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Case Report

Is Anatomic Variation of Superficial Peroneal Nerve Having Medical Implication in Internal Fixation of Lateral Malleolus Fractures? A Case Report

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Abstract

Superficial peroneal nerve (SPN) is one of the terminal branches of the common peroneal nerve which innervates muscles of the lateral compartment of the leg. It is reported in literature in cadaveric studies, that there is anatomic variation of the SPN according to course and distribution and how important this finding is in many surgical interventions around leg, ankle, and foot, with scope to avoid iatrogenic damage of the respective nerve. The aim of this study is to present a woman of 67 years old who presented in emergency department after a fall with a bimalleolar fracture of the left ankle and paresthesia distribution of superficial peroneal nerve (dorsal surface of the foot, and 3rd to 5th toes) and based on this case to analyze if this anatomic variation of SPN has an essential role in lateral approach for internal fixation of lateral malleolar fractures.

Keywords: ***Superficial peroneal nerve, peroneal nerve, anatomic variation, lateral malleolar fractures, iatrogenic nerve injuries.***

Introduction

Ankle fracture is the most common fracture in emergency department after hip fractures and requisite hospitalization with an incidence of 17% [1]. Treatment of unstable ankle fractures is predominant open reduction and internal fixation with scope to restore fibular length and rotation, while the most common surgical approach is direct lateral [2]. The superficial peroneal nerve (SPN) is one of the terminal branches of the common peroneal nerve and innervates the lateral compartment of lower leg. SPN bifurcated in two terminal branches, a lateral branch the intermediate dorsal cutaneous nerve IDCN and a medical branch the medial dorsal cutaneous nerve MDCN, which procures sensitive innervations of the dorsal surface of ankle and foot [3]. There are reports for iatrogenic injury of SPN in literature, or of its branches during multiple operative procedures around the ankle and foot as ankle arthroscopy, selective anaesthetic block, fasciotomies, external fixation devices, lateral approach for osteosynthesis for lateral malleolar fracture, ankle arthrodesis or arthroplasty [5,6,7,8]. The main cause of iatrogenic injury of SPN is topographic anatomic variation which is reported from different authors and presented in their anatomic studies according to route and branches distribution [4,9,10,11]. Barret et al (2006) postulated that clinical implication of this anatomic variation of SPN or its branches is important in surgeons who operate in lateral compartment of the leg to avoid iatrogenic nerve injuries [10].

The aim if this study is to report a case with a bimalleolar fracture after a fall with referred paresthesia of superficial peroneal nerve and based on this case to analyze if this anatomic variation of SPN has an essential role in lateral approach for internal fixation of lateral malleolar fractures.

Case Report

A 67 year-old woman proceeded in emergency department, after a fall of straight high, with pain in left ankle joint, numbness in dorsal-lateral surface of the foot and dorsal surface of 3rd to 5th toes and mild oedema in region of lateral malleolar. After x-Rays, a Weber type C bimalleolar fracture was diagnosed. (**Figure 1(a)-(b)**) Medical history of patient refers lumbar spinal fusion 04-S1 because of L5-S1 radiculitis in left lower limb in the past, which after lumbar spine surgery disappeared. Patient admitted to operative theatre and under regional anesthesia, and tourniquet, a straight lateral incision 10 cm centered over fracture performed for osteosynthesis of lateral malleolar fracture. After subcutaneous tissue dissection we diagnosed the intermediate dorsal cutaneous nerve(IDCN) with course parallel of lateral malleolus and very behind the fracture line, while peroneal tendons were inferior to nerve, and diameter of the nerve was 3mm.(**Fig 2(a)**) IDCN perforates the crural fascia posterior to fibula and crosses it in the distal one third in anterior region of left ankle joint.(**Fig 3(a)**) The nerve was released and after osteosynthesis of lateral malleolar fracture it was transposed

anteriorly. Postoperatively, patient mentioned ameliorated neurological symptoms after four days and followed the protocol of rehabilitation according to this type of fracture. At final examination (one year follow-up) patient returned to previous activity without any restriction, and without pain or any neurological deficit from superficial peroneal nerve.

(a) (b)

Figure 1: Preoperative x-rays (anteroposterior (a) profil (b) views) appear a bimalleolar fracture Weber C

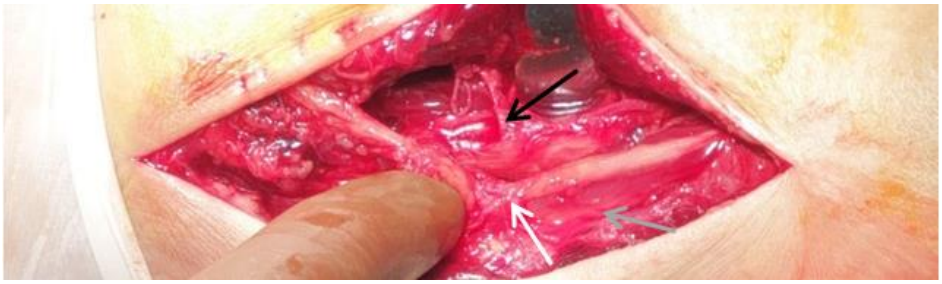

Figure 2: The IDCN (white arrow) course lateral to fibula fracture (black arrow). Peroneal tendons are posterior to nerve. (grey arrow)

