knee joint. In 30% of specimens, a separate cutaneous branch emanated from the CPN trunk, a branch that had not previously been described in the literature.

CHAPTER THREE: METHODOLOGY

3.1 Study Site

The study was conducted in the Human Anatomy laboratory at the Moi University, School of Medicine, situated in Eldoret which is about 320 kilometers northwest of Nairobi.

3.2 Study Design

The anatomical descriptive cross sectional study design was used. Lower limbs (43 right sided) which met the inclusion criteria were dissected. The surgical anatomy of the common peroneal nerve was recorded.

3.3 Study Population

Forty three Formalin fixed limbs (43 right sided) at the Moi University Human Anatomy Laboratory (MUHAL) that satisfied inclusion criteria were sampled and used.

3.4 Eligibility criteria

3.4.1 Inclusion criteria

Lower limbs without any signs of gross pathologies and any signs of previous surgical procedures were used.

3.4.2 Exclusion criteria

Lower limbs which were grossly deformed.

3.5 Sample size determination and sampling

A sample size needed was calculated so that the researcher could be able to know an appropriate number of limbs to carry out dissection on. In order to be 95% sure that the anatomical position of the CPN in relation to bony landmarks as well as its variations was well defined among the Western Kenyan population studied within Moi University Human Anatomy Laboratory in Kenya a sample was determined. The sample size sufficient to help the Researcher describe the distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula within plus or minus 0.5 mm of the population value of 45.32 mm (Rubel et al., 2004) was calculated using the Cochran, (1963) formula.

$$n = \left(\frac{Z_{1-\alpha/2}\sigma}{\delta} \right)^2$$
$$= \left(\frac{1.96 \times 2.6}{0.5} \right)^2$$
$$= 104$$

Where Z is found in a Z table (in statistics it is taken as 1.96 for 95% level of confidence), while σ is the standard deviation of the distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula. The δ is the postulated margin of error assumed to be 0.5 mm in this case. This means that a variation of no less than 1 mm can be tolerated. That is, this study is sensitive (able to detect) a variation more than 0.5 mm in the distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula. To be able to detect anything less than 1 mm requires a bigger sample size.

At MUHAL the maximum number of cadavers that could be attained was approximately 60. Therefore adjusting the sample size for the finite population gave the sample size of $104 / (1 + 104/60) = 39$. Thus the study sample size was determined to be 39 cadavers. It was deemed that this size would be sufficient to answer the question about the distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula, distance from the most prominent aspect of Gerdy's tubercle to the starting point of the superficial branch of the common peroneal nerve, and distance from the most prominent aspect of Gerdy's tubercle to the anterior recurrent branch of the nerve (Cochran, 1963).

Taking into consideration the inclusion criteria, and having established the sample size, purposive sampling was carried out, and both genders were included since previous studies have shown that there is no significant difference in the course of the nerve, and its branching pattern.

3.6 Methods

The limbs used were fixed with 10% formalin and obtained as per **The Anatomy Act Chapter 249 Revised Edition 2012 (1968) of the Republic of Kenya.**

The approach used in dissection was lateral approach as an incision, as described by Stanton et al., 2010. Further dissection was carried out as per description outlined below by Rubel et al., 2004:

The dissection was directed lateral to the proximal aspect of the tibia, around the fibula. Photographs of the dissections were taken using a digital camera.

At the posterior aspect of the lateral femoral condyle, the common peroneal nerve was identified and dissected distally as it wound around the neck of fibula. This was done carefully to avoid messing with biceps femoris fibers and peroneus longus muscles which ensured accurate measurements were taken afterwards. To preserve the location of the nerves, hypodermic needles were used as external landmarks to outline the courses of the nerves before measurements were taken. The terminal branches of the nerve were identified as they entered anterior and lateral compartments of the leg to supply them. The anterior recurrent branch was dissected and followed as it crossed the anterior compartment, perpendicular to tibial shaft. The nerve and its branches were analyzed as per the methods by Rubel et al., (2004), where they noted the Gerdy's tubercle to be the center of the nerve's circular trajectory. Distances were measured as per Rubel et al:

1. Distance d I -distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula (Figure 5).

2. Distance d II- distance from the most prominent aspect of Gerdy's tubercle to the starting point of the superior genicular branch of the CPN (Figure 6).

3. Distance d III- the distance from the most prominent aspect of Gerdy's tubercle to the anterior recurrent branch of the nerve (Figure 7).

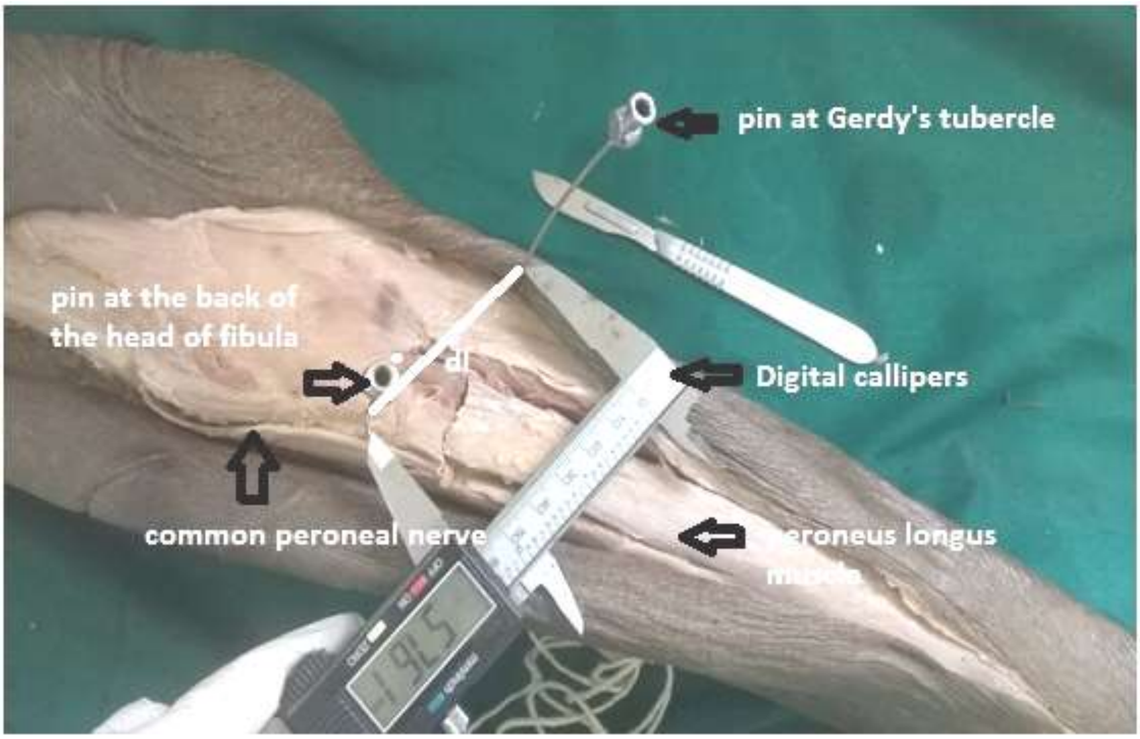


Figure 5: Measuring d1- distance from Gerdy's tubercle to the common peroneal nerve at the head of the fibula

In d I, the distance is measured from the most prominent part of Gerdy's tubercle to the CPN at the back of the head of the fibula.

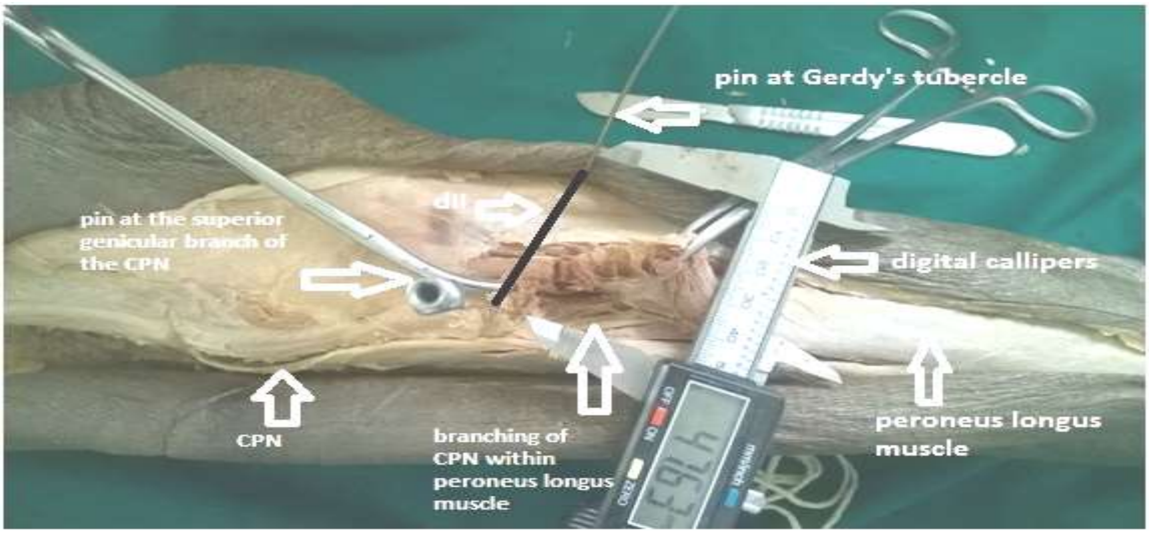


Figure 6: Measuring d II- from Gerdy's tubercle to the superior genicular branch of the common peroneal nerve

The Peroneus longus muscle is partially reflected at its origin to expose the CPN. The branches are seen here, with the most superior being the superior genicular nerve. The distance d II here is measured from Gerdy's tubercle to the superior genicular branch of the common peroneal nerve (Figure 6).

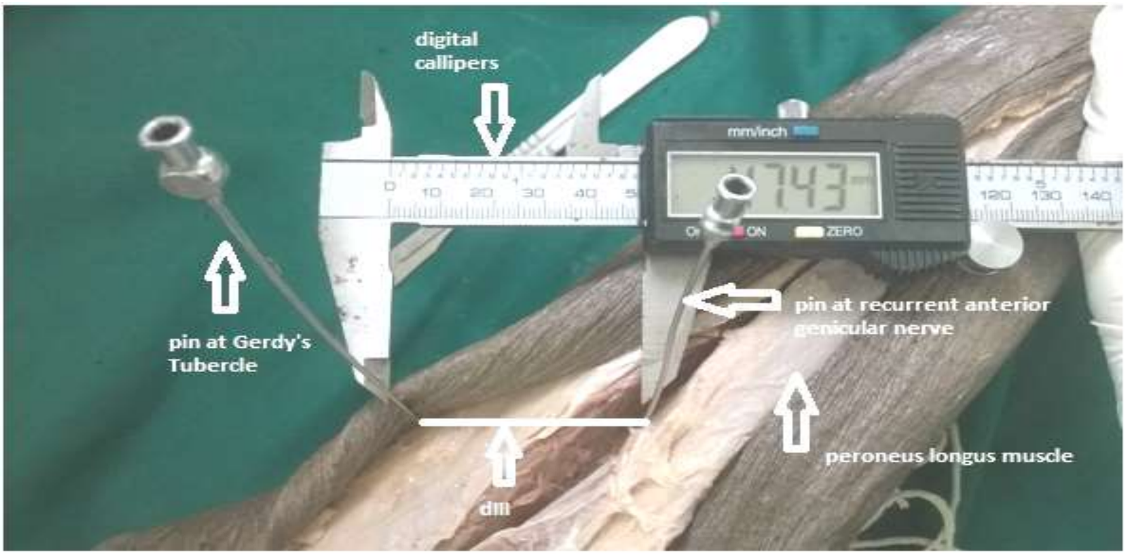


Figure 7: Measuring d III- from Gerdy's tubercle to anterior recurrent genicular nerve

In figure 7, the distance d III is shown here. The distance between Gerdy's tubercle and the anterior recurrent genicular nerve, is measured. The Peroneus longus muscle is reflected laterally so that the anterior recurrent genicular nerve can be seen piercing the Tibialis anterior muscle (Figure 8).

