

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

**THE NATIONAL RIBAT UNIVERSITY**  
**FACULTY OF GRADUATE STUDIES & SCIENTIFIC**  
**RESEARCH**

**Cadaveric Study of the Variation Site of**  
**The Sciatic Nerve Division in Sudanese People**

A thesis submitted in partial fulfillment required for the M.Sc in  
**HUMAN and CLINICAL ANATOMY**

By:

**Hadbaa Ghazi Hussain**

Supervised by:

**Dr. Yasser Seddeg Abdul-ghani**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قال تعالى:

﴿اللَّهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ مِثْلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ

الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِنْ شَجَرَةٍ مُبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ

زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَنْ يَشَاءُ وَيَضْرِبُ

اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيمٌ ﴿﴾

[ سورة النور: 35 ]

# **CHAPTER ONE**

## **INTRODUCTION & OBJECTIVES**

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### **Dedication**

To my parents,

Husband,  
My son,  
Brothers,  
Sister,  
Family,  
Relatives,  
Colleagues and  
Teachers

## **Acknowledgment**

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## المستخلص

هدفت هذه الدراسة إلى تحديد الموقع الاكثر شيوعاً لتقسيم العصب الوركي في عينات من الموتى السودانيين وأيضاً لدراسة العلاقة بين العصب الوركي وعضلة الكمثري. تم فحص مجموعه 50 جثة ، تم تشريح الألية والفخذ في 48 رجل و 2 من الإناث.

وكانت نتيجة الدراسة كالاتي :92% من العصب الوركي تمر تحت عضلة الكمثري، و 8% من العصب الوركي تقسم داخل الحوض . وتقسيم العصب الوركي كان 8% داخل الحوض ، 4% في المنطقة الألوية، و 18% في الثلث العلوي من الفخذ ، و 34% في الثلث الأوسط من الفخذ، 24% في الزاوية العلوية للحفرة المأبضية و 12% في مركز المأبضية.

وكانت علاقة العصب الشظوي المشترك إذا كان العصب الوركي منقسم داخل الحوض 4% منه خارقة للعضلة الكمثرية و4% تمر أدناه.

مع ملاحظة عدم وجود فروقات ذات دلالة إحصائية بين العينات اليسار واليمين

وتمثل هذه الدراسة أول تقرير على تقسيم أكثر المناطق في الطرف السفلي من الجسم شيوياً التي ينقسم فيها العصب الوركي في سكان السودان . تقسيم الموقع الوركي في الشعب السوداني لا تختلف كثيراً عن غيرهم من السكان.

## Abstract

This study aimed to determine common site of division of sciatic nerve in Sudanese cadaveric specimens and also to study the relation of the sciatic nerve to the piriformis muscle.

A total of 50 dissected gluteal and thigh regions 48 men and 2 female's involved unilateral samples were examined

92% of sciatic nerves pass below the piriformis muscle, and 8% of sciatic nerves divide inside pelvis .The sites of division of sciatic nerve was 8% inside pelvis , 4% in the gluteal region , 18% in the upper third of the thigh , 34% in the middle third of the thigh , 24% in the superior angle of popliteal fossa and 12% at the center of popliteal fossa .

The relation of the tibial nerve to piriformis muscle if the sciatic nerve divided inside the pelvis was 8% of tibial nerves pass below the piriformis muscle.

The relation of the common peroneal nerve if the sciatic nerve divided inside the pelvis was 4% of common peroneal the piriformis muscle nerve piercing the piriformis muscle and 4% pass below.

No significant differences between left and right specimens.

The present study represents the first report on the common site division of sciatic nerve in adult Sudanese. The sciatic site division in Sudanese population is not different from other populations.

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## **Abbreviations**

**S.N** : **Sciatic Nerve**

**T.N** : **Tibial Nerve**

**C.P.N:** **Common Peroneal Nerve**

**PM** : **Piriformis Muscle**

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## **1. Introduction & Objectives**

### **1.1 Introduction**

Sciatic nerve is the largest nerve in the body, and it is the continuation of the major flat part of the sacral plexus, measuring 2cm in breadth. It is formed as the large anterior rami of spinal nerves (L4, L5, S1, S2, and S3) converge on the anterior surface of the piriformis muscle<sup>[1]</sup>.

Sciatic nerve is really two nerves, tibial nerve derived from anterior (preaxial) divisions of the anterior rami, and the common fibular nerve derived from posterior (postaxial) divisions of the anterior rami, which are loosely bound together in the same connective tissue sheath<sup>[1]</sup>.

Sciatic nerve supplies the posterior thigh muscles, all leg and foot muscles, and skin of the most of the leg and foot .It also supplies the articular branches to all joints of the lower limb. It supplies no structures in the gluteal region<sup>[1]</sup>.

The point of division of the sciatic nerve into its major components enclosed within one sheath tibial and common peroneal is very variable. The common site is at the junction of the middle and lower thirds of the thigh, near the apex of the popliteal fossa<sup>[2]</sup>.

The division may occur at any level above this, though rarely below it. It is not uncommon for the major components to leave the sacral plexus separately, in which case the common peroneal component usually passes through piriformis at the greater sciatic notch while the tibial component passes below the muscle<sup>[2]</sup>.

Previous studies were conducted to determine the point of division of sciatic nerve in different populations. For example in a study conducted in India, the common site of sciatic nerve division is the lower part of the thigh. Another study was done in Turkia found that in 52% of the cases; the SN exited the pelvis as a whole nerve without any division.

No previous studies were conducted in Sudan, so this study aimed to find any variation of the site of sciatic nerve division in Sudanese cadaveric specimens and to compare the results with previous studies done worldwide.

## **1.2. Objectives**

### **1.2.1. General Objective:**

To find the common anatomical site of S.N division in Sudanese cadaveric specimens.

### **1.2.2. Specific Objectives:**

1. To determine the common site of division of sciatic nerve in Sudanese cadaveric specimens.
2. To study the relation of the sciatic nerve to the piriformis muscle.
3. To compare the results of this study with previous studies done worldwide.
4. In depth understanding of sciatica.
5. To reduce risks of surgical complications in gluteal region.
6. To minimize the injury of S.N following the intragluteal injections by knowing the surface marking of SN.

