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VARIATION IN THE MODE OF ORIGIN AND LEVEL OF FORMATION OF NERVE TO SOLEUS MUSCLE.

Anatomy

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ABSTRACT

Variations of nerve are of immense anatomical and embryological and clinical importance. Their requisite understanding will help in increasing surgical accuracy and decreasing indisposition. In present study variations in mode of origin and level of formation of nerve to soleus was studied. The material for the present study comprised of 60 lower extremities belonging to 30 adult human cadavers obtained from Department of Anatomy, PIMS, Jalandhar. There was one nerve to soleus, found consistently. This nerve arose independently in 83.33% legs and in common origin with tibialis posterior in 16.67%.

KEYWORDS

variation, nerve to soleus.

INTRODUCTION

The superficial surface of the soleus is in contact with gastrocnemius and plantaris. Its deep surface is related to flexor digitorum longus, flexor hallucis longus, tibialis posterior and the posterior tibial vessels and tibial nerve, from all of which it is separated by the deep transverse fascia of the leg.

Soleus is supplied by two main arteries: the superior arises from the popliteal artery at about the level of the soleal arch, and the inferior from the proximal part of the fibular artery or sometimes from posterior tibial artery. A secondary supply is derived from the lateral sural, fibular or posterior tibial vessels.

There is a venous plexus within the muscle belly that is important physiologically as part of the muscle pump complex. Pathologically, it is common site of deep vein thrombosis.

Soleus is a broad flat muscle situated immediately deep (anterior) to gastrocnemius. It arises from the posterior surface of the head and proximal quarter of the shaft of the fibula; the soleal line and the middle third of the medial border of the tibia; and from a fibrous band between the tibia and the fibula (the soleal arch) that arches over the popliteal vessels and tibial nerve. This origin is aponeurotic as most of the muscular fibres arises from its posterior surface and pass obliquely to the tendon of insertion on the posterior surface of the muscle. Other muscle fibres arise from the anterior surface of the aponeurosis. They are short, oblique and bipennate in arrangement. The fibres converge on a narrow, central intramuscular tendon that merges distally with the principal tendon. The latter gradually becomes thicker and narrower, and joins the tendon of gastrocnemius to form the calcaneal tendon. The muscle is covered proximally by gastrocnemius, but below midcalf it is broader than the tendon of gastrocnemius and is readily accessible on either side of the tendon.

An accessory part of the muscle is sometimes present distally and medialy. It may be inserted into the calcaneal tendon, the calcaneus or the flexor retinaculum.

Soleus is innervated by two branches from the tibial nerve, S1 and S2. Nerve to soleus enters its superficial aspect. The nerve arise either independently or by a common trunk supply soleus on its deep surface.

Soleus is tested by plantar flexion of foot against resistance in the spine position, with hip and knee flexed: the muscle belly can be palpated separately from those of gastrocnemius.

Gastrocnemius and soleus are the chief plantar flexors of the foot. The muscles are usually large and correspondingly powerful. Gastrocnemius provides force for propulsion in walking, running and leaping. Soleus, acting from below, is said to be more concerned with steadying the leg on the foot in standing. This postural role is also suggested by its high content of slow, fatigue-resistant (type 1) muscle fibres. However, such a rigid separation of functional roles seems unlikely in man: soleus probably participates in locomotion, and gastrocnemius in posture. Nevertheless, the ankle joint is loose-packed in the erect posture, and since the weight of the body acts through a vertical line that passes anterior to the joint, a strong brace is required behind the joint to maintain stability. Electromyography show that these forces are supplied mainly by soleus: during symmetrical standing, soleus is continuously active, whereas gastrocnemius is recruited only intermittently.[1]

MATERIAL AND METHODS:

The material for the present study comprised of 60 lower extremities belonging to 30 (well embalmed) adult human cadavers of known sex obtained from the Department of Anatomy, PIMS, Jalandhar. Skin incision was made from apex of popliteal fossa till the level of tibial tuberosity. Then the superficial fascia was stripped from deep fascia starting proximally. Deep fascia from posterior surface of popliteal fossa was stripped off and the fat from its upper angle was removed to expose the tibial nerve. This nerve was followed downwards. The muscular branches to gastrocnemius arose near the middle of fossa. The heads of gastrocnemius were separated and these branches were followed as far as possible. Then the deep fascia was reflected. Bellies of gastrocnemius were identified and were lifted from underlying soleus. Medial and lateral heads of gastrocnemius were cut carefully, preserving their nerve supply. Nerve to soleus was traced from tibial nerve and subsequently tibial nerve descended deep to tendinous arch of soleus. Skin incision was extended downwards to the insertion of the muscle as calcaneal tendon.[2]

OBSERVATION:

- **Nerve to Soleus**

Soleus is supplied by two independent branches from tibial nerve, one in the popliteal fossa and other in the posterior compartment of leg.