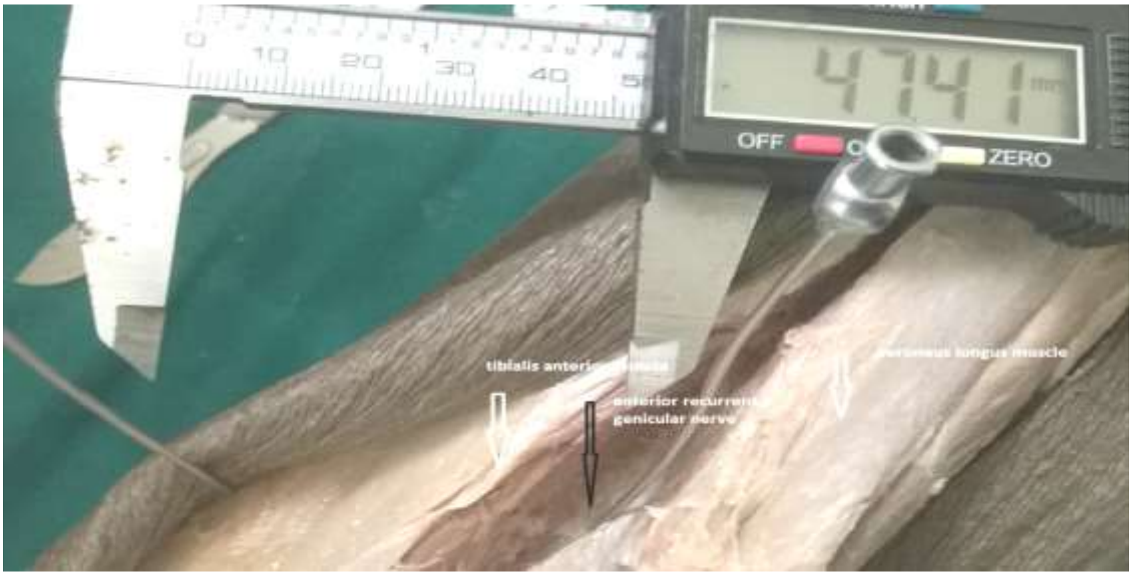


Figure 8: A closer view of the anterior recurrent genicular nerve while taking d III measurement

The distances were measured using Vernier calipers in mm. The average distances of the nerves from Gerdy's tubercle and standard deviations were then calculated. Photographs of the dissections were also taken.

3.7 Data management

Data captured using designed forms was entered into an electronic database. The database was encrypted with password to ensure confidentiality. The password was only accessible to the Principal Researcher. The forms were destroyed once conversion to electronic database was complete. Compact discs were used to store backups of data collected.

3.8 Data analysis and presentation

Data was imported into **STATA 13 SE** where data cleaning, coding and analysis was done. Gaussian distribution assumption of the data was assessed using Shapiro Wilk test. Therefore continuous variables were summarized through means and corresponding standard deviations then presented in tables and histograms when normally distributed. Where Gaussian assumptions were violated, median and the corresponding interquartile range was used to summarize the data which was then presented in tables and box plots. Continuous variables whose distribution assumed Gaussian distribution were compared using two independent sample **t-** test.

3.9 Ethical Considerations

Approval was obtained from the Institution Research and Ethics committee (IREC), Moi University school of Medicine, approval number **0001477**, and the Department of Human Anatomy at Moi University before the commencement of the study (Appendices 8 and 9).

The study was conducted in accordance with **The Anatomy Act Chapter 249, Revised Edition 2012 (1968) of the Republic of Kenya** which entitles the person registered as a Medical student of any approved School of Anatomy to examine cadavers anatomically.

Results obtained were disseminated through oral defense of the thesis and thereafter presentations at conferences, seminars and publications both locally and internationally.

3.10 Scope and Limitations

Specimen used in this study included formalin- fixed right sided lower limbs and both genders were included. Specimen handling during the dissection could alter the exact location of CPN and the related branches. This was minimized by preserving the location of the nerves with the use of hypodermic needles as external landmarks to outline the courses of the nerves before measurements were taken.

CHAPTER FOUR: RESULTS

4.1 Introduction

The findings are based on 43 cadaveric lower limbs; all were right sided (100%). Thirty two (74.4%) of limbs were from male cadavers, while 11 were from female cadavers. The position of the CPN in relation to Gerdy's tubercle on the tibia as well as the distances between the nerve and Gerdy's tubercle at 3 points along the course of the nerve in each limb, and the length of main trunk of CPN were measured and documented. The different branches of CPN as well as the variations in the course of CPN were documented.

4.2 The position of the CPN in relation to Gerdy's tubercle on the tibia and distances dI, dII, and dIII

Table 3: Summary of statistics for d I, d II, d III and MT

Variable	N	Mean(SD) [mm]	Median(IQR) [mm]	Min [mm]	Max[m]
d I	43	57.5(5.1)	58(54,62)	48	68
d II	43	53.1(6.3)	54(47,58)	39	63
d III	43	49(8.5)	49(44,53)	30	65
Total mean of d I, d II, d III=57.6 (SD 5) mm					
MT	43	212.6(124.9)	153(138,230)	105	523

n-Number of limbs
Min- Minimum.
Max-Maximum
SD- Standard deviation
IQR- Interquartile range
d I-distance from Gerdy's tubercle to the common peroneal nerve behind head of fibula
d II-distance from Gerdy's tubercle to the starting point of the superficial genicular (lateral) branch of common peroneal nerve
d III-distance from Gerdy's tubercle to anterior recurrent genicular branch of the common peroneal nerve
MT-length of the main trunk
**All distances measured in mm*

Three distances d I, d II and d III described in the methodology section were measured and tabulated (Table 3) to enable plotting of Gerdy's safe zone in the Western Kenyan population. The measurements in millimeters are shown as mean

(SD), median (IQR) and the range (Minimum and maximum), with their corresponding Shapiro- Wilk test. Thus the radius defining Gerdy's safe zone in this population ranged from 52.6 mm to 62.6mm as demonstrated in table 3. The d I- d III had p>0.05.

Table 4: Comparing the distances dI, dII, dIII and MT between the genders

Variable	**Female (n=11)**	**Male (n=32)**	**p- Value**
d I (mean)	56.82(5.07) mm	58.03(5.15) mm	0.504*
d II (mean)	51.55(6.34) mm	53.64(6.38) mm	0.352*
d III (mean)	50.60(5.81) mm	48.50(9.28) mm	0.505*
MT (median)	175(140,330) mm	152.5(134.5, 212.5) mm	0.220†
*Comparison of means using **t**-test			
†Comparison of Medians using Mann Whitney test			
mm- millimeters n-number of limbs d I-distance from Gerdy's tubercle to the common peroneal nerve behind head of fibula d II-distance from Gerdy's tubercle to the starting point of the superficial genicular (lateral) branch of common peroneal nerve d III-distance from Gerdy's tubercle to anterior recurrent genicular branch of the common peroneal nerve MT-length of the main trunk			

Table 4 shows a comparison of the statistics between the genders. The male limbs had slightly higher mean measurements for d I and d II compared to the females. However the difference was not statistically significant. On average, females had higher mean values for d III and higher median values for MT although the difference was not statistically significant either (p>0.05).

The three distances (d I, d II and d III) were further presented in charts (Figures 6-8).

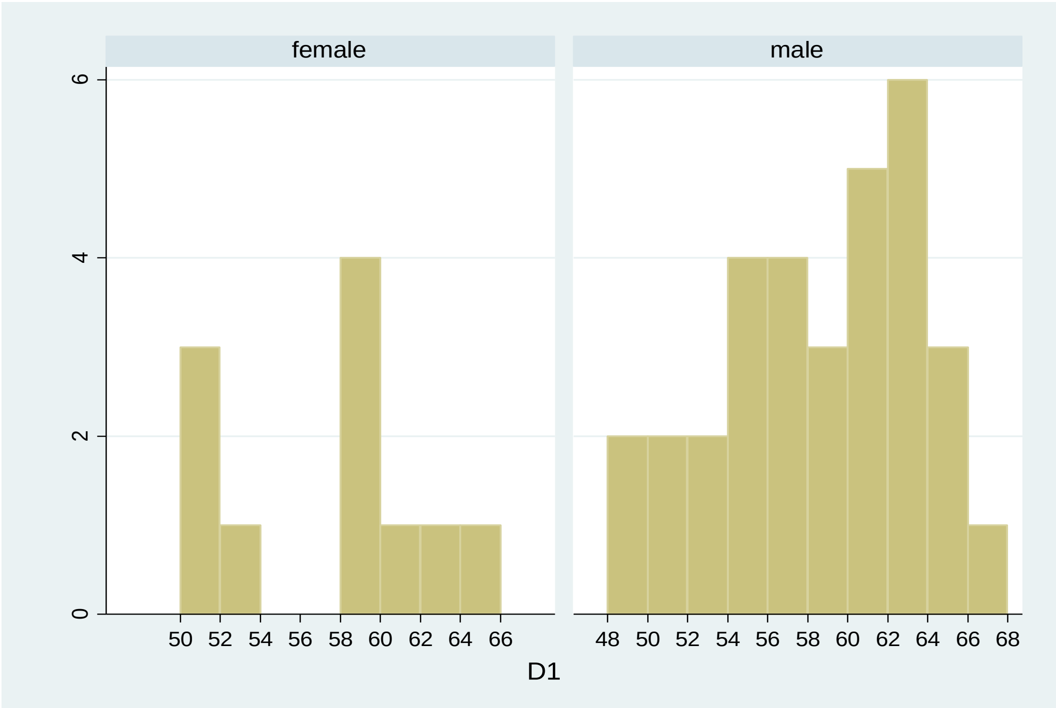


Figure 9: d I= Distance 1 (D1) measurements from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula

The distance d I was measured and the values found presented in charts (Figure 9). In females, the measured values ranged from 50mm to 65mm; mean of 56.8(SD 5.0) mm with W=0.914 and p=0.273. Fifty percent (50%) of values ranged from 50mm to 58mm while 75% of the values ranged from 50mm to 60mm.

Comparatively the measured values in males ranged from 48mm to 68mm; mean of 58.0 (SD 5.1) mm with W=0.971 and p=0.529. Fifty percent (50%) of values ranged from 48mm to 58.5mm while 75% of the values ranged from 48mm to 62mm.

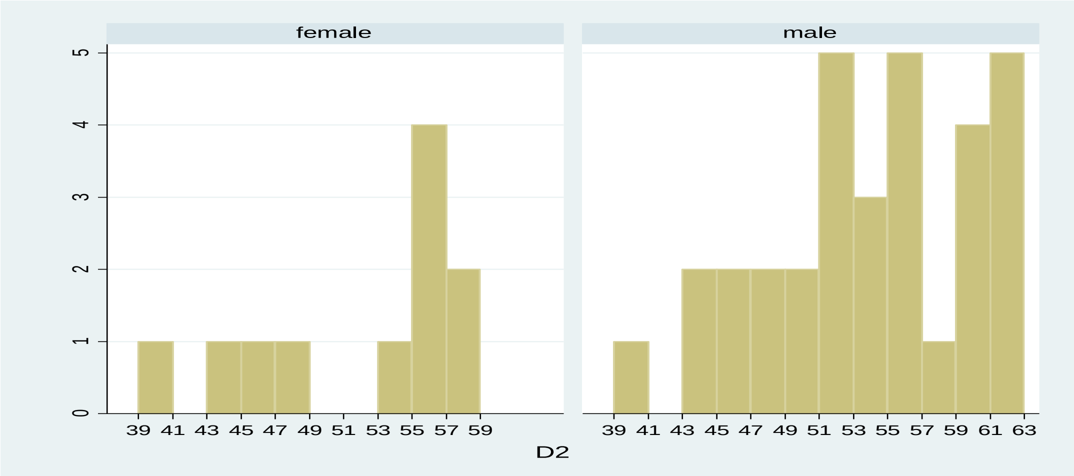


Figure 10: d II= Distance 2 (D2) measurements from the most prominent aspect of Gerdy's tubercle to the starting point of the superior genicular branch of the CPN

With regards to d II measurement (Figure 10), in females, the measured values ranged from 40mm to 58mm; mean of 51.5 (SD 6.3) mm, with W= 0.884 and p= 0.116. Comparatively in males, measurements ranged from 39mm to 63mm; mean of 53.6 (SD 6.4) mm with W= 0.971 and p= 0.530.