## **2. Literature Review**

### **2.1. Anatomy of Sciatic nerve:**

The sciatic nerve leaves the pelvis via the greater sciatic foramen below piriformis and descends between the greater trochanter and ischial tuberosity, along the back of the thigh, dividing into the tibial and common peroneal (fibular) nerves at varying levels proximal to the knee. Superiorly it lies deep to gluteus maximus, resting first on the posterior ischial surface with the nerve to quadratus femoris between them. It then crosses posterior to obturator internus, the gemelli and quadratus femoris, separated by the latter from obturator externus and the hip joint. It is accompanied medially by the posterior femoral cutaneous nerve of the thigh and the inferior gluteal artery. More distally it lies behind adductor magnus and is crossed posteriorly by the long head of biceps femoris <sup>[2]</sup>.

Articular branches arise proximally to supply the hip joint through its

posterior capsule. These are sometimes derived directly from the sacral plexus. Muscular branches are distributed to biceps femoris, semitendinosus, semimembranosus and the ischial part of adductor magnus. The sciatic nerve supplies the knee flexors and all the muscles below the knee <sup>[2]</sup>.

## **2.2. Surface marking of Sciatic nerve:**

The sciatic nerve corresponds to a line drawn from just medial to the midpoint between the ischial tuberosity and greater trochanter to the apex of the popliteal fossa <sup>[2]</sup>.

## **2.3. Blood supply of Sciatic nerve:**

The sciatic nerve is supplied with blood by a branch from the inferior gluteal artery; This artery of sciatic nerve represents the remnant of the original axial artery of the limb and it may persist as a large vessel<sup>[3]</sup>.

## **2.4. The Tibial nerve**

The tibial nerve, the larger sciatic component, is derived from the ventral branches (anterior division) of the fourth and fifth lumbar and first to third sacral ventral rami <sup>[2]</sup>.

It descends along the back of the thigh and popliteal fossa to the distal border of popliteus. It then passes anterior to the arch of soleus with the popliteal artery and continues into the leg. In the thigh it is overlapped proximally by the

hamstring muscles but it becomes more superficial in the popliteal fossa, where it is lateral to the popliteal vessels. At the level of the knee the tibial nerve becomes superficial to the popliteal vessels and crosses to the medial side of the artery. In the distal popliteal fossa it is overlapped by the junction of the two heads of gastrocnemius <sup>[2]</sup>.

In the leg, the tibial nerve descends with the posterior tibial vessels to lie between the heel and the medial malleolus <sup>[2]</sup>.

Proximally it is deep to soleus and gastrocnemius, but in its distal third is covered only by skin and fasciae, overlapped sometimes by flexor hallucis longus. At first medial to the posterior tibial vessels, it crosses behind them and descends lateral to them until it bifurcates. It lies on tibialis posterior for most of its course except distally, where it adjoins the posterior surface of the tibia. The tibial nerve ends under the flexor retinaculum by dividing into the medial and lateral plantar nerves <sup>[2]</sup>.

The branches of the tibial nerve are articular, muscular, sural, medial calcaneal and medial and lateral plantar <sup>[2]</sup>.

Articular branches accompany the superior, inferior, medial and middle genicular arteries to the knee joint. They form a plexus with a branch from the obturator nerve and supply the oblique posterior ligament. The branches accompanying the superior and inferior genicular arteries also supply the medial

part of the capsule. Just before the tibial nerve bifurcates it supplies the ankle joint [2].

Proximal muscular branches arise between the heads of gastrocnemius and supply gastrocnemius, plantaris, soleus and popliteus. The nerve to soleus enters its superficial aspect. The branch to popliteus descends obliquely across the popliteal vessels, curling round the distal border of the muscle to its anterior surface. It also supplies tibialis posterior, the proximal tibiofibular joint and the tibia, and gives off an interosseous branch that descends near the fibula to reach the distal tibiofibular joint [2].

Muscular branches in the leg, either independently or by a common trunk, supply soleus (on its deep surface), tibialis posterior, flexor digitorum longus and flexor hallucis longus. The branch to flexor hallucis longus accompanies the peroneal vessels [2].

#### **2.4.1. The Medial and Lateral planter nerves:**

These are derived from the tibial nerve in the calf. The tibial nerve divide into medial and lateral planter branches, under cover of the flexor retinaculum, the artery higher than the nerve, so that on medial and lateral borders of the sole the artery is more marginal than the nerve. The medial planter nerve is larger than the lateral; it supplies fewer muscles (though their bulk is considerable)

than the lateral plantar nerve but it supplies much more skin. The neurovascular plane of the sole lies between the first and second layers, upon the long tendons <sup>[3]</sup>.

The medial plantar artery runs forward on the marginal medial side of the medial plantar nerve under cover of the muscles of the first layer. Both give off many branches to the sole, which perforate the plantar aponeurosis in the interval between abductor hallucis and flexor digitorum brevis <sup>[3]</sup>.

The nerve supplies these two muscles, and also the flexor hallucis brevis and the first lumbrical; in addition it gives off digital cutaneous branches that supply the medial three and a half toes on their plantar surfaces and on their dorsal surfaces proximal to the nail beds. Its most lateral cutaneous branch communicates with the neighboring lateral plantar digital branch across the plantar surface of the fourth metatarsophalangeal joint, where pressure on the nerve may give rise to the painful condition known as metatarsalgia <sup>[3]</sup>.

The lateral plantar nerve give off cutaneous branches to the sole that perforate the plantar aponeurosis in the interval between flexor digitorum brevis and abductor digiti minimi. The lateral plantar nerve crosses the sole obliquely just deep to the first layer of muscles .It supplies flexor accessorius and abductor digiti minimi and sends perforating branches through the plantar aponeurosis to supply skin on the lateral side of the sole. Near the base of the fifth metatarsal bone it divides into superficial and deep branches. The superficial branch supplies the

fourth cleft and communicates with the medial plantar nerve and, by a lateral branch, supplies the skin of the lateral side and distal dorsum of the little toe <sup>[3]</sup>.

