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Anterior Approach Total Ankle Arthroplasty: Superficial Peroneal Nerve Branches at Risk

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ABSTRACT

In ankle arthroplasty, little attention has been given to intraoperative nerve injury and its postoperative sequelae. The aim of the present anatomic study was to determine the relationship of the superficial peroneal nerve to the standard anterior approach for total ankle arthroplasty. The superficial peroneal nerve was dissected in 10 below-the-knee cadaver specimens. The medial and intermediate dorsal cutaneous branches were identified. A needle was placed at the ankle joint. The following measurements were recorded: bifurcation into the medial and intermediate dorsal cutaneous branches, reference needle to the branches of the medial and intermediate superficial peroneal nerve, and the crossing branches of the medial dorsal cutaneous nerve. Two specimens (20%) had a medial dorsal cutaneous branch cross from medially to laterally. Eight specimens (80%) had a crossing branch of the medial dorsal cutaneous branch within 5 cm of the incision. No intermediate dorsal cutaneous branches were within the incision. The results from the present cadaver study suggest that during an anterior ankle approach, aberrant branches of the superficial peroneal nerve could require transection in 20% of patients at the joint level and $\leq$80% of patients with distal extension $>$35 mm from the ankle joint. The risk of injury to branches of the superficial peroneal nerve is substantial. The risk of nerve injury can be decreased with meticulous operative technique, smaller incisions, and the avoidance of aggressive retraction.

Total ankle arthroplasty (TAA) cases have steadily increased during the past 20 years, and, as such, the orthopedic community is also beginning to understand the learning curve (1). Despite the technical details involved in each case, complications have occurred at an overall rate of 12.4% at 64 months postoperatively (2,3).

The complications in TAA can be categorized into intraoperative and postoperative groups and divided into low, medium, and high grade (3). The intraoperative complications include malleolar fracture, vascular compromise, component malalignment, and nerve injury. The postoperative complications can include, but are not limited to, wound healing, arthrofibrosis, heterotopic ossification, and aseptic loosening or subsidence (4–11). Low-grade complications include intraoperative bone fracture or wound-healing problems and do not typically predispose to implant failure. Medium- or high-grade complications can lead to TAA failure and include component malalignment, postoperative fracture, subsidence, and deep infection. Most complications can be avoided by using an appropriate technique.

One reason the technique is important for the anterior ankle approach is to avoid the superficial and deep neurovascular structures. Attinger et al (12,13) and Taylor and Palmer (14) and Taylor and Pan (15) have well elucidated the angiosomes that outline the incision: the peroneal and anterior tibial arteries. These angiosomes provide an extensive network of choke vessels on which the incision relies for healing. The healing process also relies on the skin tension postoperatively, and preoperative oxygen tensiometry has been proposed (7). The superficial peroneal nerve (SPN) lies in the superficial fascial plane as it divides into the medial and lateral dorsal cutaneous branches. The variation of SPN branches and distribution has been described by multiple investigators (16,17). The SPN branches split in the anterior distal lower leg to provide cutaneous sensation to the dorsolateral ankle and foot as the intermediate dorsal cutaneous nerve. The medial dorsal cutaneous nerve supplies the dorsomedial aspect of the ankle and foot, not including the first web space, which is supplied by the deep peroneal nerve. The saphenous nerve and the lateral dorsal cutaneous nerve medially and laterally flank the distal

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foot cutaneous sensation, respectively. The anterior approach for TAA has an intimate relationship to the branches of the SPN.

Typically, the deep neurovascular structures lie just deep to the extensor hallucis longus tendon at the level of the ankle. Thus, these structures should be mobilized laterally to avoid complications. Without proper dissection and technique, neurovascular structures are at risk with an anterior approach. Seddon (18,19), Seddon et al (20), and Sunderland (21) have described 2 classification schemes for peripheral nerve injury. Seddon (18,19) and Seddon et al (20) described the injuries as neurapraxia, axonotmesis, and neurotmesis from mild to severe sensorimotor symptoms, respectively. Sunderland (21) added to Seddon's classification by expanding and relating surgical repair to each of these injuries. If a thorough understanding of the anatomic planes of dissection is present and careful manipulation