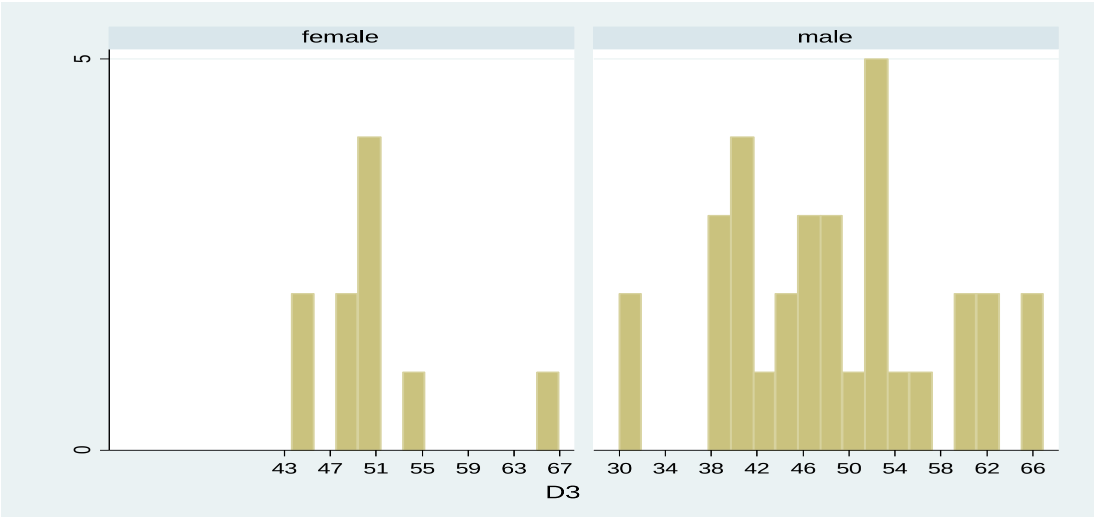


Figure 11: d III= Distance 3 (D3) measurements from the most prominent aspect of Gerdy's tubercle to the anterior recurrent branch of the nerve

With regards to d III measurement (Figure 11), in females, the measured values ranged from 45mm to 65mm; mean of 50.6 (SD 5.8) mm, with W= 0.829 and p=

0.032. Comparatively in males the measured values ranged from 30mm to 65mm; mean of 48.5(SD 9.3)mm with W= 0.987and p= 0.965.

4.3 The length of the CPN (MT) in the Kenyan population

The length of the main trunk (MT) in millimeters can be seen in Tables 3 and 4. In Table 3, the MT had mean of 212.6 (SD 124.9), median of 153 (138, 230), range 105-523, and Shapiro- Wilk test of W= 0.717, p<0.001. As for gender (Table 4), the females and males had median of 175 (140, 330), and 152.5 (134.5, 212.50 respectively with Mann Whitney test of p= 0.220.

The median measurements of the main trunk were represented in a box plot (Figure 9).

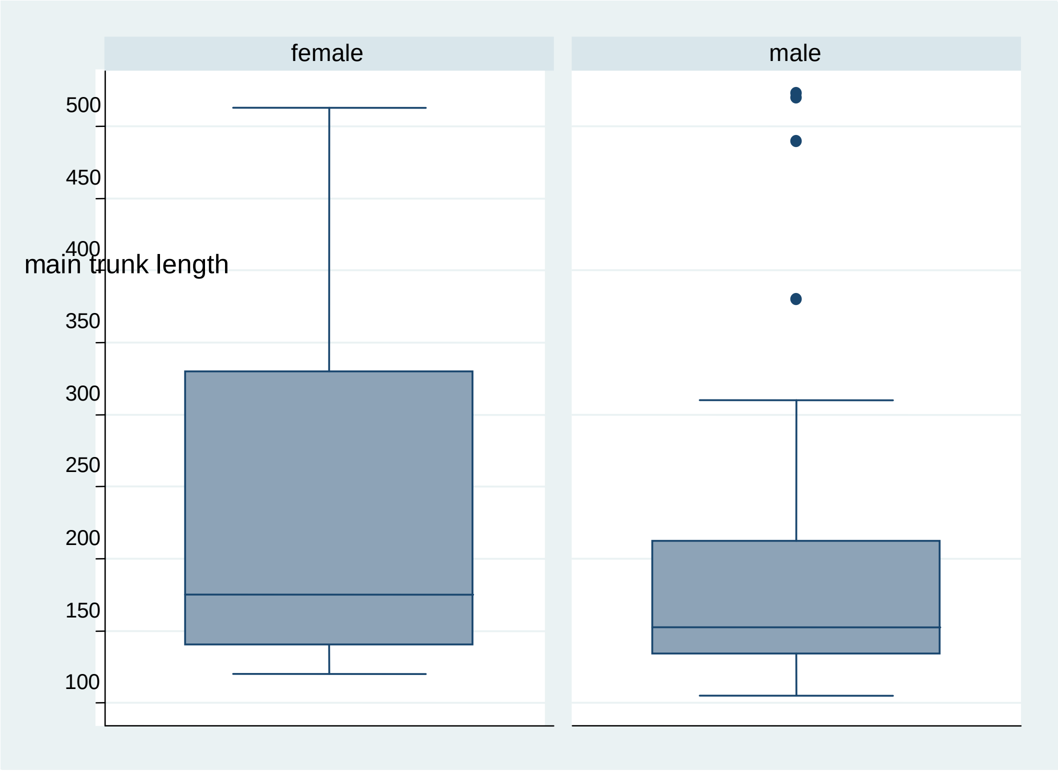


Figure 12: Main trunk (MT) measurements

In females as represented in Figure 12, the MT measurements ranged from 120-513mm; median of 175 (IQR 140- 330); W= 0.773 and p= 0.004 while in males measurements ranged from 105- 523mm; median of 152.5 (IQR 134.5, 212.5); W= 0.696 and p= 0.000. This was statistically significant.

4.4 The different branches arising in the course of the nerve

In 39 limbs (91%) the CPN pierced the peroneus longus muscle and then divided into its branches (Figure 13a). The CPN divided into 5 major branches just before curving around the neck of the fibula in 9% of specimens (Figure 13b).

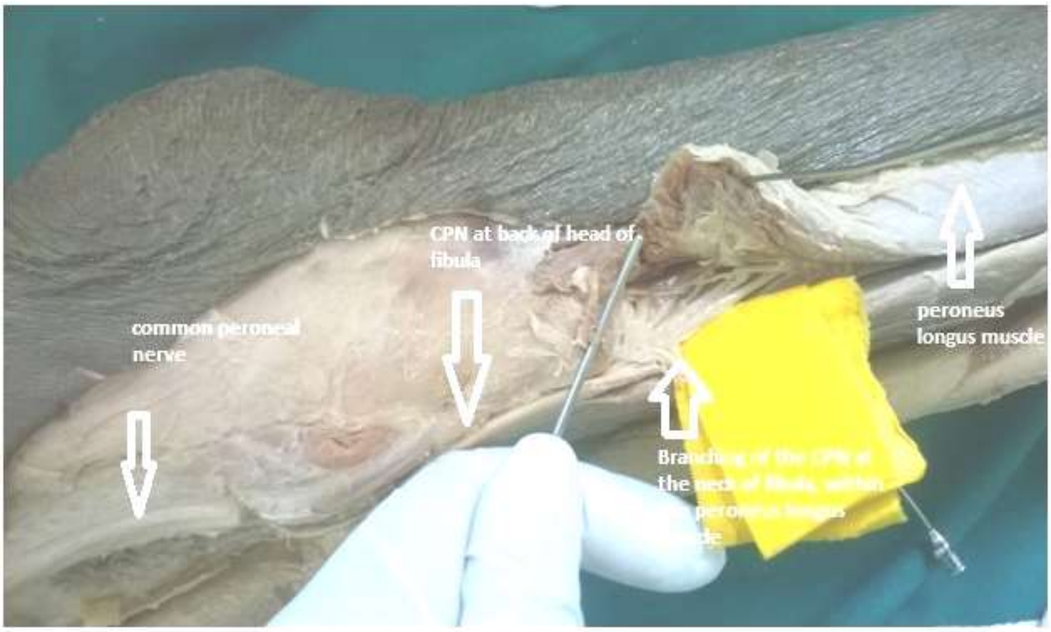


Figure 13a: Branching of the nerve inside the peroneus longus muscle at the neck of the fibula

The CPN branches within the peroneus longus (Figure 13a). This was seen in 39 limbs (91%).

In 4 limbs (9%), there were variations noted. In 2 out of 4 limbs it divided into its 5 branches before it pierced the peroneus longus (Figure 13b). In 1 out of 4 limbs, the superficial and deep peroneal branches divided outside the peroneus longus, while the main trunk pierced the peroneus longus muscle and the rest of the branches bifurcated within its fibres. In the last limb, only the superficial peroneal nerve exited the main trunk of the CPN before piercing the peroneus longus muscle. The rest of the branches, divided within the peroneus longus muscle.

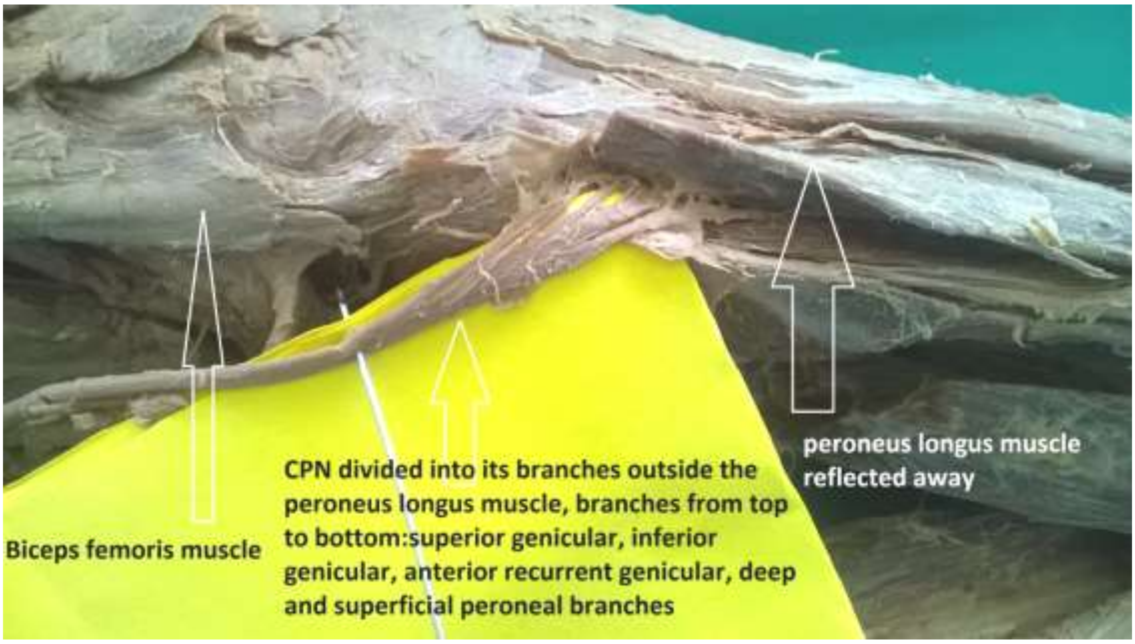
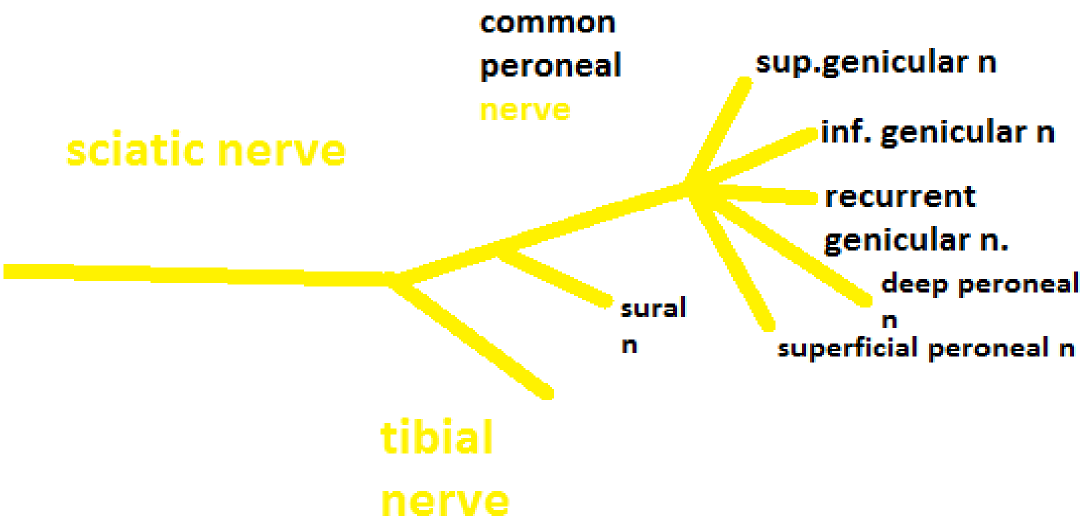


Figure 13b: Image of branching of the Common Peroneal Nerve outside the peroneus longus muscle seen in 4 limbs((9%)

The CPN divided into its branches outside the peroneus longus muscle in 4 limbs (9%). The peroneus longus muscle is reflected away (Figure 13b) to show the branches clearly. The branches demonstrated from superior to inferior are as follows: superior genicular (lateral) nerve, inferior genicular (lateral) nerve, recurrent genicular nerve, deep peroneal nerve and superficial peroneal nerve.