Unlike the superficial branch of the ulnar nerve, these branch supplies three muscles, namely flexor digiti minimi brevis and the two interosseous of the fourth space (third plantar and fourth dorsal). The deep branch lies within the concavity of the plantar arch and ends by sinking into the deep surface of the oblique head of adductor hallucis. It gives off branches to the remaining interosseous, to the transverse head of adductor hallucis and to the three lateral (bicipital) lumbricals. The branch to the second lumbrical passes dorsal to the transverse head of adductor hallucis and recurves ventrally to enter the lumbrical <sup>[3]</sup>.

## **2.5. The common peroneal nerve:**

The common peroneal nerve also known as common fibular nerve is approximately half the size of the tibial nerve and is derived from the dorsal branches of the fourth and fifth lumbar and first and second sacral ventral rami. It descends obliquely along the lateral side of the popliteal fossa to the fibular head, medial to biceps femoris. It lies between the bicipital tendon, to which it is bound by fascia, and the lateral head of gastrocnemius. The nerve then passes into the anterolateral muscle compartment through a tight opening in the thick fascia

overlying tibialis anterior. It curves lateral to the fibular neck, deep to peroneus longus, and divides into superficial and deep peroneal nerves.

The common peroneal nerve has articular and cutaneous branches. It terminates as the superficial and deep peroneal nerves <sup>[2]</sup>.

There are three articular branches. Two accompany the superior inferior and lateral genicular arteries, and may arise in common. The third, the recurrent articular nerve, arises near the termination of the common peroneal nerve. It ascends with the anterior recurrent tibial artery through tibialis anterior and supplies the anterolateral part of the knee joint capsule and the proximal tibiofibular joint <sup>[2]</sup>.

The two cutaneous branches, often from a common trunk, are the lateral sural and sural communicating nerves. The lateral sural nerve (lateral cutaneous nerve of the calf) supplies the skin on the anterior, posterior and lateral surfaces of the proximal leg. The sural communicating nerve arises near the head of the fibula and crosses the lateral head of gastrocnemius to join the sural nerve. It may descend separately as far as the heel <sup>[2]</sup>.

The deep fibular (peroneal) nerve is the nerve of the anterior compartment of the leg. It is one of the two terminal branches of the common fibular nerve, arising between the fibularis longus muscle and the neck of the fibula. After its entry into the anterior compartment, the deep fibular nerve

accompanies the anterior tibial artery, first between the TA and EDL and then between the TA and EHL. The deep fibular nerve then exits the compartment, continuing across the ankle joint to supply intrinsic muscles (extensors digitorum and hallucis brevis) and a small area of the skin of the foot. A lesion of this nerve results in an inability to dorsiflexion the ankle (footdrop) <sup>[1]</sup>.

The superficial fibular (peroneal) nerve, a terminal branch of the common fibular nerve, is the nerve of the lateral compartment. After supplying the FL and FB, the superficial fibular nerve continues as a cutaneous nerve, supplying the skin on the distal part of the anterior surface of the leg and nearly all the dorsum of the foot <sup>[1]</sup>.

### **2.5.1. The Sural Nerve:**

The sural nerve is formed by union of the medial sural cutaneous nerve (from the tibial nerve) and sural communicating branch of the common fibular nerve, respectively. The level of junction of these branches is variable; it may be high (in the popliteal fossa) or low (proximal to heel). Sometimes the branches do not join and, therefore, no sural nerve is formed. In these people, the skin normally innervated by the sural nerve is supplied by the medial and lateral sural cutaneous branches. The sural nerve accompanies the small saphenous vein and enters the foot posterior to the lateral malleolus to supply the ankle joint and skin along the lateral margin of the foot <sup>[1]</sup>.

## **2.6. Histology of sciatic nerve:**

The sciatic nerve like another peripheral nerves, the nerve fibers are grouped in bundles to form the nerves. It has a whitish, homogeneous, glistening appearance because of their myelin and collagen content. Nerves have an external fibrous coat of dense connective tissue called perineurium, which also fills the space between the bundles of nerve fibers. Each bundle is surrounded by the perineurium, a sleeve formed by layers of flattened epithelium like cells. The cells of each layer of the perineurium sleeve are joined at their edges by tight junctions, an arrangement that makes the perineurium a barrier to the passage of most macromolecules and has the important function of protecting the nerve fibers from aggression. Within the perineurium sheath run the Schwann cell-sheathed axons and their enveloping connective tissue, the endoneurium. The endoneurium consists of a thin layer of reticular fibers, produced by Schwann cells <sup>[4]</sup>.

## **2.7. Development of sciatic nerve:**

This previous Serbian study conducted to determine the morphometric development, location and variant formations of the sciatic nerve using anatomic dissection method during the fetal period. Sciatic nerves of 200 human fetuses (103 males and 97 females) aged between 9 and 40 weeks of gestation were studied bilaterally. The bifurcation level of the sciatic nerve to its terminal branches was

evaluated with respect to popliteal fossa. Then the length of the sciatic nerve, starting from where it leaves the piriformis muscle till the bifurcation point of the nerve, and its width at the point where it leaves infrapiriforme foramen and its width at the bifurcation level were measured. We also measured the distance of the sciatic nerve to the ischial tuberosity, the greater trochanter and the intergluteal sulcus. Mean values and standard deviations of all parameters according to trimesters were calculated. Results: We found that all parameters increase with age during the fetal period ( $P < 0.05$ ). Parameters do not show any significant differences between sexes ( $P > 0.05$ ). In our analysis, we observed that in 98 % of the cases (on the right and the left side) the sciatic nerve leaves the pelvis below the piriformis muscle. The remaining cases (2%) are variant formations. We believe that our study will be useful for better understanding of sciatic nerve development and it may contribute to future studies in obstetrics, orthopedics and fetal pathology. Knowledge of variant formations of the sciatic nerve, its bifurcation level and its relation with neighboring structures may be important for blockade of the nerve in newborn surgeries <sup>[5]</sup>.

## **2.8. Clinical importance:**

The gluteal region is a common site for intramuscular injection of drugs because the gluteal muscles are thick and large, providing a large area for venous absorption of drugs. Injections into the buttock are safe only in the

superolateral quadrant of the buttock. Wounds or surgery on the medial side may injure the sciatic nerve and its branches to the hamstrings. Paralysis of these muscles results in impairment of thigh extension and leg flexion. Complications of improper technique include nerve injury, hematoma, and abscess formation <sup>[1]</sup>.