Number:-

In the present study, there was 1 branch in 50 (83.33%) limbs (25 on right and 25 on left), 2 branches in 8 (13.33%) limbs (4 on right and 4 on left) and 3 branches in 2 (3.33%) limbs (1 on right and 1 on left).

Table no.1 Percentage distribution of number of Ns. to soleus

No. of nerves	No. of limbs with particular no. of Ns. [n (%)]		
	Right 30(100%)	Left 30(100%)	Total 60(100%)
1	25(83.33%)	25(83.33%)	50(83.33%)
2	04(13.33%)	04(13.33%)	08(13.33%)
3	01(03.33%)	01(03.33%)	02(03.33%)

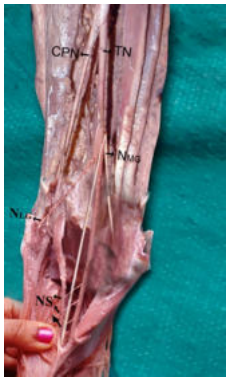

Fig.1 showing 3 nerves supplying soleus

Origin :-

The nerve to soleus arose independently in 50 (83.33%) limbs (25 on right and 25 on left) and in common origin with nerve to lateral head of gastrocnemius in 10 (16.67%) limbs (5 on right and 5 on left).

Table no.2 Percentage distribution of mode of origin of nerve to soleus

Mode of origin	No. of limbs with particular mode of origin [n (%)]		
	Right 30(100%)	Left 30(100%)	Total 60(100%)
Independent trunk	25 (83.33%	25 (83.33%	50 (83.33%)
Common trunk with N. to la head of gastrocnemius	05 (16.67%	05 (16.67%	10 (16.67%)

DISCUSSION:

Soleus appeared first in mammals and may be derivative of lateral head of gastrocnemius.[3]

Wongphaet et al [4] dissected 61 limbs and found that there was 1 branch to soleus in 45 (73.77%) limbs, 2 branches in 12 (19.67%) limbs and 3 branches in 4 (6.56%) limbs.

Table no.3 Comparison of number of Ns. to soleus

Author	Year	No. of limbs studied	No. of limbs with particular no. of Ns. [n (%)]		
			1	2	3
Wongphaet et al[4]	2005	61	45(73.77%)	12(19.67%)	04(06.56%)
Present study	2016	60	50(83.33%)	08(13.33%)	02(03.33%)

Hwang et al[5] dissected 70 limbs in which he found that nerve to soleus originated as independent branch in 49(70%) limbs and as common trunk with nerve to lateral head of gastrocnemius in 21(30%) limbs

Table no.4 Comparison of mode of origin of nerve to soleus

Author	Year	No. of limbs studied	No. of limbs with particular mode of origin [n (%)]	
			Independent trunk	Common trunk with nerve to lat. head of gastrocnemius
Hwang et al[5]	2003	70	49(70.00%)	21(30.00%)
Present Study	2016	60	50 (83.33%)	10(16.67%)

Accessory soleus is a rare anatomical variation in posteromedial aspect of ankle which is supplied by branch of tibial nerve only. It is an anomalous muscle that mimics soft tissue tumour. It may be because of exertional pain and swelling secondary to increased physical activity especially in athletes. In this situation surgical excision fasciotomy is necessary.[6]

Nerve to soleus is good donor for nerve transfer for treatment of footdrop. Transfer of soleus nerve to deep peroneal nerve is used as alternative technique for treatment of foot drops.[7]

Gastrocnemius-soleus dysfunction is a most common result of cauda equine lesions, stroke, brain injury and above all peripheral neuropathies. Temporary tibial nerve paralysis constitutes a comparable laboratory condition which allows controlled examination of aspects of these disabilities. These provide a basis for the assessment of the effectiveness of different orthotic designs in restoring a normal gait pattern.[8]

The diagnostic nerve to soleus block and neurotomy leads to spasticity and gait improvement.[9] For these purposes precise knowledge number of nerves to soleus and its mode of origin is must.

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