The branching pattern that was seen in most specimens has been illustrated in the schematic in Figure 14. The branches from superior to inferior were: Superior genicular (lateral) branch of the CPN, Inferior genicular (lateral) branch, Anterior recurrent genicular branch (Figure 15 where it pierces the Tibialis anterior muscle), and Deep peroneal and Superficial peroneal branches.

These 5 main branches were seen in all 43 limbs.



schematic of the branching pattern of the common peroneal nerve observed during dissection

Figure 14: Schematic showing branching of the CPN at the neck of the fibula

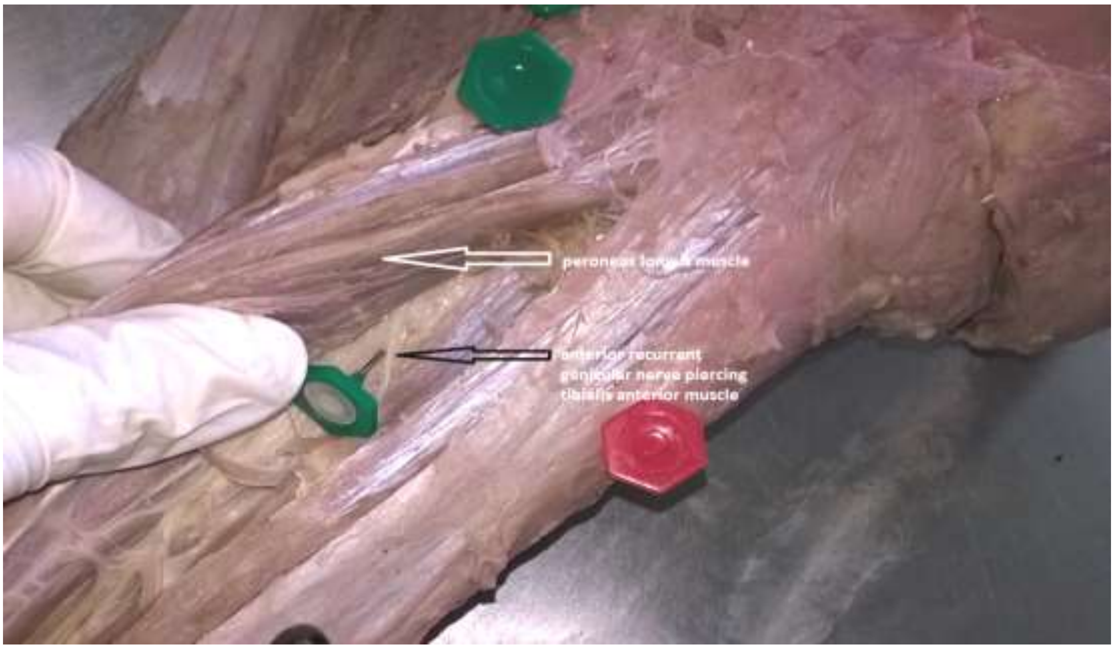


Figure 15: A closer look at the anterior recurrent genicular branch as it pierces the Tibialis anterior muscle

The branches are from the main trunk of the CPN at different distances (Tables 5a and 5b).

Table 5a: Summary of statistics for branches of the CPN

Variable	**n**	**Mean (SD)**	**Median (IQR)**	**Min**	**Max**
Sural communicating	28	90(117)	55(40, 79)	5	420
Superior genicular	43	212(125.1)	155(138,231)	90	524
Inferior genicular	43	212.4(125)	155(139,230)	90	524
Recurrent anterior genicular	43	214.6(124.1)	165(140,233)	100	524
Deep peroneal	43	220.6(127.2)	168(145,230)	102	565
Superficial peroneal	43	220.6(126.6)	168(144,234)	94	565

Table 5b: Summary of statistics for branches of the CPN compared between the genders

Variable	Gender	N	Mean (SD) [mm]	Min [mm]	Max [mm]	Median (IQR)[mm]	p-value
Sural Communicating	Female	5	139.4 (148.9)	12	395	82 (78, 130)	0.111
	Male	23	79 (110.1)	5	420	55 (40, 63)	
Superior genicular	Female	11	245.3 (141.5)	123	511	176 (143, 332)	0.186
	Male	32	200.6 (119.3)	90	524	153 (132, 213.5)	
Inferior genicular	Female	11	245.7 (141.4)	124	511	177 (144, 333)	0.190
	Male	32	200 (119.1)	90	524	154 (132.5, 214)	
Recurrent genicular	Female	11	247.6(140.6)	126	512	186 (146, 330)	0.210
	Male	32	203.3 (118.3)	100	524	158 (134, 215.5)	
Deep peroneal	Female	11	252.6 (140.7)	126	517	207 (158, 331)	0.236
	Male	32	209.7 (122.8)	102	565	162 (142, 213)	
Superficial peroneal	Female	11	251.4 (138.1)	124	510	207 (158, 331)	0.259
	Male	32	210.1(126)	94	565	160 (142, 215)	

Mann Whitney Test, n=number of limbs, min=minimum, max=maximum, SD= standard deviation, IQR= Interquartile range,

The different branches arose from the main trunk of the CPN at different distances from the beginning of the CPN as it bifurcated from the sciatic nerve (Table 5a and 5b). The difference in medians for males and females was not statistically significant ($p>0.05$) for sural communicating nerve, superior genicular, inferior genicular, recurrent genicular, deep peroneal and superficial peroneal.

4.5 Variations in the course of CPN and branches in the Kenyan population

Table 6 shows a summary in the variations of the site in which the common peroneal nerve branched from the sciatic nerve.

Table 6: Variations in the levels at which the common peroneal nerve bifurcated from the sciatic nerve

Site of origin of CPN	Number of limbs where this was seen	Percentage of limbs where this was seen (%)
Pelvis	1	2.3
Proximal third of the thigh	4	9.3
Middle third of the thigh	8	18.6
Distal third of the thigh	30	69.8
Total	**43**	**100**

The common peroneal nerve was found to branch from the sciatic nerve in the following pattern: in 1 limb (2.3%), the nerve emerged below the piriformis muscle after dividing in the pelvis (Figures 16a-16c).

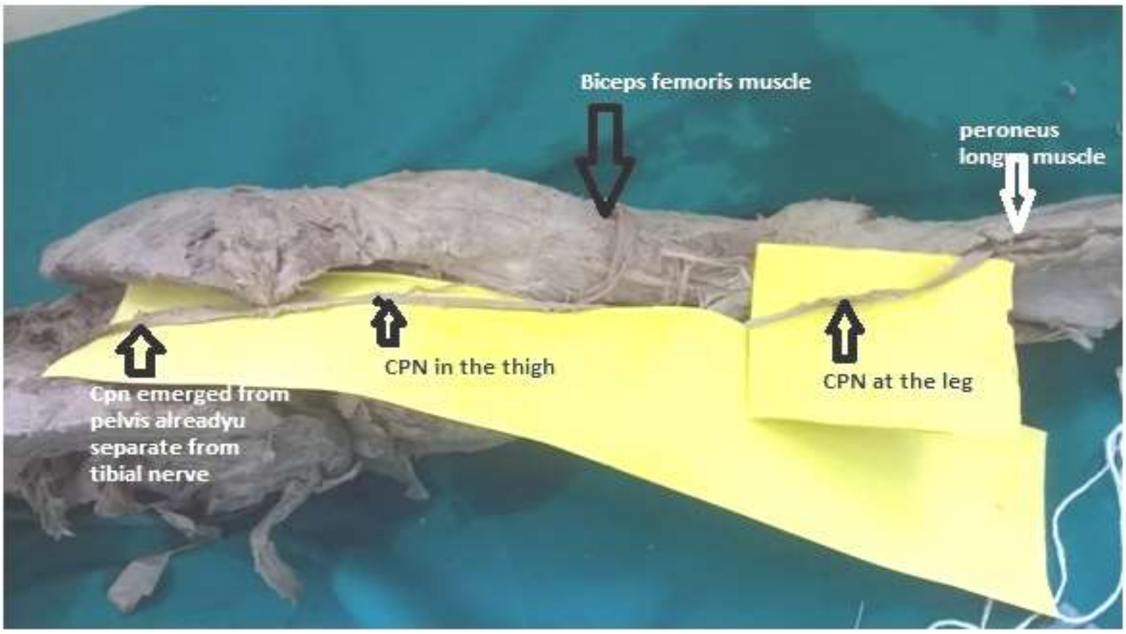


Figure 16a: Common Peroneal Nerve (sciatic nerve bifurcated at a more proximal site, in the pelvis)

The CPN emerged having bifurcated in the pelvis, this was seen in one limb (2.3% of limbs) (Figures 16a-16c).

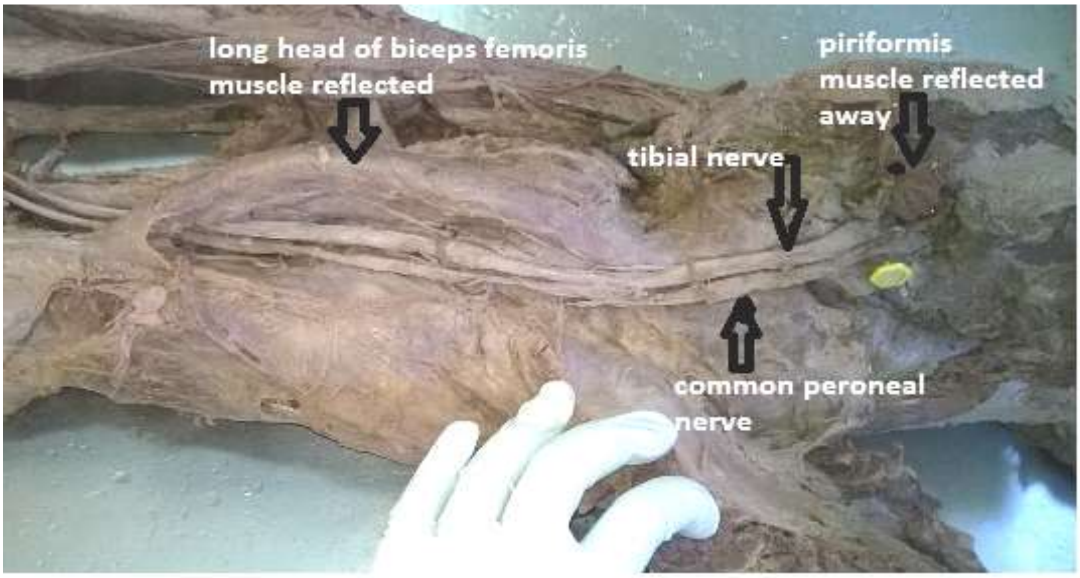


Figure 16b: Common peroneal nerve pictured here emerging from the pelvis separate from the tibial nerve. They emerged below the piriformis muscle which has been reflected away. This was seen in 1 limb(2.3%)

