The surgical anatomy of the dorsomedial cutaneous nerve of the hallux

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Most techniques described for the correction of hallux valgus require exposure of the distal aspect of the first metatarsal. A dorsomedial incision is often recommended. Texts counsel against damaging the dorsal digital nerve, as a painful neuroma is an unwelcome surgical complication.

Our study on cadavers aimed to investigate the anatomy of the dorsomedial cutaneous nerve in the metatarsophalangeal region, with special reference to surgical incisions. A constant, previously unrecognised branch of the nerve was identified. This branch is likely to be damaged if a dorsomedial approach is used. It is recommended that a mid-medial incision be used instead, i.e. at the junction of the plantar and dorsal skin.

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Many operations have been described for the surgical correction of hallux valgus.\(^1\) For mild to moderate deformity the common procedures are distal osteotomies of the first metatarsal.\(^1-5\) Standard texts describe a dorsomedial approach to the metatarsophalangeal (MTP) joint and the distal aspect of the first metatarsal.\(^6-8\) Readers are warned that the dorsal cutaneous nerve is vulnerable and that care should be taken to avoid iatrogenic trauma.

The cutaneous nerve supply to the medial border of the hallux is shared by the distal branches of the superficial peroneal nerve dorsally and the medial plantar nerve.\(^9\) Some texts\(^7\) erroneously attribute the supply of the dorsomedial skin to the saphenous nerve.\(^10\) The branches of the superficial peroneal nerve on the dorsum of the foot are very variable,\(^11,12\) but usually the main trunk divides into medial and intermediate cutaneous nerves. Each divides again, and the most medial branch of the medial cutaneous nerve is the dorsomedial cutaneous nerve to the hallux. This passes as far as the level of the nail before dividing into three terminal branches.\(^13\)

Complications of surgery for hallux valgus related to cutaneous nerves include loss of sensation and the formation of a neuroma.\(^13,14\) Sensory loss was reported by Campbell\(^13\) in 45% of operations. Chaudry et al\(^15\) found similar problems after operations for hallux rigidus, undertaken using a dorsomedial approach. Meier and Kenzora\(^14\) reported an incidence of painful scars of 5% in their series. These problems are difficult to treat and a potent cause of dissatisfaction for both patient and surgeon.\(^16,17\)

Our aim was to examine the anatomy of the dorsomedial cutaneous nerve to the hallux in the region of the first MTP joint.

Materials and Methods

We dissected 15 cadavers to expose the superficial peroneal nerve from above the level of the ankle to the interphalangeal joint of the hallux. The cadavers had been preserved by techniques which maintain the plasticity of the soft tissues. The limbs more closely resembled post-mortem specimens than the traditional desiccated cadaver. One foot from each specimen was randomly selected, and the relation of the nerve to bony landmarks recorded. All measurements were made to the nearest millimetre.

Results

In all specimens a definite medial branch of the dorsomedial cutaneous nerve was identified. In 12 this was a single large branch, of a size similar to the main trunk; in three cases two smaller branches were found. All the branches followed a plantar and distal course. The origin of this branch was a mean of 20.9 mm proximal to the MTP joint. For specimens with two smaller branches the figure for the more distal was used. Measurements between the dorsomedial cutaneous nerve and identifiable anatomical landmarks are summarised in Table I. In all but one case there was a gap of at least 12 mm between the tendon of extensor hallucis longus (EHL) and the nerve. The minimum distance was 6 mm.
The proximal anatomy of the superficial peroneal nerve is very variable. Blair and Botte \(^{12}\) described three patterns of branching in the region of the ankle. On the dorsum of the foot, Canovas et al \(^{11}\) identified three different variations in a study of 30 specimens. They noted that this is fewer than the 12 patterns observed by Kosinski. \(^{18,19}\) At a more distal level the anatomy is less variable, but the number of studies is very small. Miller and Hartman \(^{10}\) studied the dorso-medial cutaneous nerve of the great toe in 12 specimens, and noted its course in relation to anatomical landmarks. Campbell \(^{13}\) recorded the constant position of the terminal branches in relation to the nail bed. None of these studies mentions a medial branch.

