Variations in the gluteal region and its clinical significance – A cadaveric study

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Abstract

Introduction: Anatomical structures involving muscles and nerves in the gluteal region are important as any variations of Sciatic nerve (SN) and its surrounding muscles like piriformis muscle (PM) can lead to entrapment or compression of this nerve causing sciatica and piriformis syndrome.

Aim: To find out variations in the gluteal region related to piriformis muscle and the nerves surrounding it.

Materials and Methods: The study was done on 20 embalmed cadavers (total 40 gluteal regions) during routine cadaveric dissection. The anatomical relations of the piriformis and surrounding nerves i.e. sciatic nerve, its divisions and gluteal nerves were studied.

Results: The dissection was done on 40 gluteal regions. In 36 gluteal regions (90%) the sciatic nerve emerged below the piriformis as a single trunk. While in 4 gluteal regions (10%) there was a higher division of sciatic nerve. In one cadaver we observed an accessory piriformis muscle just inferior to the main piriformis muscle. The sciatic nerve was also dividing higher up into common peroneal nerve and tibial nerve in the gluteal region. The common peroneal nerve (CPN) was observed emerging between the main and the accessory piriformis muscle. Along with it the inferior gluteal nerves were also seen traversing between the main and the accessory piriformis muscle.

Conclusion: Knowledge of anatomical variations in the gluteal region is important to explain the myalgia and neuropathies in this region. This knowledge is also important in performing hip surgeries and giving intramuscular injections in the gluteal region.

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1. Introduction

Sciatic nerve is formed by the anterior and posterior divisions of the lumbosacral plexus. It is derived from the spinal nerves L4-S3. In 85-90% individuals it divides into Tibial nerve (TN) and Common Peroneal nerve (CPN) at the apex of popliteal fossa.¹ It supplies the skin and the muscles of the back of the thigh, leg and the foot. Normally it enters the gluteal region from pelvis by coming out of greater sciatic foramen. It lies below the piriformis and then continues as a single trunk. Variations in the gluteal region involving the divisions of sciatic nerve and piriformis muscle may cause compression of sciatic nerve leading to sciatica and piriformis syndrome. These variations of sciatic nerve in the lower limb in relation to piriformis have been classified by various authors.²⁻⁸ This study was done to see any variations of sciatic nerve along with other nerves in this region and their relation to piriformis so that this knowledge can be applied while performing the hip surgeries. Moreover, the variations can be kept in mind while giving intramuscular injections in the gluteal region.

2. Materials and Methods

20 formalin fixed cadavers were used following routine cadaveric dissection on 40 gluteal regions. The study was carried out in the Department of Anatomy, HIMSR during the period of two years. Twelve cadavers were male and eight cadavers were female. All cadavers were further dissected to identify sciatic nerve and its division, glueteal...
nerves and its relation to the piriformis muscle. The sciatic nerve division and its relation to piriformis muscle was identified in order to find out if the nerve was dividing below the piriformis, above the piriformis or passing through the piriformis muscle. All the variations of the nerves surrounding the piriformis were recorded.

3. Results

In 90% of the gluteal region studied i.e. 36 regions showed the normal course of the sciatic nerve passing below the piriformis as a single trunk with no variations seen in piriformis and the surrounding structures. In 4 gluteal regions (i.e.10%) the sciatic nerve was dividing higher up and passing below the piriformis. In one case i.e. right gluteal region of male cadaver we observed an accessory piriformis muscle present below the main piriformis muscle and appearing as a separate muscle as shown in Table 1. The sciatic nerve was also dividing into CPN and TN in the gluteal region. The CPN was observed passing between the main and accessory piriformis muscle. In addition, the inferior gluteal nerves were seen traversing between the main and accessory piriformis muscle. Moreover, the CPN and TN were not uniting at any point of their course and traversed as separate nerves. As shown in Figure 1.

4. Discussion

In 1937 Beaton & Anson gave a classification for variations of SN and PM in 120 specimens. According to their classification 6 types of variations can be seen : Type 1 having undivided nerve below undivided muscle, Type 2 having divisions of nerve between and below undivided muscle, Type 3 where divisions are above and below the undivided muscle, Type 4 having undivided nerve between heads of piriformis, Type 5 where divisions are present between and above heads of piriformis and Type 6 having undivided nerve above undivided muscle.