Seen in one limb (2.3% of limbs)

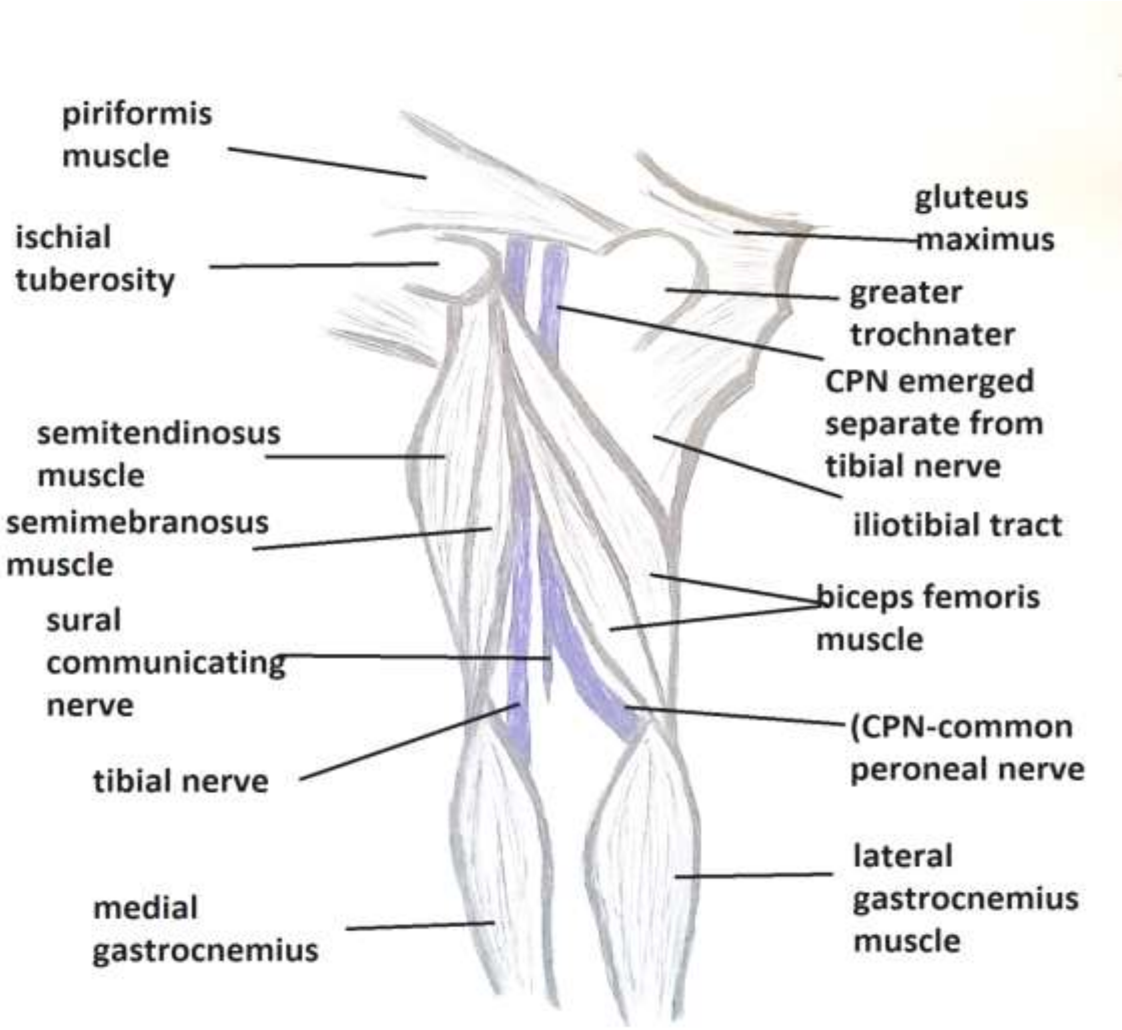


Figure 16c: Sketch of the common peroneal nerve emerging from pelvis while already bifurcated

As summarized in table 6, the CPN branched from the sciatic nerve in the proximal third of the thigh in 4 (9.3%) limbs, in the middle third of the thigh in 8 limbs (18.6%) and the distal third of the thigh in 30 limbs (69.8%) (Figures 16a-16c). This varied origin means that the nerves which branched more proximally would be longer than those that branched more distally. Six limbs were found to have extreme values with regard to lengths of the main trunk of the CPN (380, 490, 510, 513, 520, 523mm).

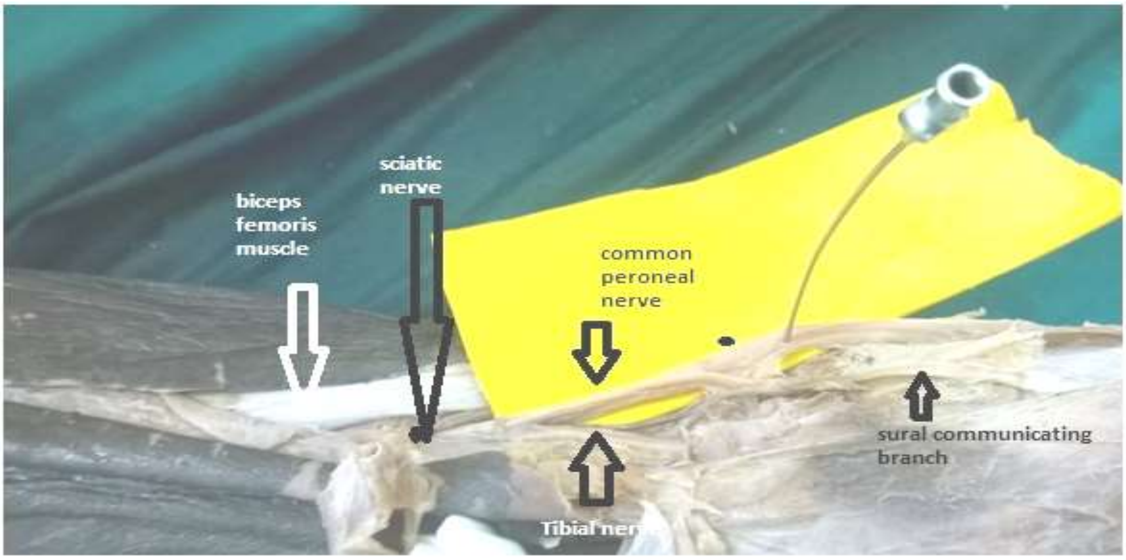


Figure 17a: Bifurcation of Sciatic Nerve into Common Peroneal Nerve, in the distal third of the thigh

This was seen in 30 limbs (69.8%).

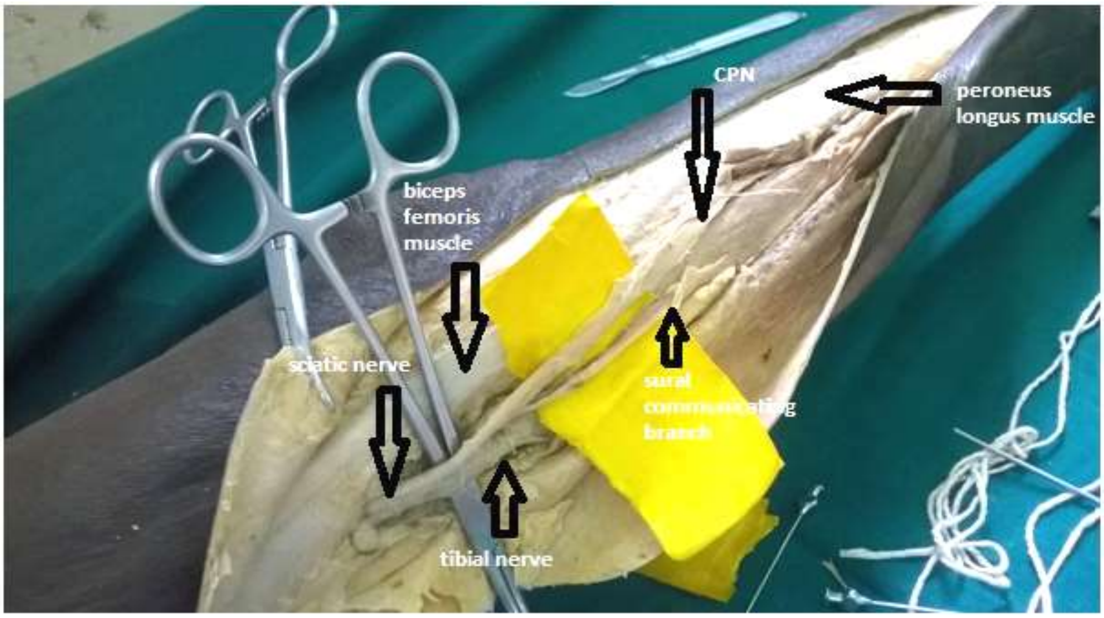


Figure 17b: Sciatic Nerve bifurcated in distal third of thigh. Note Sural Communicating Nerve arising from CPN shortly after it bifurcates

The CPN was found to run beneath the biceps femoris muscle. It emerged from beneath it to run downwards and medially to the biceps femoris tendon in the distal third of the thigh. It was then noted to run behind the head of the fibula (Figures 17a-17c) and twisted round the neck of the fibula.

In the Kenyan population, in most of the specimens, the common peroneal nerve gave off the sural communicating nerve branch (Figures 17a-17c) before winding around the neck of the fibula. In this population (most specimens) the CPN bifurcated from the sciatic nerve in the distal third of the thigh, (Figures 17a and 17b). The sciatic nerve is visible here as it divides into the CPN and tibial nerve. The sural communicating branch is seen arising from the CPN. The CPN then proceeded to pierce the peroneus longus muscle and branch within it. The same features are depicted in the sketch (Figure 17c).

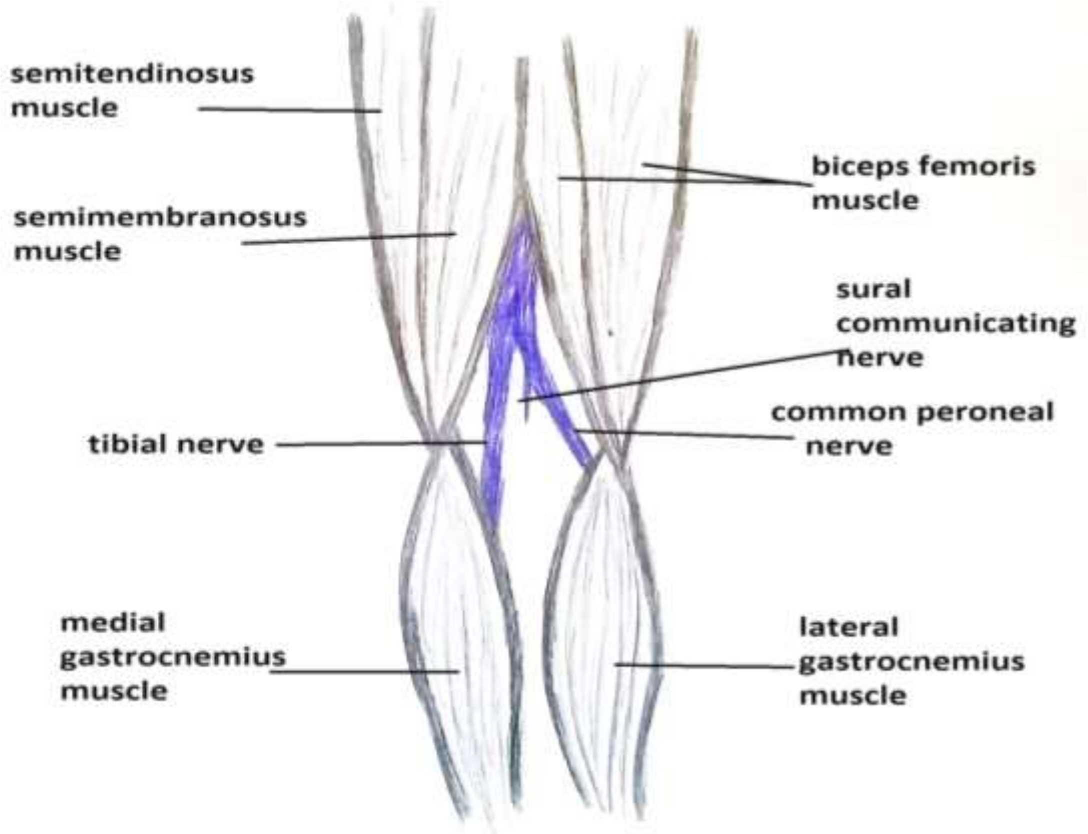


Figure 17c: Sketch of the common peroneal nerve branching in the distal third of the thigh within the popliteal fossa

CHAPTER FIVE: DISCUSSION

5.1 The position of the Common Peroneal Nerve in relation to Gerdy's tubercle on the tibia

Most studies that have been done on the Common Peroneal Nerve (CPN) have been in relation to the fibula. This Moi University Human Anatomy Laboratory (MUHAL) study set out to study the common peroneal nerve in relation to Gerdy's tubercle. Rubel et al., (2004) conducted a study on the course of the CPN in relation to the Gerdy's tubercle on the tibia to determine a safe zone where there is no risk to the common peroneal nerve as one does procedures on the proximal tibia.