Sciatic nerve injury occurs between 0.5% and 2.0% of the time during total hip arthroplasty<sup>[6]</sup>. Sciatic nerve palsy is a complication of total hip arthroplasty with an incidence of 0.2% to 2.8% of the time, or with an incidence of 1.7% to 7.6% following revision<sup>[6]</sup>.

Sciatic nerve palsy can also result from severe spinal stenosis following the procedure, which can be addressed by spinal decompression surgery. Other disease Bernese periacetabular osteotomy resulted in major nerve deficits in the sciatic in 2.1% of 1760 patients, of whom approximately half experienced complete recovery within a mean of 5.5 months. Sciatic nerve exploration can be done by endoscopy in a minimally invasive procedure to assess lesions of the nerve. Endoscopic treatment for sciatic nerve entrapment has been investigated in deep gluteal syndrome; Patients were treated with sciatic nerve decompression by resection of fibrovascular scar bands, piriformis tendon release, obturator internus, or quadrates femoris or by hamstring tendon scarring<sup>[6]</sup>.

Previously, the prevalence figures of piriformis and sciatic nerve anomalies had ranged from 1.5 to 35.8% in dissected specimens. This study systematically

reviews and meta-analyses the prevalence of piriformis and sciatic nerve anomalies in humans using previously published literature. A further review is conducted regarding the anatomical abnormalities present in surgical case series of procedures for patients suffering from piriformis syndrome. After pooling the results of 18 studies and 6,062 cadavers, the prevalence of the anomaly in cadavers was 16.9%; 95% confidence interval (CI) 16.0–17.9%. The prevalence of the piriformis and sciatic nerve anomaly in the surgical case series was 16.2%, 95% CI: 10.7–23.5%. The difference between the two groups was not found to be significant 0.74%; 95% CI: -5.66 to 7.13; P = 0.824. Because of the high likelihood of an anomaly being present in a patient, clinicians and surgeons should be aware of the potential complications<sup>[7]</sup>.

### **2.8.1: Sciatic nerve pain**

Also known as sciatica is a painful condition that is most commonly indicated by pain that radiates through the leg. Sciatica can be caused by an injury, but sometimes this frustrating condition can be traced to the presence of a degenerative spine condition in the lumbar spine in the lower back. When the sciatic nerve becomes compressed in the spinal column, the regular function of the sciatic nerve is interfered with and sciatic nerve pain is experience<sup>[8]</sup>.

When the sciatic nerve becomes irritated or compressed, regular function of the nerve is interfered with, which can lead to muscle weakness, numbness or tingling, and significant leg pain. Sciatic nerve pain is an extremely common condition in older patients because it is frequently caused by a degenerative spine condition in the lower back. Over the years, the intervertebral discs that cushion the spine deteriorate, the vertebral joints that stabilize the spine become arthritic, vertebrae become misaligned, and bone spurs develop in the spinal column. These conditions are all actually asymptomatic by themselves, but when they result in the compression of the sciatic nerve, pain can be experienced <sup>[8]</sup>.

It has long been observed that partial sciatic nerve injuries usually affect the common peroneal nerve more severely than the tibial nerve. Less frequently, the common peroneal nerve is the only component affected, mimicking a distal common peroneal nerve lesion. It is believed that the greater vulnerability of the peroneal division is due to the following: The difference in the fascicular pattern and cushioning effect of the epineurium between the 2 divisions; the tibial nerve has many fascicles distributed between elastic epineural tissues, whereas the peroneal nerve is composed of fewer fascicles with limited supportive tissue. The difference in the anatomical course between these 2 nerves: the tibial nerve is loosely fixed posteriorly, whereas the peroneal nerve is taut and secured at the sciatic notch proximally, and the fibular neck distally. Consequently, traction of

the sciatic nerve results in more damage to the peroneal than the tibial nerve in the thigh <sup>[9]</sup>.

### **2.8.2. The piriformis syndrome:**

First described in 1928, is a highly controversial disorder. Based on the close relation between the sciatic nerve and the piriformis muscle, it is proposed that leg pain ("sciatica") may be caused by compression of the sciatic nerve at the pelvic outlet by the piriformis muscle. The clinical manifestations of the piriformis syndrome, according to its proponents, include buttock and leg pain without low back pain, worse during sitting; pain exacerbated by internal rotation or abduction and external rotation of the hip (and straight leg raise test); exquisite local tenderness in the buttock; soft or no neurologic signs; and normal imaging studies of the spinal canal and nerve roots. These advocates, usually anesthesiologists and surgeons, feel that these symptoms are caused by sciatic nerve compression by the piriformis muscle as some patients improve following sciatic nerve block or decompression. Many proponents of the syndrome rely on the presence of positive test maneuvers used in the bedside diagnosis of the piriformis syndrome <sup>[9]</sup>.

The sciatic nerve may be wounded in penetrating injuries or in posterior dislocation of the hip associated with fracture of the posterior lip of the acetabulum, to which the nerve is closely related. Damage to the sciatic nerve is followed by paralysis of the hamstrings and all the muscles of the leg and foot

(supplied by its distributing branches);there is loss of all movements in the lower limb below the knee joint with footdrop deformity. Sensory loss is complete below the knee, except for an area along the medial side of the leg, over the medial malleolus and down to the hallux, which is innervated by the saphenous branch of the femoral nerve. The sciatic nerve is accompanied by a companion artery (derived from the inferior gluteal artery) which bleeds quite sharply when the nerve is divided during an above-knee amputation. The artery must be neatly isolated and tied without any nerve fibres being incorporated in the ligature, since this would be followed by severe pain in the stump<sup>[10]</sup>.

### **2.8.3. Deep Fibular Nerve Entrapment:**

Excessive use of muscles supplied by the deep fibular nerve may result in muscle injury and edema in the anterior compartment. This entrapment may cause compression of the deep fibular nerve and pain in the anterior compartment. Compression of the nerve by tight-fitting ski boots, for example, may occur where the nerve passes deep to the inferior extensor retinaculum and the EHB. Pain occurs in the dorsum of the foot and usually radiates to the web space between the 1st and 2nd toes. Because ski boots are a common cause of this type of nerve entrapment, this condition has been called the “ski boot syndrome”; however, the

syndrome also occurs in soccer players and runners and can also result from tight shoes <sup>[1]</sup>.