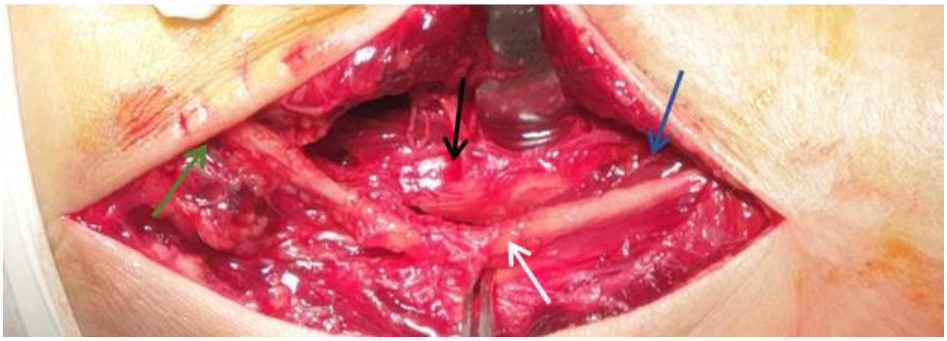

Figure 3. IDCN perforate crural fascia (blue arrow) posterior to fibula and crossed in the distal 1/3 in anterior region of ankle joint (green arrow).

Discussion

On literature review, it is revealed that many authors have reported anatomical variation of the superficial peroneal nerve. Adkinson et al (1991) report, in an anatomic study, that SPN exists in lateral compartment 74%, in the anterior compartment 14% and in 12% of cadavers the SPN was both in the anterior and lateral compartment [12]. Rosson et al(2005) in 35 lower limbs report that 43% SPN had a branch outside of the lateral compartment [13]. Styf (1989) report that five cases of 21 patients with operated legs, have an SPN course in anterior compartment while in one case SPN have a bifurcation in both lateral and anterior compartments [15].

Takao et al(1998) in 29 cadavers, investigating the anterolateral and anterocentral portal for ankle arthroscopy, classified the SPN in five types, which two branches of SPN were found in 32% in all cadavers [14]. Distance of ICDN from lateral malleolus varied from 2,3 to 4,7 cm, with the type II to be closer in lateral malleolus. In contrary Darland et al (2015) in his study report that distance between IDCN and lateral malleolus varied from 3,5± 1,2cm, while type Takao V is closer to lateral malleolus.7 Solomon et al(2001) in his anatomic research conclude that there are more than 1 SPN branch at the level of ankle joint and that many (29%) had 3 or 4 and this is important to the surgeon during operative procedure at the ankle joint [6].

Blair et al (1994) describe three variations of the SPN around the ankle and foot. Type A SPN perforated the anterior crural fascia approximately 12 cm at a higher level of the ankle and divided into two branches, the medial dorsal cutaneous nerve (MDCN) and the intermediate dorsal cutaneous nerve IDCN at a mean distance of 4 cm proximal to ankle. In type B variation, the MDCN and IDCN arise independently from the common peroneal nerve in the mid-calf, and IDCN perforated the crural fascia posterior to the fibula of about 5 cm proximal to the ankle joint and crosses the lateral border of the fibula. Finally, in type C variant, the MDCN and IDCN

originates independently and IDCN perforates the crural fascia anterior to the fibula approximately 5 cm above ankle joint and continued distally near the anterior fibular border [8]. In our case report, the anatomical variation of IDCN was type B and the distance from fibula was 1,5cm.

Kim et al(2010) agree with Blair's classification and suggest that type B variation have greater iatrogenic risk(3,8% in his series) in osteosynthesis of lateral malleolar fracture and therefore propose that careful attention during dissection and anterior transposition of the nerve may reduce iatrogenic SPN injury in open reduction and internal fixation of lateral malleolar fractures [11]. Redfern et al(2003) investigated SPN injuries following ankle fractures comparing conservative treatment with ORIF with an average of follow-up of two years and report that 9% of cases belonged in cast group and 21% in ORIF group had painful symptoms from iatrogenic SPN injuries [16]. Author suggests that the posterolateral approach is more suitable to avoid these nerve injuries [16]. Zhou et al(2008) suggest that in order to avoid the SPN iatrogenic injury the surgical approach to the upper 2/3 part of fibula must be at the posterior crural septum while in lower 1/3 at the anterior crural septum [17]. We agree with Zhou and we followed this surgical approach because we thought that is most safe for two reasons: first to avoid the risk of iatrogenic damage and second because in most of cases there is a swollen or hematoma area approximatively in anterolateral surface of lateral malleolus from the fracture.

Simultaneous injury to IDCN with lateral malleolar fracture is uncommon and in general is due to nerve injury by bony fragments or stretching nerve during mechanism of injury [18]. In case of preoperative neurological symptoms, the continuity and integrity of nerve must be explored during osteosynthesis of the fracture [11]. In our case the neurological symptoms were ameliorated in 4th postoperative day and the thought that IDCN symptoms were provoked from the injury because of stretching violence during failing of the patient.

Conclusion

Superficial peroneal nerve course present a long spectrum of anatomic variation providing a high risk of iatrogenic injury during operative procedure at the ankle joint, especially in osteosynthesis of lateral malleolar fracture. Suspicion of surgeons, about SPN variation, selection of surgical approach (posterolateral) and careful dissection of subcutaneous tissue, results in avoiding the risk of iatrogenic damage.

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Conflict of interest

The authors declare that have no conflict of interest.

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