The main aim of this MUHAL study was to define Gerdy's safe zone. The nerve was noted to take an almost arc like trajectory in relation to this tubercle. The safe zone is enclosed in this circular area. Previous studies demonstrated no nerves in this region, hence why it is a safe zone. In previous studies it was noted that this zone was considered safe for orthopedic procedures that would be carried out in the proximal region of the tibia as documented by Cao et al., 2018, Labronici et al., 2010; and Rubel et al., 2004.

In this MUHAL study, distance I- (Gerdy's tubercle to the CPN at the back of the head of the fibula) had a mean measurement of 57.5 (SD 5.1) mm and a median measurement of 58mm (IQR 54, 62). This measurement was larger and thus not in agreement with what was found out by Cao et al., 2018, Labronici et al., 2010; and Rubel et al., 2004.

Regarding the d II- (distance from Gerdy's tubercle to the starting point of the superficial branch of the CPN): since the superior genicular branch emerges just anterior to the lateral aspect of the fibula the dimensions in this study were not any different. The measurements for d II in this study were a mean measurement of 53.1

(SD 6.3) mm and a median measurement of 54mm (IQR 47, 58). This measurement was larger and thus not in agreement with what was found out by Cao et al., 2018, Labronici et al., 2010; and Rubel et al., 2004.

Regarding d III- (distance from Gerdy's tubercle to anterior recurrent genicular branch), mean measurements were 49 (SD 8.5) mm, with a median of 49mm (IQR 44, 53). This was a larger measurement and thus not in agreement with what was found out by Cao et al., 2018, Labronici et al., 2010; and Rubel et al., 2004.

In this study, using d 1 (distance from Gerdy's tubercle to the CPN at the back of the head of the fibula) as a radius to plot the circular region to define the Gerdy's safe zone, the radius was 57.6 (SD 5) mm, which does not agree with that in a study by Cao et al., (2018) (average radius of 45 mm) and Rubel et al., 2004 (average radius of 45mm).

The researcher did not get studies done on Africans to compare the findings with. The researcher also did not come across studies that compared the CPN in men and women, and as such is unable to compare findings with other populations.

The most plausible explanation that could be deduced for higher readings for dI in this MUHAL study (56.8 for females and 58mm for males) compared to the study by Rubel et al., (2004) (average radius of 45mm) was that dI was more of a bony measurement and as such African bones have been noted to have larger dimensions.

Putman et al., (2013) conducted a study in African and Caucasian women where they investigated skeletal microarchitecture and strength in the radii and tibias of the participants. They found that African Americans had denser and larger bones when compared to the Caucasian women.

Mahfouz et al., (2012) conducted a study on the three dimensional morphology of the knee. The team studied femoral (distal) and proximal tibia dimensions in Africans, Caucasians and Asians of both genders. They found that African males had larger dimensions of both bones as compared to African females. This might be the reason why the dI measurements in this population were larger in males when compared to females. They also found that the dimensions for the medial lateral length of the proximal tibia were larger in African males as opposed to Asian males. However their findings for Caucasian males were larger compared to African males which differed with previous studies.

Based on the above three studies, it might be safe to think that the values gotten in this study were due to Africans having larger dimensions for bones when compared to Asian populations. With regards to comparisons to the Caucasian populations, it might be harder to make conclusions due to differing findings in the aforementioned studies.

When the researcher studied the values of the means gotten in this MUHAL study, for d I to d III it was noted that they also seem to plot an arc like course for the nerve around the Gerdy's tubercle, despite the values being larger than the previous two studies by Labronici et al., 2010; and Rubel et al., 2004. In this regard, the nerve in this Kenyan population defines an arc like course around the tubercle, hence this course is in agreement with the ones in the previous three quoted studies, and it is only that the measurements are greater. In this study, categorization of d I to d III of all the limbs and even by gender were not statistically significant ($p>0.05$).

With regards to the fibula, in this MUHAL study, the nerve coursed on the lateral condyle of the femur, traversed the back of the head of the fibula then curved around the fibular neck. The nerve then branched in the substance of the peroneus longus muscle with exception in 4 limbs that were elucidated when it comes to discussion of the branching pattern of the nerve later in this chapter. This was in agreement with the course described in standard textbooks of Anatomy according to Koshi, 2017; Sinnatumby, 2011; and Standring, 2016.

5.2 The length of the CPN in the Kenyan population

In this MUHAL study, it was noted that there were 6 (13.9%) limbs with extreme values (380, 490, 510, 513, 520 and 523mm) for the length of the main trunk. These were the ones in which the bifurcation of the sciatic nerve was noted to be in the mid thigh and proximal thigh/ pelvis.

The dimensions of the main trunk in this MUHAL study were a mean length measurement of 212.6 (SD 124.9) mm, with a median measurement of 153mm (IQR 138, 230). This was not in agreement with Ankolekar et al., (2015) who found a mean measurement of 177 (SD 70) mm in the right sided limbs (left sided lower limbs-191 (SD 71)mm); and Cao et al., (2018)-120.6mm. The researcher found no possible ethnic reason for the differences in measurements. Categorization of CPN main trunk dimensions was statistically significant ($p<0.05$), though by gender it was not statistically significant ($p>0.05$).

Also in this study, only right sided limbs were used. As such, the researcher is not aware if there would be differences in the lengths of the main trunk dependent on the side of the limb (right or left). The Researcher did not find any reason for these findings in the literature review.

The researcher found no study mentioning differences in the lengths of the main trunk between genders and as such is unable to compare the findings in this population to other populations. With regards to stature, the researcher did not come across any study correlating the length of the main trunk of the nerve to the height of the individual.

5.3 The different branches arising in the course of the nerve

In terms of branching patterns, the branches were immediately outside the Gerdy's safe zone. However, the Researcher did not find studies in the Literature review for comparative purpose that showed the distances at which the different nerves emerged from the main trunk.

The Researcher noted during the dissection that most of the branches emerged roughly at the same level, with the exception of the sural nerve which emerged before reaching the neck of the fibula as indicated in standard anatomic text books. In females (5 limbs) it emerged at a mean distance of 139.4 (SD 148.9) mm from the bifurcation. In the males it emerged at a mean distance of 79 (SD 110.1) mm from the bifurcation. These values look this way because one should recall that the varied bifurcation of the sciatic nerve may have skewed some of the results.

The nerve was noted to divide into 5 branches in majority of limbs at the anterolateral aspect of the fibula, just beneath the origin of the peroneus longus. This concurred with the findings of Labronici et al., 2010. It contrasted with the findings of Takeda et al., (2001) who only mentioned three nerves- anterior recurrent genicular(proximal muscular branches to tibialis anterior muscle), deep peroneal and superficial peroneal nerves. There were 4 limbs where the division into branches occurred before the nerve entered the peroneus longus. The 5 branches at the anterolateral aspect of the fibula emerged in the following pattern from superior to inferior: superior genicular nerve, inferior genicular nerve, recurrent genicular nerve, deep peroneal nerve, and superficial peroneal nerve. The branching patterns in this study categorized by gender was not statistically significant ($p>0.05$).

This pattern was present in all limbs studied. Occasionally a short muscular branch to peroneus longus was noted above the recurrent genicular nerve in some specimens.

5.4 The variations in the course of the CPN and branches in the Kenyan population

The researcher noted one limb in which the nerve had divided in the pelvis. The nerve emerged below the piriformis muscle. This was the nerve whose main trunk was 510mm. This nerve was also noted to have divided into the superficial and deep peroneal nerves outside the peroneus longus muscle, just below the joint line. The nerve whose main trunk was 523 mm emerged and split 20mm below the pelvis. This MUHAL study finding concurred with those in the other studies in relation to where the CPN bifurcated with majority being in the distal thigh.

In this MUHAL study, in majority of the limbs, the bifurcations of the sciatic nerve were in the middle and distal third of the thigh. This concurred with studies by several authors (Adibatti & Sangeetha, 2014; Berihu & Debeb, 2015; Ibrahim et al., 2013; Kukiriza et al., 2010; Leishiwon et al., 2015; Ogengo et al., 2011; Okrazewska et al., 2002; Ugrenović et al., 2005). This study finding however contrasted with that by Kumar et al., (2011) and Prakash et al., (2010) who had a figure of 35% of limbs in which the CPN bifurcated from the sciatic nerve in the distal third of thigh.

The following variations were noted in the 4 (9%) limbs. The nerve divided into 5 branches outside the peroneus longus muscle in two specimens, while in one specimen, the superficial peroneal nerve branched outside the peroneus longus muscle and in the last specimen, the superior, inferior and recurrent genicular nerves branched within the peroneus longus while the deep and superficial peroneal nerves branched outside the peroneus longus muscle.

This is important to know as injury to CPN can occur at the hip (in case of proximal division) during total hip replacement arthroplasties etc. and also at the knee.

Deutsch et al., (1999) in their study noted that in 10% of specimens the nerve divided proximal to the knee joint. This is an important knowledge to know as one does arthroscopy techniques and inside out repair of the lateral meniscus. This finding is in agreement with what the researcher found in the MUHAL study.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

1. This MUHAL study has shown that the CPN in the Kenyan population has a circular arc like course around the Gerdy's tubercle in the tibia which is in agreement with international studies. However, the mean distance (D1) for both gender (58 (SD 5.1) mm in males, and 56.8 (SD 5.1) mm in females) can be used to plot the course of the nerve preoperatively to define the Gerdy's safe zone so that one can plan for surgeries to the proximal tibia as there are no nerves within this described area.

2. The mean length of the CPN in this population was 212.6 (SD 124.9) mm.

3. Five main branches were seen in all limbs- superior and inferior genicular branches, anterior recurrent genicular branch, deep and superficial peroneal branches of the CPN.

4. In the case of variations, in 9% of limbs the CPN in this population divided outside the peroneus longus.

6.2 Recommendations

1. When planning surgeries and using the Gerdy's safe zone, in the Kenyan population, the surgeon should use a larger radius (52.6mm-62.5mm) compared to the one used in the Caucasian population.

2. The CPN in the Kenyan population has a mean length that indicates it starts in the mid and distal thigh, so surgeons have to be careful when performing surgery in the mid and distal thigh as they can easily injure the nerve during procedures.

3. Surgeons need to be careful when carrying out surgeries at the neck of fibula as this is where the origin of the 5 branches of CPN is.

4. Surgeons who perform knee arthroscopies and Total knee arthroplasties need to remember that CPN divided into its branches before piercing the peroneus longus muscle in 9% of the limbs. This information is important when carrying out inside out repair of the lateral meniscus, arthroscopy and total knee arthroplasty on valgus knees in the Kenyan population.

5. Recommendation for further studies: More studies need to be carried out on the nerve where patient characteristics like obesity are correlated with the course of the nerve, through radiological means either by ultrasound or MRI. More studies also need to be carried out on fetuses and children locally so as to enable more understanding about the nerve and its changes in anatomy during growth. This would be of help to pediatric Orthopedic Surgeons.