#### **2.8.4. Superficial Fibular Nerve Entrapment:**

Chronic ankle sprains may produce recurrent stretching of the superficial fibular nerve, which may cause pain along the lateral side of the leg and the dorsum of the ankle and foot. Numbness and paresthesia (tickling or tingling) may be present and increase with activity <sup>[1]</sup>.

#### **2.9. Previous studies:**

There are studies that were conducted in the same context. Which study conducted by Natsis in 147 Caucasian cadavers (294 limbs) was dissected and the result which found: the sciatic nerve and piriformis muscle relationship followed the typical anatomical pattern in 275 limbs (93.6 %). In 12 limbs (4.1 %) the common peroneal nerve passed through and the tibial nerve below a double piriformis. In one limb (0.3 %) the common peroneal nerve coursed superior and the tibial nerve below the piriformis. In one limb (0.3 %) both nerves penetrated the piriformis. In one limb (0.3 %) both nerves passed above the piriformis. Four limbs (1.4 %) presented non-classified anatomical variations. When a double

piriformis muscle was present, two different arrangements of the two heads were observe<sup>[11]</sup>.

Another study conducted by Parkash in India the highest incidence of sciatic nerve division (40.7 percent) was observed in the lower part of the posterior compartment of the thigh. In 34.9 percent of the specimens, the sciatic nerve was divided into tibial and common peroneal nerves in the popliteal fossa. 16.3 percent of extremities showed sciatic nerve division proximal to its entrance in the gluteal region<sup>[12]</sup>.

Another study was conducted by Shailes in 86 gluteal regions were examined in 43 formalin-fixed adult cadavers from different medical colleges of Gujarat region. From the study we found higher division of sciatic nerve bilaterally mainly in the female which is very rare and unilateral higher division of sciatic nerve which is also rare. The differences in the exit routes of these two nerves are important for surgeons, as this is the area of frequent surgical manipulation, nerve injury during deep intramuscular injections in gluteal region, failed sciatic nerve block in anesthesia and injury during posterior hip operations<sup>[13]</sup>.

This study conducted by Pokorny in Czech Republic in 91 cadavers and found an atypical relationship in 19 cases (20.9%). In this study individual variations were found with the following frequency: the sciatic nerve exits below

the piriformis muscle in 79.1% of the cases. the sciatic nerve separates into two divisions above the piriformis, one branch passing through the muscle, the other below it (14.3%).an unsplit nerve passes through the piriformis muscle in 2.2%.the nerve separates into two divisions above the piriformis, one branch exiting above the muscle and passing along its dorsal aspect, the second exiting distally below the muscle in 4.4%<sup>[14]</sup>.

Turkish study conducted by Guvence in 50 gluteal regions was examined in 25 formalin-fixed adult male cadavers. The result which was found: in 52% of the cases, the SN exited the pelvis as a whole nerve without any division, whereas in 48% a high division was observed. Branches of the SN left the pelvis through the infrapiriforme foramen (IP) as two separate nerves In 24%. One branch of the SN left the pelvis through the IP and other through a different route in another 24%<sup>[15]</sup>.

This study conducted by Vloka in New York, USA, We studied the level of division of the SN in the popliteal fossa and its relationship to the common epineural sheath of the SN. The level of division of the SN sheath into TN and CPN above the knee was measured in 28 cadaver leg specimens. The SN was invariably formed of independent trunks (TN and CPN) encompassed in one common epineural sheath. The SN divided at a mean distance of 60.5 +/- 27.0 mm (range 0 to 115 mm) above the popliteal fossa crease. We conclude that the TN and

CPN leave the common SN sheath at variable distances from the popliteal crease. This finding and the relationship of the TN and CPN sheaths may have significant implications for popliteal block. When performing popliteal block, insertion of the needle at 100 mm above the popliteal crease is more likely to result in placement of the needle proximal to the division of the sciatic nerve than placement at 50 or 70 mm, according to the classical teaching<sup>[16]</sup>.

### **3. Materials and Methods:**

**3.1. Study design:** Descriptive cross sectional cadaveric based study.

**3.2. Study area:** Medical colleges of different university in Khartoum state.

**3.3. Study population:** human cadaveric bodies fixed in formalin in dissection room.

**3.4. Study duration:** the study were conducted in period between April 2014 to July 2014.

**3.5. Sample size:** 50 dissected cadaveric samples, dissected

**3.6. Data analysis:** Data was analysis by SPSS version 19.

**3.7. Methods and Tools:** identification of the sciatic nerve by dissection of the cadaver.

## **4. Results**

This study was conducted in 50 dissected gluteal and thigh regions. Eighty four were males and 2 were females the study involved unilateral samples to determine the common site of division of the sciatic nerve. The male samples

represent 96% and females sample represent 4% see table (4.1) and figure (4.1).

Right sciatic nerves were 54%, LFT 46% see table (4.2) and figure (4.2).

