Journal of the Anatomical Society of India xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Journal of the Anatomical Society of India

journal homepage: www.elsevier.com/locate/jasi

Original Article

Variations in the level of exit and division of sciatic nerve

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ARTICLE INFO

Article history:
Received 9 April 2015
Accepted 26 August 2016
Available online xxx

Keywords:
Sciatic nerve
Piriformis
Greater sciatic foramen
Tibial nerve
Common peroneal nerve

ABSTRACT

Introduction: The sciatic nerve divides normally into the tibial and common peroneal nerves at the apex of the popliteal fossa. But the division can occur at any level from the sacral plexus to the inferior part of the popliteal fossa. When it divides within the pelvis, the two branches may leave the pelvis through different routes and may be compressed by other structures, causing non-discogenic sciatica. The aim of this study was to determine the level of the exit and of the division of the sciatic nerve.
Methods: Sixty inferior extremities were examined in 30 adult male cadavers in the Department of Anatomy, JNIMS, Imphal.
Results: Sciatic nerve divided into tibial and common peroneal nerves at the apex of popliteal fossa in 58.3% of cases, below the apex in 13.3% and above the apex in 28.4%. In 5 cases (8.4%), it divided within the pelvis where common peroneal nerve passed through and tibial nerve below the piriformis in 3 cases, both the nerves passed below in 1 case and in another case, common peroneal nerve passed between and tibial nerve passed above the heads of the piriformis.
Discussion: In sciatic neuropathy, the extent of neurological deficits depends on the level of the sciatic nerve division. Division at a higher level can result in the involvement of only one out of the two branches. On the other hand, it may result in failure of popliteal block anaesthesia.

1. Introduction

The sciatic nerve, the thickest nerve in the body; almost 2 cm wide at its origin, is formed in the pelvis by the ventral rami of the spinal nerves L4-S3. It leaves the pelvis through the greater sciatic foramen below piriformis and usually divides into the tibial and common peroneal nerves near the apex of the popliteal fossa. However, the division may occur at any level above this, though rarely below it. The common peroneal component usually passes through while the tibial component passes below piriformis if they leave the sacral plexus separately. The sciatic nerve supplies the knee flexors and all the muscles below the knee so its complete palsy will result in flail foot and severe difficulty in walking. Complete sciatic nerve palsy is very rare and for some reason, possibly anatomical, the common peroneal nerve is more usually affected causing foot drop and a high stepping gait.[1] Anatomical variations of the sciatic nerve may contribute to piriformis syndrome, sciatica, coccygodynia and muscle atrophy.[2]

Sciatic nerve, via its main branches, provides sensory supply to most of the leg and foot.[1] Popliteal fossa block provides effective analgesia after foot and ankle surgery in children.[3] An ideal popliteal block is by insertion of the needle at 100 mm above the popliteal crease, i.e., proximal to division of sciatic nerve so, the high division may account for failures in the popliteal block.[4] Thus, considering the fact that there are many variations in the course and division of the sciatic nerve and that each variation has a different and a case-specific clinical presentation, this study was carried out with the aim of determining the level of the exit and the level of the division of the sciatic nerve.

2. Materials and methods

Thirty adult male cadavers without any pathology (60 inferior extremities) were studied during routine dissection classes in the Department of Anatomy, JNIMS, Imphal. Both the inferior extremities were carefully dissected to expose the sciatic nerve. The location where the sciatic nerve exits the pelvis along with its

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http://dx.doi.org/10.1016/j.jasi.2016.08.007
0003-2778/

relation to piriformis and the level of its division were all recorded. Photographs were taken for proper documentation.

3. Results

Four types of exit of sciatic nerve from the pelvis were observed in the present study as shown in Table 1. In the majority of the cases (55 cases; 91.6%), the sciatic nerve exited the pelvis as a single undivided nerve below piriformis: E1 type (Fig. 1a). In the remaining 5 cases (8.4%), there were high division of the sciatic nerve within the pelvis with variable relationship between the branches and piriformis. E2 type of exit where both the branches passed below piriformis was seen in just one case (Fig. 1b). There was also a single case of E3 type, where the tibial nerve passed above and common peroneal nerve passed between the two heads of piriformis. In this case, there was a connection between the tibial nerve and inferior gluteal nerve with the latter also passing above piriformis (Fig. 1c). There were three cases of E4 type where the common peroneal nerve passed through and tibial nerve passed below piriformis (Fig. 1d). From Table 1, it can be seen that the common peroneal nerve passed through piriformis in four cases but not a single case of either the sciatic nerve or tibial nerve passed through piriformis.

The specimens were divided into five groups depending upon the level of division of the sciatic nerve as shown in Table 2. Maximum number (35 cases; 58.3%) of division of sciatic nerve occurred at the apex of popliteal fossa (D4) (Fig. 2c). High division within the pelvis-(D1) was seen in 5 cases (8.4%) (Fig. 1b–d), division in the gluteal region (D2) in 3 cases (5%) (Fig. 2a) and division in the back of thigh above the apex of popliteal fossa (D3) in 9 cases (15%) (Fig. 2b). Thus, overall 17 cases (28.4%) had division above the apex of popliteal fossa whereas only 8 cases (13.3%) had division below the apex, i.e., within the popliteal fossa (D5) (Fig. 2d).

