Intraoperative Tibial Nerve Recording During Trauma Reconstruction and Deformity Correction with Multiplanar Ring External Fixation

Purpose

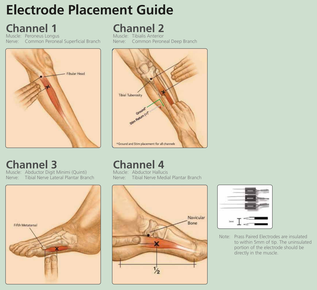
The authors illustrate the benefits of intra-operative tibial nerve testing to determine neural injury prior to and during application of a multiplanar ring external fixator for the treatment of traumatic articular injuries and deformity correction of the lower extremity.

Methods

A retrospective review of 26 patients who received intra-operative nerve recording (NIM, Medtronic) during reconstructive procedures utilizing a multiplanar ring external fixator were evaluated postoperatively and AOFAS scores were obtained. The patient population consisted of eight females and eighteen males. Seventeen of these patients underwent deformity correction of the lower extremity and the remaining nine patients received trauma reduction utilizing the multiplanar ring external fixator.

Procedures

Utilizing the intra-operative nerve-recording device, the tibial nerve was tested prior to beginning any surgical procedures in all patients who were undergoing deformity correction or trauma reconstruction of the lower extremity. The tibial nerve was tested at the distal one-third of the lower extremity and amplitude was recorded. The electrodes were placed as follows: head of the gastrocnemius muscle belly, abductor hallucis muscle belly, and the abductor digiti minimi muscle belly. After application of the multiplanar ring external fixator the tibial nerve was once again tested in the exact same position. Any decrease in amplitude when compared to the pre-operative value was an indication of iatrogenic nerve injury during the procedure and immediate wire removal and redirection was indicated.



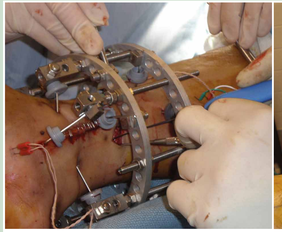


Figure 1: Intraoperative nerve testing.

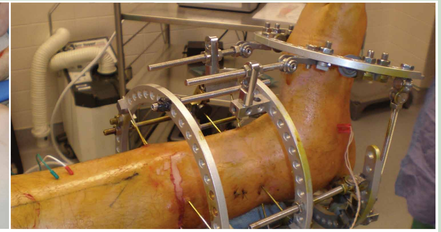


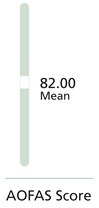
Figure 2: Placement of electrodes.

Literature Review

During the past century, external fixation has become a common method of surgical treatment for trauma reconstruction and deformity correction.[1,2] Although not a common complication, iatrogenic nerve damage has been noted with all types of external fixation including that of multiplanar ring fixators.[3,4,5] SSEP (Somatosensory Evoked Potential) has been effectively utilized to determine the extent of nerve damage with ring external fixator application.[6] The literature also demonstrates that with proper technique and understanding of anatomy, the risk of iatrogenic nerve injury can be decreased significantly.[7,8]

Results

During the review of this case series, no iatrogenic nerve damage was noted during the application of the multiplanar ring external fixators. Post-operatively several patients described numbness along varying dermatomes. This is likely due to an increase in compartmental pressures and resolved with time. The mean AOFAS score postoperatively was 82 and illustrated the sequelae associated with articular fractures such as past traumatic degenerative joint disease.



Discussion

Minimizing peri-operative complications are of the utmost importance for all surgeons. The incidence of peripheral nerve damage during application of multiplanar ring external fixation is well documented. Deformities associated with rotation of the distal tibia and severe rearfoot valgus are frequently associated with traction of the tibial and common peroneal nerves. Verifying this disease process pre-operatively or intra-operatively allows the surgeon to address these neural issues during reconstruction. The authors have also determined a prophylactic release of the tibial nerve is required during reconstruction of severe equinovarus deformities of the lower extremity.

This technique will aid in decreasing the incidence of iatrogenic nerve injury intra-operatively when applying external fixators and when correcting severe deformities. Removing the offending transosseous fixation and redirecting the fixation component can avoid permanent damage to the peripheral nerves. The authors have discovered the use of a tourniquet affects the outcome of nerve testing intra-operatively and should be avoided. In addition, the electrode sites should be marked to insure continuity of testing.

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