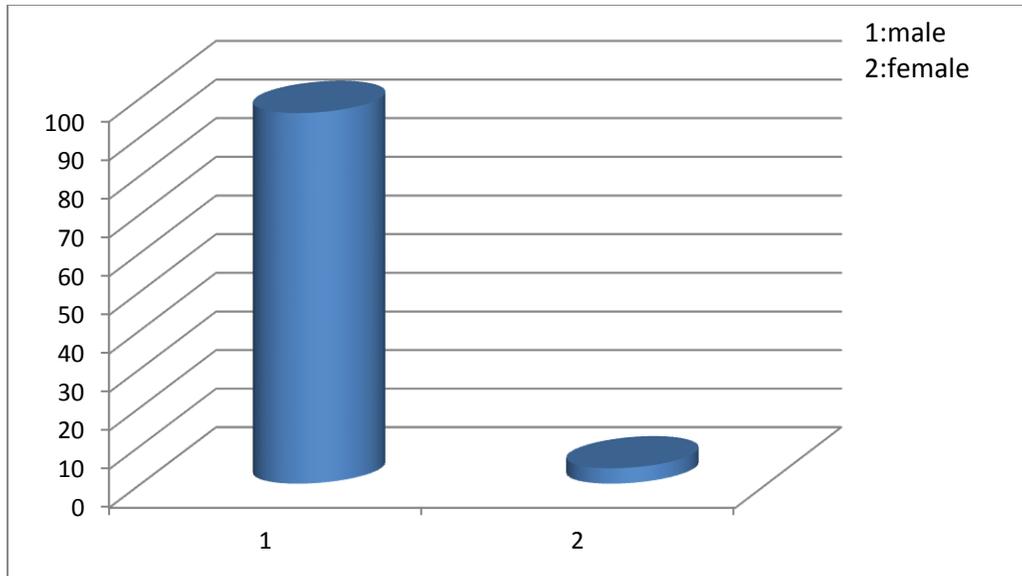
92% of sciatic nerves pass below the piriformis muscle, and 8% of sciatic nerves divide inside pelvis see table(4.3 )and figure(4.3 ). The sites of division of sciatic nerve was 8% inside pelvis , 4% in the gluteal region , 18% in the upper third of the thigh , 34% in the middle third of the thigh , 24% in the superior angle of popliteal fossa and 12% at the center of popliteal fossa see table ( 4.4)and figure(4.4 ).

The relation of the tibial nerve to piriformis muscle if the sciatic nerve divided inside the pelvis was 8% of tibial nerves pass below the piriformis muscle.

The relation of the common peroneal nerve if the sciatic nerve divided inside the pelvis was 4% of common peroneal the piriformis muscle nerve piercing the piriformis muscle and 4% pass below see table( 4.5)and figure(4.5 ).

**Table (4.1); Distribution of gender among the samples.**

Gender	Frequency	Percent
Male	48	96.0
Female	2	4.0
Total	50	100.0

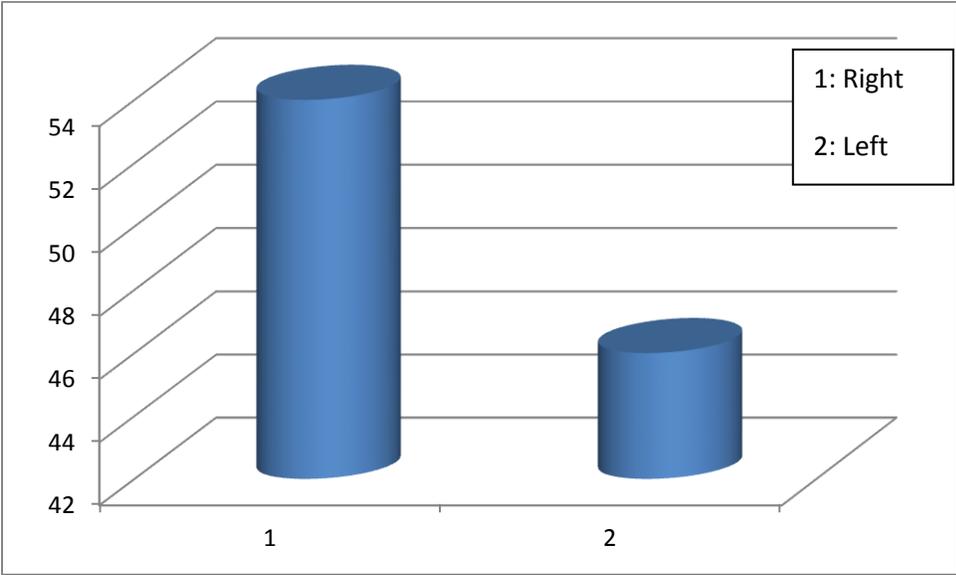


**Figure (4.1); Distribution of Gender among the Samples:**

**Table (4.2); Sciatic Nerve lateralization side (Right or Left):**

Side	Frequency	Percent
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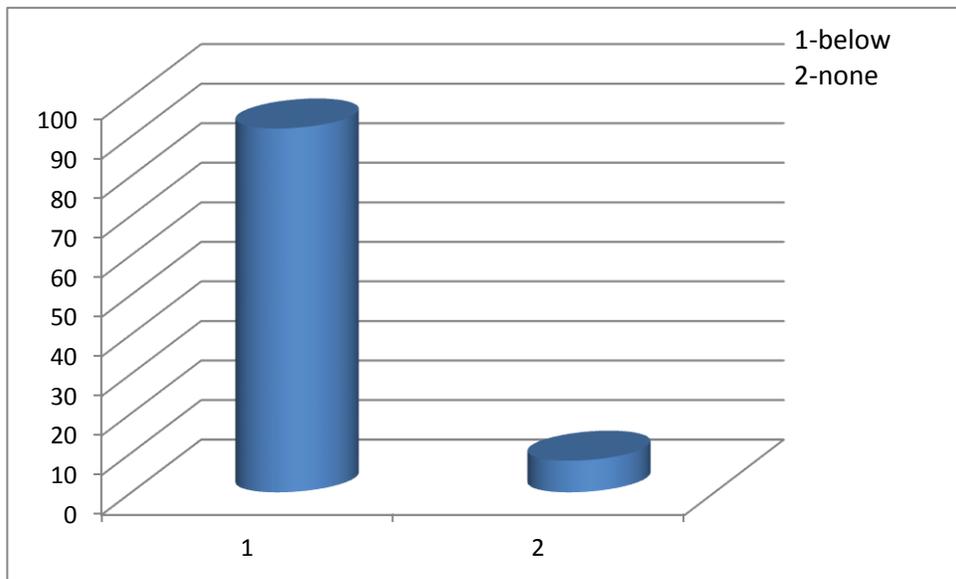
Right	27	54.0
Left	23	46.0
Total	50	100.0



**Figure (4.2); Sciatic Nerve lateralization side (Right or Left):**

**Table (4.3); Relation of Sciatic Nerve to Piriformis muscle:**

	Frequency	Percent
Below	46	92.0
None	4	8.0
Total	50	100.0



**Figure (4.3); Relation of Sciatic Nerve to Piriformis muscle:**

**Table (4.4); The Site of Division of Sciatic Nerve:**

Site division	Frequency	Percent
Gluteal Region	2	4.0
Upper Third of The Thigh	9	18.0
Middle Third of The thigh	17	34.0
Superior Angle of Popliteal Fossa	12	24.0
Center of Popliteal Fossa	6	12.0
Total	50	100.0