Patel et al. studied on 86 lower extremities and found Type1 variation in 91%. Pokorny et al. found type 1 in 79% cadavers and Type 2, 3&4 in 14.3%, 4.4% and 2.2% respectively. Similarly Ugrenovic et al found Type 1 variation in 96% cases and in 4% cases they found variable relationship between SN and piriformis muscle. They also found CPN perforating the piriformis muscle in 2.5% cases while Tibial nerve leaving the below the piriformis. Our study found that in 90% gluteal regions showed type 1 where sciatic nerve was passing as a single trunk below the piriformis. In 4 gluteal regions (10%) the sciatic nerve was dividing higher up and passing below the undivided piriformis which comes under type 2.

Many authors have reported the accessory head of piriformis along with main piriformis. Natsis et al. observed two heads of piriformis where CPN and TN passed below the double piriformis in 4% cases. Only in one limb they found that nerves were piercing through the piriformis and in another limb they were passing above it. Similarly Battaglia et al. found two bellies of piriformis and CPN was passing between them. The TN was passing below the inferior border of piriformis. Jacommo et al. found in one cadaver that SN was dividing high along with an accessory piriformis muscle. They also observed that SN was dividing under the piriformis and TN was passing between accessory piriformis and superior gemillus muscle. Kabkci et al. studied in 60 fetuses that in 98.3% cases the SN was exiting below the piriformis and in only 1.67% there was a high division of SN.

Lewis et al. studied 51 corpses and found that in 89% cases the SN was undivided and passing as a single trunk below piriformis. In 8.8% CPN was seen piercing the piriformis and in 2.9% cases the CPN was passing over the piriformis. In our study we found that in 2.5% cases the CPN was passing between the main and the accessory piriformis muscle. Our study is different from all these studies as we observed the inferior gluteal nerves along with CPN passing between the main and an accessory piriformis muscle.

Inferior gluteal nerve (IGN) arises from the sacral plexus (L5,S1and S2dorsal rami). The other nerves arising from the
sacral plexus are sciatic nerve, superior gluteal nerve, the pudendal nerve and the posterior femoral cutaneous nerve.\textsuperscript{1} The inferior gluteal nerve along with the sciatic nerve leaves the pelvis through the sciatic notch and both lie below the piriformis. Inferior gluteal nerve then supplies the gluteus maximus muscle.

Sforsini et al\textsuperscript{19} observed IGN arising from posterior cutaneous nerve of thigh instead of having an independent origin. Nagarajan et al\textsuperscript{20} found a communication between common peroneal and inferior gluteal nerve and that communicating nerve was found to lie in the substance of lower piriformis.

Jacomo et al\textsuperscript{16} found common peroneal nerve passing between the piriformis and accessory piriformis muscle and then giving a branch i.e. inferior gluteal nerve.

S. L. Fahrioglu et al\textsuperscript{21} found an accessory piriformis muscle and high division of sciatic nerve. They also observe that piriformis muscle was fused with the gluteus medius muscle. They found inferior gluteal nerve, common peroneal nerve and posterior cutaneous nerve of thigh located between main and accessory piriformis muscle.

The clinical symptoms due to IGN entrapment alone cannot be differentiated from those due to entrapment of sciatic nerve, piriformis syndrome, posterior cutaneous nerve entrapment, sacroiliac joint pathology etc. Most commonly piriformis abnormality leads to several concurrent entrapment since IGN, sciatic nerve and posterior cutaneous nerve of thigh travel together.

Many authors have done MRI studies for the variations of piriformis. Polesello et al\textsuperscript{22} through an MRI study observed an accessory muscle belly of left piriformis and common peroneal nerve passed between its fibers and the standard piriformis muscle in one female patient of 45 year old. Varenika et al\textsuperscript{23} by MRI study found normal sciatic nerve anatomy in 87% case and the other 13% showed one of the division of sciatic nerve passing through piriformis and the other passing below the piriformis.

Thus the anatomical variations seen in sciatic nerve and the piriformis muscle present in gluteal region is an important cause of clinical syndrome called piriformis syndrome.\textsuperscript{14} It is characterised by radiating pain in gluteal region and the lower limb.\textsuperscript{24}

\section*{5. Conclusion}

The anatomical knowledge of the variations present in gluteal region is of utmost importance for the surgeons who perform surgeries around the hip joint and gluteal region. This knowledge is also important to the clinicians while giving intramuscular injections in this region to prevent sciatic injury. Moreover also can help in managing patients of piriformis syndrome which can be due to compression of common peroneal nerve and gluteal nerve between the piriformis and accessory head of piriformis.

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\section*{7. Conflict of Interest}

The authors have no conflicts of interest.

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