Three surgical approaches to the distal aspect of the first metatarsal and MTP joint are commonly used. The dorsal approach lies medial and parallel to the tendon of EHL. \(^{6}\) This is most commonly employed for surgery for hallux rigidus. \(^{20,21}\) The approach described for McBride’s \(^{22,23}\) procedure for hallux valgus is similar proximally. In this study the dorsomedial cutaneous nerve was a minimum of 6 mm from the tendon, and therefore an incision placed no more than 5 mm from the medial edge of the tendon of EHL did not compromise the dorsomedial cutaneous nerve.

The dorsomedial approach uses a more medially placed incision. It is commonly recommended by surgical texts and by authors of the standard surgical techniques for first metatarsal osteotomy. \(^{1,2,4-8,24}\) It is probably the approach most commonly used in British orthopaedic practice. This incision is extremely close to the dorsomedial cutaneous nerve, and proximally will cross the medial branch which has been identified in this study (Fig. 1). The high incidence of complications of peripheral nerves reported by authors using this approach is therefore consistent with the local anatomy. \(^{13,14}\) Many North American surgeons prefer the mid-medial approach, particularly when undertaking the Chevron osteotomy. \(^{1}\) The first reports of this technique, however, described the use of a dorsomedial skin incision. \(^{3}\) There are, to our knowledge, no reports in the literature documenting the incidence of damage to cutaneous nerves when the mid-medial approach has been used. Anecdotally, painful scar formation is less common with the mid-medial approach at the junction of the plantar and dorsal skin. Our findings suggest that this is because there is less chance of injury to the cutaneous nerve than when the dorsomedial approach is used (Fig. 1).

Injury to a nerve occurs often in surgery of the forefoot, but it is not known what proportion of damaged nerves develop a neuroma. Familiarity with the local anatomy and adequate exposure are important if inadvertent injury is to be avoided. \(^{16,25}\) The treatment of a neuroma is difficult, and prevention is preferable. \(^{17}\) The issue of informed consent arises when considering surgical complications. Guidelines suggest that the discussion between the surgeon and patient of potential complications before treatment should be ‘primarily a matter of clinical judgement’. \(^{26}\) It is difficult to justify withholding information about a complication with an incidence approaching 50%, even if that complication is relatively minor. Nerve damage after surgery to the hallux is common when the dorsomedial approach is used, \(^{1,3,15}\) and the risks should probably be discussed with the patient, preoperatively.

Our study has identified a large branch of the dorsomedial cutaneous nerve to the hallux. A dorsomedial incision in the region of the first MTP joint puts the dorsal digital nerve at risk, and will almost inevitably damage the large medial branch, which is a constant feature of the local anatomy.

Easley, Davis and Anderson \(^{27}\) have shown that operations more usually carried out through a dorsal approach can be adequately performed using a medial incision. To minimise the risk of iatrogenic nerve damage it is recommended that the dorsomedial approach be avoided.

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**Table 1.** Measurements (mm; mean; range) between the dorsomedial cutaneous nerve and identifiable anatomical landmarks for 15 feet obtained from cadavers

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Mean (Range)</th>
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<tbody>
<tr>
<td>First metatarsal length</td>
<td>58.7 (50 to 74)</td>
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<tr>
<td>Nerve crosses EHL tendon</td>
<td>7.8 (0 to 16) proximal to MT/cuneiform joint</td>
</tr>
<tr>
<td>‘Bunion branch’ arises</td>
<td>20.9 (5 to 31) proximal to MTP joint</td>
</tr>
<tr>
<td>Gap between EHL and nerve</td>
<td>13.1 (6 to 18)</td>
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References