Table 1
Level of exit of sciatic nerve from the pelvis.

Type	Level of exit of the sciatic nerve	Left	Right	Total	
				No.	%
E1	Single undivided nerve below piriformis	28	27	55	91.6
E2	High division with both branches below piriformis	0	1	1	1.7
E3	High division with tibial nerve above and common peroneal nerve through piriformis	1	0	1	1.7
E4	High division with common peroneal nerve through and tibial nerve below piriformis	1	2	3	5.0
	Total	30	30	60	100

4. Discussion

There are many variations in level of exit of the sciatic nerve from the pelvis. Previous anatomical studies demonstrated 15–30% variation in the relationship between piriformis and the sciatic nerve[5] and the Beaton and Anson classification[6] given below is the widely accepted method of classification of this relationship:

Type 1: Undivided nerve below undivided muscle
Type 2: Divisions of nerve between and below undivided muscle
Type 3: Divisions above and below undivided muscle
Type 4: Undivided nerve between heads
Type 5: Divisions between and above heads
Type 6: Undivided nerve above undivided muscle

The comparison of the previously published results and those of the present study as shown in Table 3 revealed a higher incidence of Type 1 and a lower incidence of Type 2 in the present study. There were no Type 3 or Type 4 variations in the present study. Type 5 and 6 variations were defined hypothetically by Beaton and Anson[6] and many studies including the present one found no case of Type 6 variation however Ozaki et al.[8] and Sayson et al.[9] each reported one case of Type 6 variation. The specific variant encountered in just one case in the present study which was described as the E3 exit where the common peroneal nerve passed between and tibial nerve above the heads of piriformis is a new variant that has never been reported in any literature till date, to the best of our knowledge, and it should fit to Type 5 variation, i.e., divisions between and above heads. Babinski et al.[2] and Mas et al.[10] each reported a single case of a rare variation where the common peroneal nerve passed below piriformis and the tibial nerve below superior gemellus. Since this variation was not described by Beaton and Anson, Guvencer et al.[11] proposed that this variation may be nominated as Beaton and Anson Type 7. In the present study, there was a single case of another rare variation where the two branches

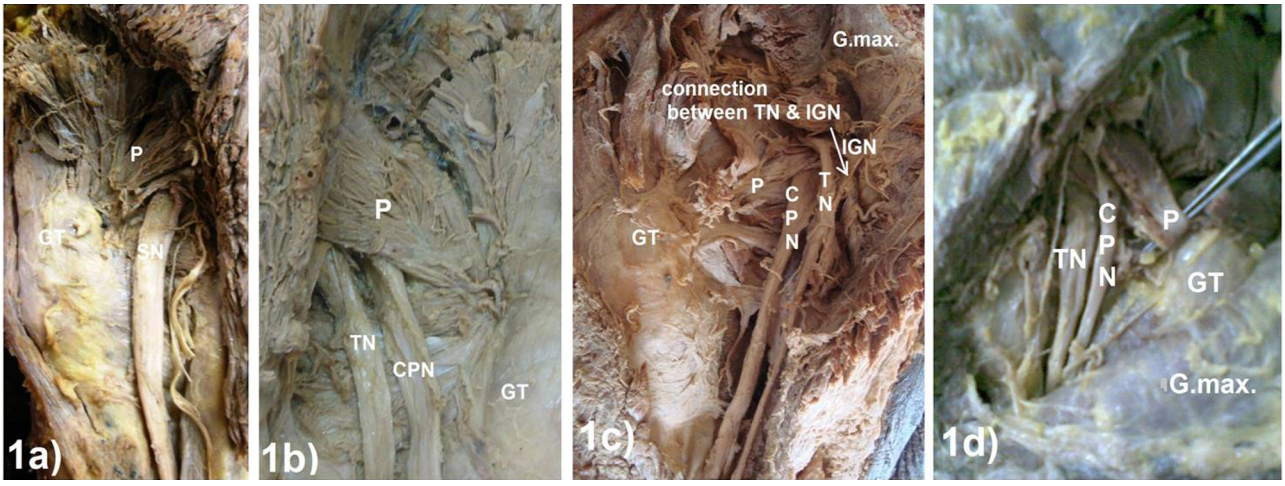

Fig. 1. Photographs showing the different levels of exit of the sciatic nerve from the pelvis. (a) E1 exit: a single undivided sciatic nerve (SN) below piriformis (P). (b) E2 exit: both tibial (TN) and common peroneal nerves (CPN) below piriformis (P). (c) E3 exit: common peroneal nerve (CPN) between and tibial nerve (TN) above the heads of piriformis (P). A connection is present between tibial nerve (TN) and inferior gluteal nerve (IGN) which also passes above piriformis and supplies gluteus maximus (G. max.). (d) E4 exit: common peroneal nerve (CPN) through and tibial nerve (TN) below piriformis (P). *Note*: GT: greater trochanter, (b–d) belong to D1 division of the sciatic nerve in the pelvis.

Please cite this article in press as: Wahengbam S, et al. Variations in the level of exit and division of sciatic nerve, *J Anat Soc India.* (2016), http://dx.doi.org/10.1016/j.jasi.2016.08.007