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APPENDICES

Appendix 1: Equipment

a. Dissection kit

b. Measuring instruments- Vernier calipers, calibrated rulers

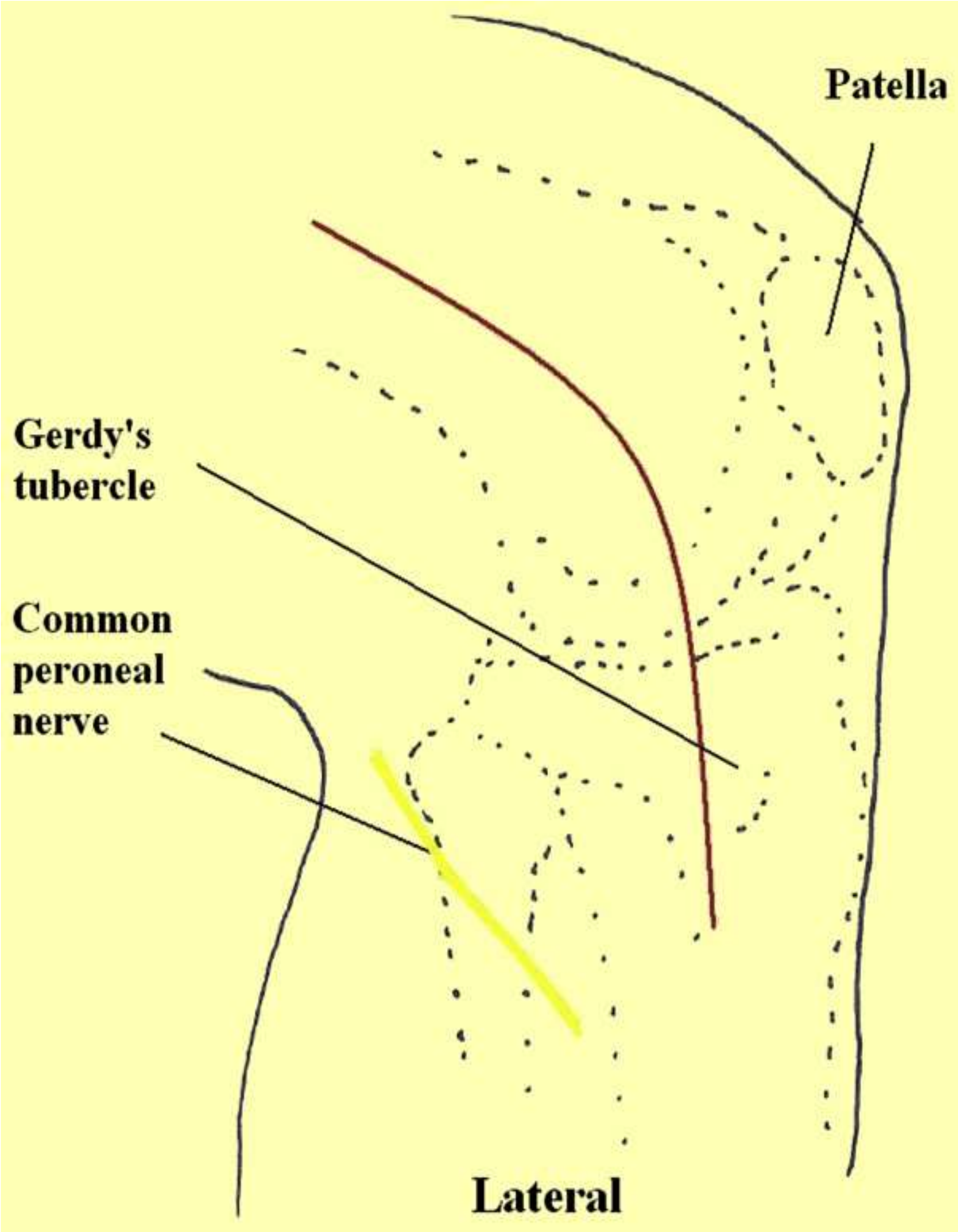
c. Digital camera

d. Stationery

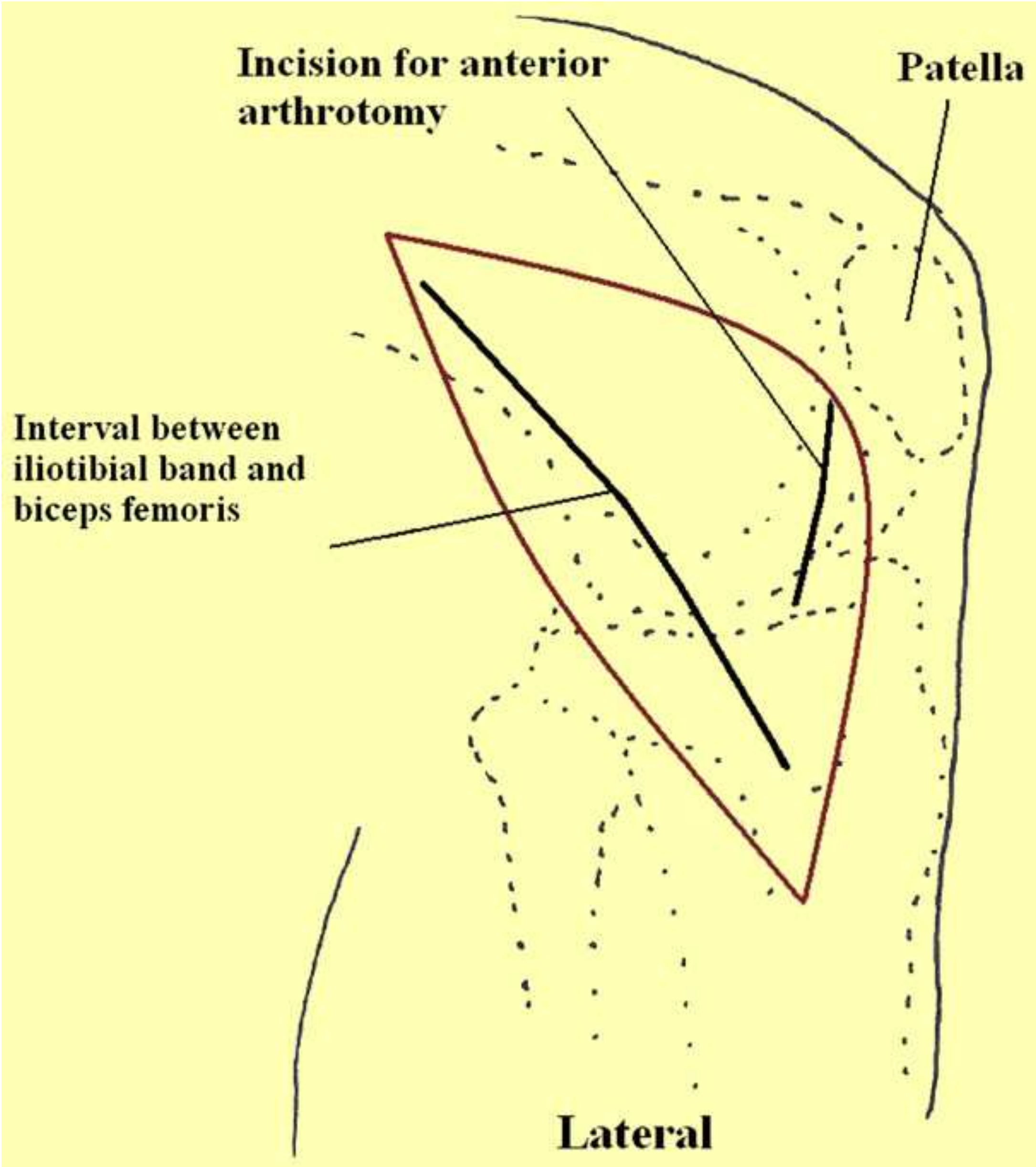
e. Gloves

f. String and identifiers-to tag dissected branches

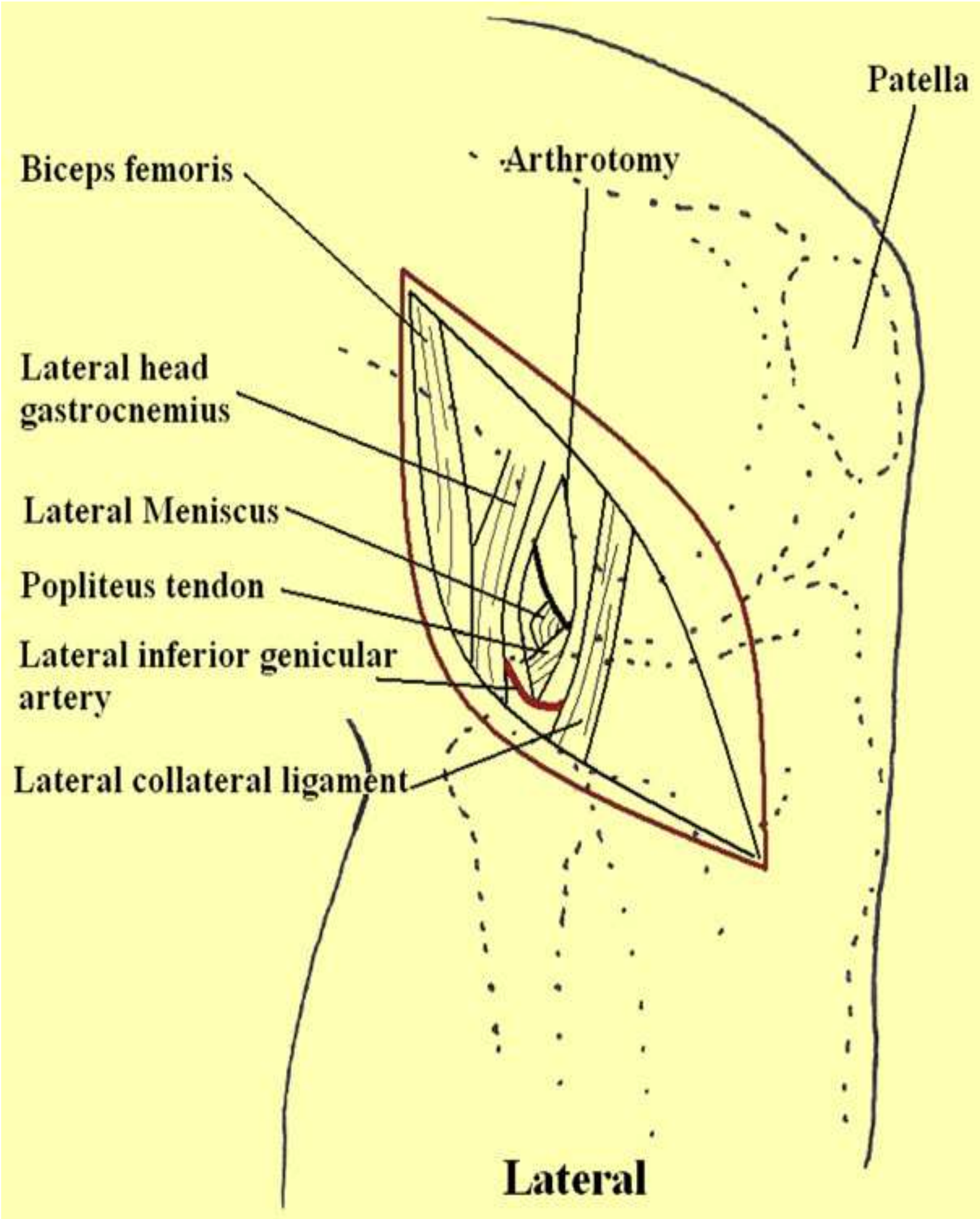
Appendix 2: Lateral approach as described by Stanton et al., 2010