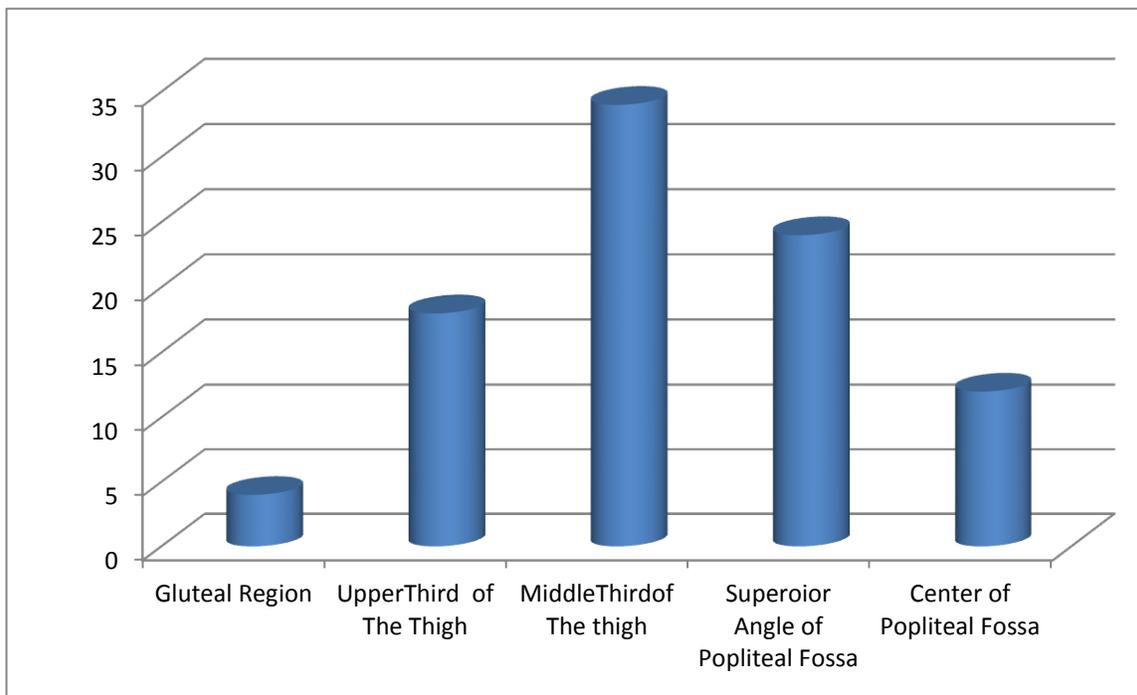
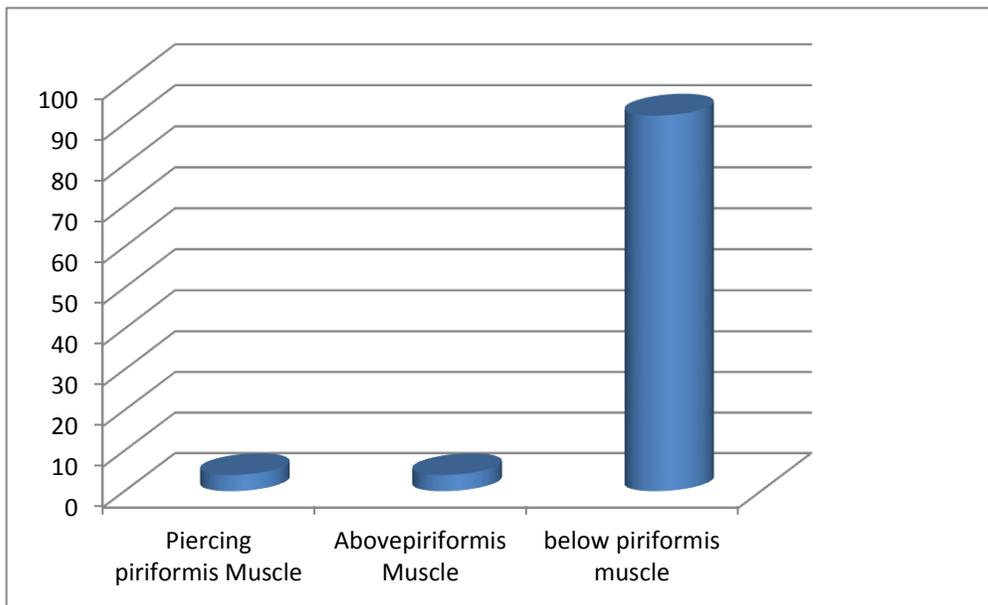


Figure (4.4); The Site of Division of Sciatic Nerve:

**Table (4.5); Relation of common peroneal nerve to piriformis muscle if sciatic nerve divided inside pelvis:**

Relation to piriformis M	Frequency	Percent
Piercing piriformis M.	2	4.0
Above piriformis M.	2	4.0
Below Piriformis M.	46	92.0
Total	50	100.0



**Figure ( 4.5 ) ; Relation of common peroneal nerve to piriformis muscle if sciatic nerve divided inside pelvis:**

## **5. Discussion:**

**Most of the text books of anatomy, orthopedic and surgery state that the sciatic nerve bifurcation levels are important in clinical and treatment aspects<sup>[2]</sup>. Normally undivided SN passes out through greater sciatic foramen below piriformis and divides at the apex of the popliteal fossa (85 to 89 %) <sup>[2]</sup>. Interpretation of the nerve variation in the limbs requires a consideration of Phylogeny and development of the sacral plexus. This study builds on previous reports in literature and re-emphasis the importance of identifying sciatic nerve bifurcation levels. Its pattern of bifurcation on the right and left side and male and female were not of significant in anatomy texts and journals. Height of an individual and level of bifurcation of the nerve are not related<sup>[17]</sup>. Topographic variations of the relationship of the sciatic nerve and piriformis muscle and its relationship was studied by Pokorny et al.<sup>[14]</sup>. The authors studied 91 cadavers and found an atypical relationship in 19 cadavers (20%). In their study, individual variations were found. According to them SN exist below the piriformis muscle in 79.1% cases, SN separates into divisions, one branch passing through the muscle and other below it (14.3%). An unsplit nerve passes through piriformis muscle (2.2%). The incidence of anatomical variation of both SN and piriformis is 15-30%.**