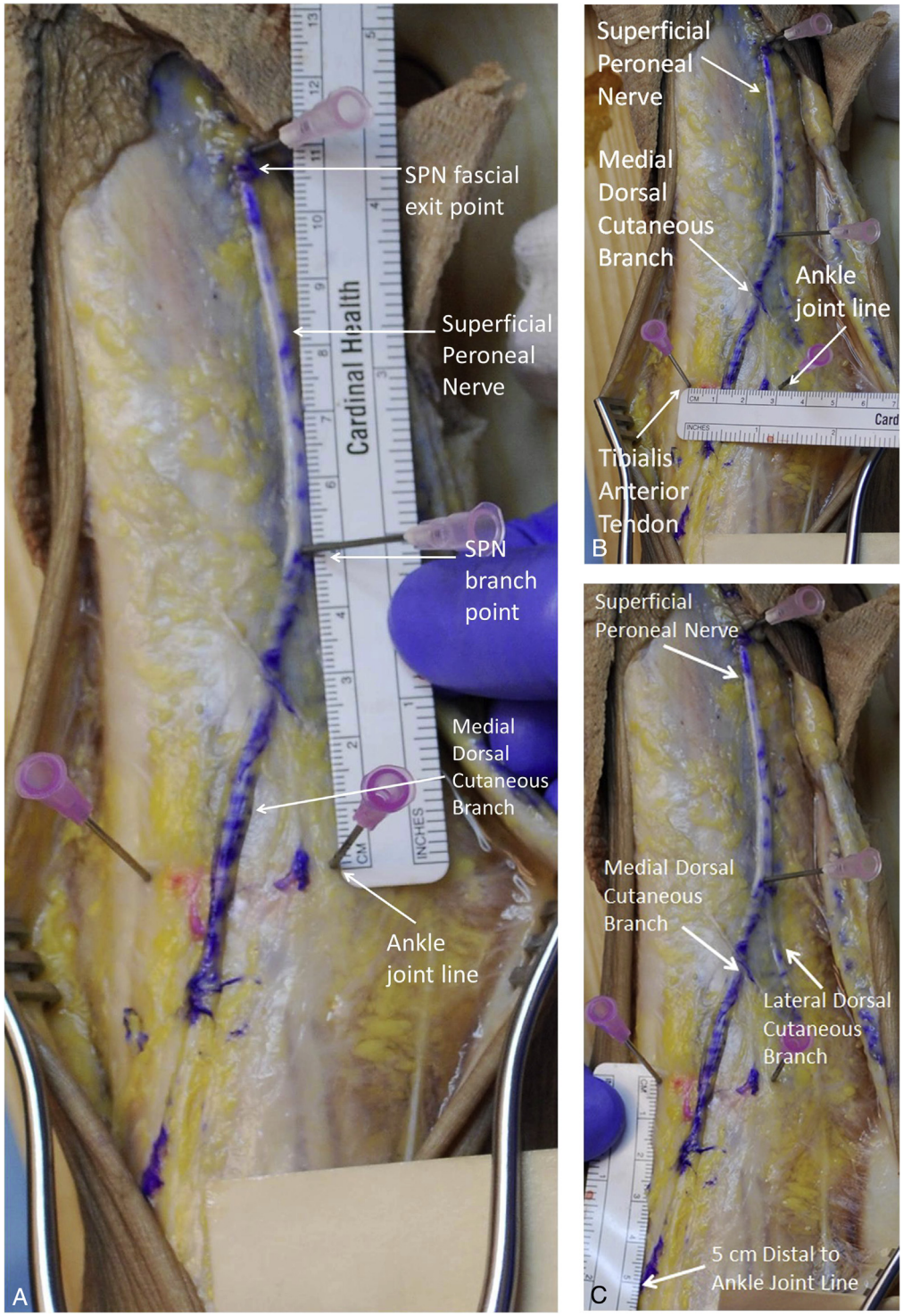

Fig. (*A*) Measurement of superficial peroneal nerve branch at fascial exit and level of branch bifurcation from the ankle joint reference line. (*B*) Measurement of medial dorsal cutaneous nerve branch at the level of the ankle joint. (*C*) Measurement of medial dorsal cutaneous nerve branch distal to the ankle joint.