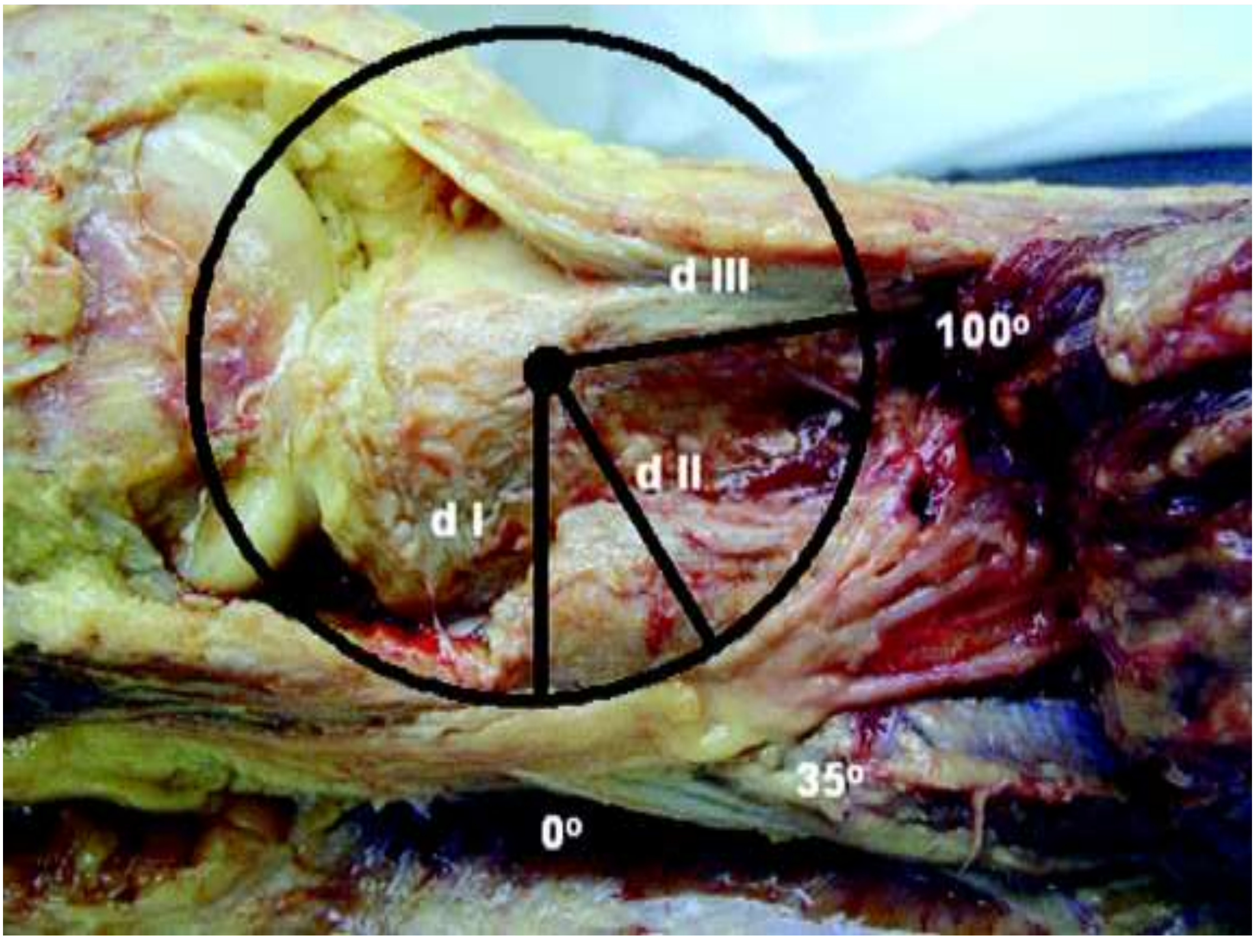
Appendix 3: Superficial Dissection As Per Stanton et al., 2010



Appendix 4: Deep dissection as illustrated by Stanton et al., 2010



Appendix 5: Description of distances measured during dissection as described by Rubel et al., 2004



d I = distance from the most prominent aspect of Gerdy's tubercle to the CPN behind the head of the fibula (at 0°)

d II = distance from the most prominent aspect of Gerdy's tubercle to the starting point of the superficial branch of the CPN (at 35°)

d III = distance from the most prominent aspect of Gerdy's tubercle to the anterior recurrent branch of the nerve (100°) (Rubel et al., 2004).

Appendix 6: Data collection sheet/checklist

ID code for limb	**Limb side**		**sex**		**measurements**			**Number of branches seen**	**Other remarks**
	Right	Left	Male	Female	D1	D2	D3		

Appendix 7: List of some Websites offering Legal Services to those suffering from Drop foot (Complication of Peroneal Nerve Injury) After Surgery

www.aaos.org/news/aaosnow/jun08/clinicaln.asp

www.aboutlawsuits.com/hip-replacement-malpractice-lawsuit-nerve-damage

www.bilfieldandassociates.com/CM/custom/settlement-Verdicts.html

www.carterlaw.org/Medical-Malpractice/Foot-drop.shtml

www.illinoislawyers.com/illinois-foot-drop-lawyers-asp

www.losangelespersonalinjurylawyers.co>MedicalMalpractice

downtownlalaw.com/foot-drop-nerve-damage-lawsuit/

www.medmalfirm.com/drop-foot/cases-we-handle/.../drop-foot.../what-is-drop-foot/

www.prslaw.com/medical-malpractice-law_2.html

www.spanglaw.com/medical-malpractice/foot-drop-cleveland-injury-lawyers

Appendix 8: IREC Approval Letter

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2015/139
Approval Number: 0001477

27th August, 2015

Dr. Mwanaidi Muhavi Ayumba,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
27 AUG 2015
APPROVED

Dear Dr. Muhavi,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Surgical Anatomy of the Common Peroneal Nerve in the African Population".

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1477*** on 27th August, 2015. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 25th August, 2016. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

For [signature]

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	Director	-	MTRH	Dean	-	SOP	Dean	-	SOM
	Principal	-	CHS	Dean	-	SON	Dean	-	SOD

Appendix 9: Approval from Department of Human Anatomy to carry out the study

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICINE
Department of Human Anatomy

INTERNAL MEMO

FROM: HOD, Human Anatomy **DATE**: 06/08/2015

TO: Chairman, IREC **RE:** MU/CHS/SOM/HA/

RE: POST GRADUATE RESEARCH: - DR. MWANAIDI A. MUHAVI

Dr. Mwanaidi Muhavi an MMed. Postgraduate student in Orhopeadic Surgery wish to conduct research in "**Surgical Anatomy of the common peroneal nerve in the African population.**"

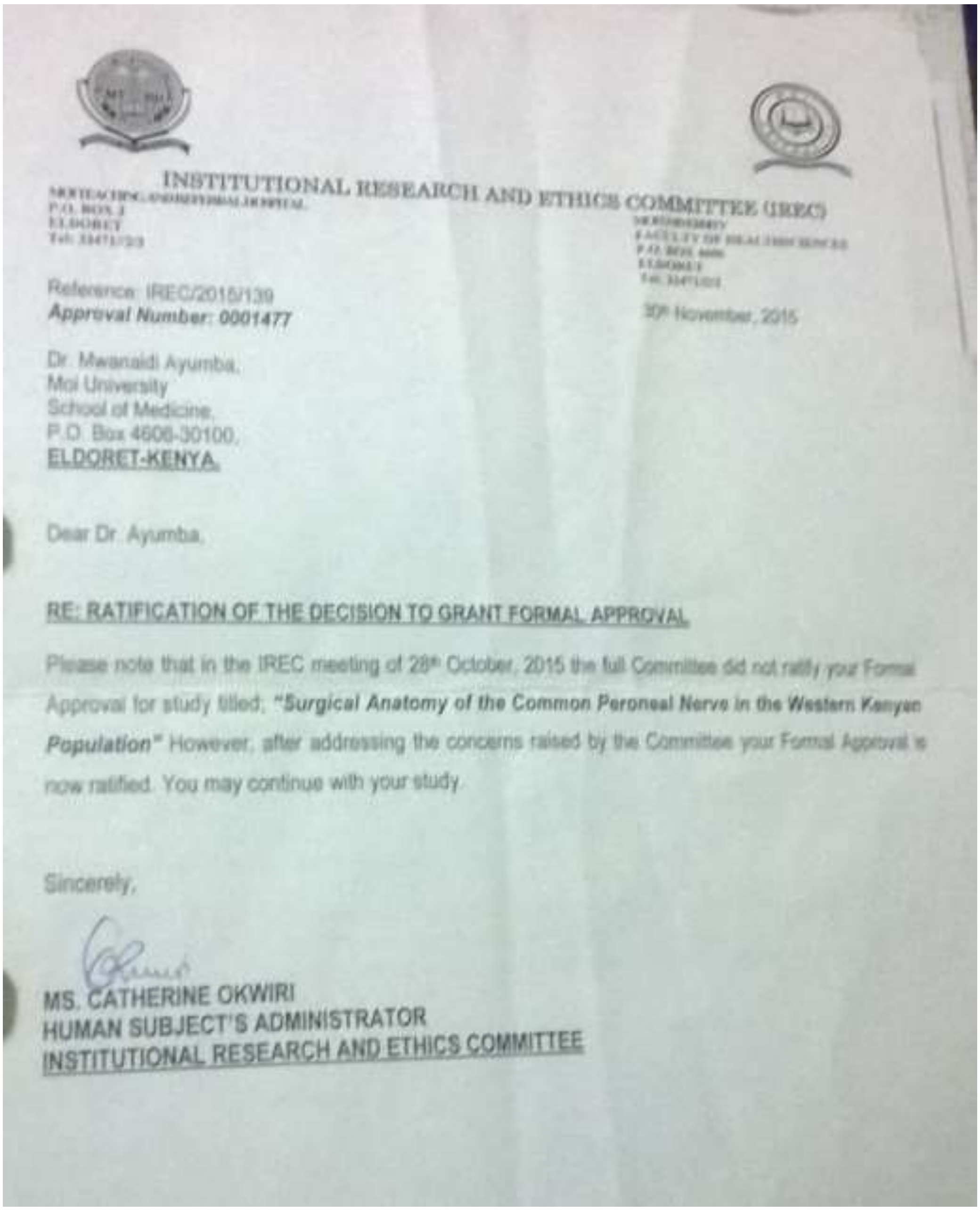
We wish to confirm that the Department has enough research materials to support this research.

DR. A. N. NJOROGE
HOD, HUMAN ANATOMY

Cc: Dr. Mwanaidi Muhavi

Cc: Dr. Mwanaidi Muhavi

Appendix 10: Ratification Letter



INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

Reference: IREC/2015/139
Approval Number: 0001477

30th November, 2015

Dr. Mwanaidi Ayumba,
Moi University
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Dr. Ayumba,

RE: RATIFICATION OF THE DECISION TO GRANT FORMAL APPROVAL

Please note that in the IREC meeting of 28th October, 2015 the full Committee did not ratify your Formal Approval for study titled; ***"Surgical Anatomy of the Common Peroneal Nerve in the Western Kenyan Population"*** However, after addressing the concerns raised by the Committee your Formal Approval is now ratified. You may continue with your study.

Sincerely,

MS. CATHERINE OKWIRI
HUMAN SUBJECT'S ADMINISTRATOR
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

Appendix 11: Study Timeline

ACTIVITY	DURATION	DATE	PARTICIPANTS
Topic selection	1 month	January- February, 2015	Researcher and supervisors
Concept paper presentation to department	1 month	February- March, 2015	Researcher and supervisors
Proposal writing	2 months	March- May, 2015	Researcher, Biostatistician and supervisors
Submission to and approval of proposal by IREC		May- September, 2015	Researcher
Data collection and analysis		October, 2015– December, 2016 January – August, 2017	Researcher
Thesis writing		August, 2017- December, 2018	Researcher and supervisors
Submission of thesis	1 month	January, 2019	Researcher
Oral defense of thesis	1 month	May, 2019	Researcher and supervisors
Submission of bound thesis	1 month	August, 2019	Researcher

Appendix 12: Budget

Item	**Amount (Kenyan shillings)**
IREC Fee	500
Digital camera	10000
Vernier calipers, rulers	9000
Dissection kit	6000
Flash discs, CDs	5000
Folders and files	2000
Tape measures, gloves	1300
Stationery (pens, pencils, paper, eraser)	5000
Printing and binding services	10000
Data handling	20000
Miscellaneous expenses	1200
Total	**70000**