**The level of the sciatic nerve division and its relation to the piriformis muscle was also studied by Ugrenovic<sup>[18]</sup>. According to them SN left**

the pelvis through the infrapiriforme foramen in 192 lower limbs (96% cases), while in 8 lower limbs (4%) the variable relations between SN and piriformis muscle were detected. CPN penetrated the piriformis and left the pelvis in 5 limbs (2.5%) and TN left the pelvis through the infrapiriforme foramen. In 3 limbs (1.5%) CPN was present above the piriformis and TN was below the piriformis. The present study showed typical 92% but atypical 8% of SN (has variable relation to PM).

Sharma<sup>[19]</sup>. Observed in routine dissection of 60 years male cadaver that two divisions of SN were separate in the gluteal region on both the sides with TN passing below the piriformis and CPN piercing the piriformis muscle. The high division may account for failures in the popliteal block. Similar feature was observed in our study. The division of the SN in the popliteal fossa is related to anatomical implications for popliteal nerve blockade. Vloka<sup>[16]</sup>. concluded in their studies that SN divided at a mean distance ranging from 0-115 mm above the popliteal fossa. An ideal popliteal block is by insertion of the needle at 100 mm above the popliteal crease i.e. proximal to division of SN. Saleh<sup>[20]</sup>. Mentioned in their studies that SN division occurs at a variable level about the 50-180 mm above the knee and may account for frequent failures with popliteal blocks.

The present study had 96% male 4% cadaveric limbs with bilateral and unilateral variation in the division of SN in the different regions. On the 24% of S.N divide in the superior angle and 12% at the center of popliteal fossa. Variations in the high division of the SN and relationship between the SN and the Piriformis were studied by Guvencer<sup>[15]</sup>. Their study included 25 male cadavers. Their results was that in 52% of cases the SN exited as whole nerve without any division, whereas in 48% a high division was observed. According to them, 24% of cases CPN left the pelvis above and TN below the

piriformis and 24% of cases followed different route. Our study included 50 cadaveric limbs. The results of anatomical variations were only seen in 4 cadavers in our study with high division of SN in 4 lower limbs (8%).The differences in their exit routes of these two nerves are important clinical etiology of sciatica and require reviewing the piriformis syndrome. A rare variation in the high division of the SN surrounding the superior gemellus muscle was observed by Babinski et al <sup>[21]</sup>. In their paper they described a new anatomical variation in which the CPN passed superior and TN inferior to superior gemellus muscle. Such variations may contribute piriformis syndrome, coccygodynia and muscle atrophy. This type of variation was not seen in our study. Arifoglu et al <sup>[22]</sup>. Case reported with double superior gemellus and double piriformis muscles associated with the SN dividing high and passing between two Piriformis. It has not previously been described in the literature. Supernumerary superior gemellus and piriformis muscles may exert pressure on the SN and should be taken into account by the clinicians. Similar SN divisions were not found in our cadavers.

**Table (5.1):** below shows comparison between the results of this study and results of previous studies regarding site of bifurcation of SN.

<b>Studies</b>	<b>Typical SN</b>	<b>Atypical SN</b>
Guvence study	<b>52%</b>	<b>24%</b>
Pokorny study	<b>79.1%</b>	<b>20.9%</b>
Natsis study	<b>93.6%</b>	<b>6.4%</b>
<b>Present study</b>	<b>92%</b>	<b>8%</b>

## **Conclusion and Recommendations**

### **6.1. Conclusion**

- **The common site of SN division at the middle third of the thigh in Sudanese people.**
- **Results of the present study agree with results of previous studies done worldwide.**
- **Some times SN divides inside pelvis.**
- **Knowledge of these variations represents a very important issue for orthopedic and new surgeons.**

## **6.2. Recommendations**

- Variations of the sciatic nerve and its branches should be considered in mind during gluteal surgery.
- More studies are needed about the sciatic nerve and its correlation among different ethnic groups.
- New methods are needed to study S.N in large population includes both males and females.
- Orthopedic surgeons should be aware of the variations between the S.N and Piriformis muscle during hip surgery to reduce rate of the risk.

- Anesthetists should be aware of the thigh division of S.N at the gluteal region, so they do proper S.N block in popliteal fossa.
- During intragluteal injections awareness of the surface marking and variations of S.N division is very important to minimize the hazard of nerve injury.
- The nurse staff should be encouraged to know these variations for administration of injections.
- Further MRI studies should be carried out in patients with low back pain and Sciatica, firstly to see the variations between the S.N and piriformis muscle and secondly to correlate between these variations and low back pain.

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## **ANEXXES**

Data Collection sheet

Cadaveric study of the variation of the sciatic nerve division in Sudanese people

1. Cadaver number:

2. Gender: Male:  female:

3. Sciatic nerve: Rt:  Lt:

4. Relation of sciatic nerve to piriformis muscle:

Below:

Above:

Within:

5. The site of division of sciatic nerve at:

The Pelvis:

The gluteal region:

The greater sciatic foramen:

The gluteal fold:

Upper 1/3 of the thigh:

Middle 1/3 of the thigh:

Superior angle of popliteal fossa:

Inferior angle of popliteal fossa

Center of popliteal fossa:

**6. Relation of tibial nerve to piriformis muscle if sciatic nerve divided inside pelvis:**

Piercing piriformis:	<input type="text"/>
Below piriformis:	<input type="text"/>
Above piriformis:	<input type="text"/>

**7. Relation of common peroneal nerve to piriformis muscle if sciatic nerve divided inside pelvis:**

Piercing piriformis:	<input type="text"/>
Above piriformis:	<input type="text"/>
Below piriformis:	<input type="text"/>

**8. Symmetry pattern**

Yes	<input type="text"/>	No	<input type="text"/>
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Other variations.....

