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Lateral soft-tissue release through a medial incision: Anatomic comparison of two techniques

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ABSTRACT

Background: The distal soft tissue procedure is an integral part of hallux valgus surgery, providing soft tissue balance and alignment restoration of the first metatarsophalangeal joint. Various approaches have been established to this end. For techniques that do not include a separate dorsal incision, lateral release may be achieved via a transarticular approach or via a medial incision and a dorsal flap over the first metatarsal. Compared to the double-incision technique, these techniques are not only cosmetically superior and thus meet the demands of most surgeons and patients.
Material and methods: Using six pairs of frozen cadaveric feet, lateral release was performed using one of the above techniques in a randomized manner with pair comparison. The specimens were then dissected and the completeness of the release as well as any damage to anatomic structures was documented.
Results: The transarticular technique enabled complete release of the metatarsal-sesamoid suspensory ligament (MSL) and the transverse and oblique head of the adductor hallucis muscle in five of six specimens. The comparative technique enabled the same in only two of six cases for the adductor hallucis muscle and in four cases for the MSL. The transarticular approach achieved complete release of the lateral joint capsule in three of six specimens, whereas the dorsal approach achieved no release in any specimen. Neither of the methods caused any macroscopic injury to the surfaces of the first metatarsophalangeal joint. The examined arteries, veins, and nerves remained intact in all specimens treated with the transarticular approach, but dorsal release resulted in one documented injury to the first dorsal metatarsal artery and its concomitant veins.
Conclusions: Compared to release by dissection superficially to the extensor tendons, transarticular release provides a more complete lateral release and less injuries to neurovascular bundles. Further anatomic and clinical studies are needed, however, before conclusive recommendations can be made.

1. Introduction

The distal soft tissue procedure is an integral part of hallux valgus surgery and almost invariably serves to complement various first metatarsal osteotomies [1]. Its purpose is to balance and reposition the first metatarsophalangeal (MTP) joint [2]. For this purpose, particularly the contracted lateral structures should be released, such as the lateral capsule, the adductor hallucis muscle, the lateral metatarsal-sesamoid suspensory ligament (MSL) and, depending on the surgeon, the transverse metatarsal ligament (TML) [2]. To this end, various approach techniques have been established [2–8]. Of particular note are the techniques utilizing either a separate incision in the area of the first intermetatarsal space [3,6] or a medial approach for osteotomy [3–5,7,8]. In the case of techniques that do not include a separate dorsal incision, lateral release may be achieved via the transarticular approach [5] or by elevating a dorsal flap over the first

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metatarsal by dissecting just superficial to the extensor tendons in the first interspace using a somewhat more dorsally located medial incision [7,8]. In addition, different osteotomies have an additional option of transmetatarsal release by osteotomy [4]. Compared to the double-incision technique, these techniques are cosmetically superior, thus meeting the demands of most patients. Some authors cite additional benefits, such as the avoidance of avascular necrosis of the first metatarsal head, diminished postoperative swelling and better postoperative function [5,7,8].

The transarticular approach was studied anatomically by Lin et al. [3] and Stamatis et al. [5]. These studies, however, yielded conflicting results. Based on their study, Lin et al. [3] concluded that both transarticular release and release via a separate incision in the area of the first intermetatarsal space produce inconsistent and irreproducible results, whereas Stamatis et al. [5] concluded that the transarticular release is consistently reproducible and easily performed. To our knowledge, the reliability of release by elevating a dorsal flap over the extensor tendons has not been evaluated previously in an anatomic study.

In the present study, we examined transarticular release in further detail, and compared both standard lateral release techniques without a separate incision (the transarticular approach vs. elevating a dorsal flap over the extensor tendons). Our hypothesis was that the transarticular approach results in a more complete release and causes less collateral tissue damage.

The main goal of this study was to show the differences between both techniques, including their potential pitfalls, to help foot and ankle surgeons select and perform the appropriate technique.

2. Material and methods

The cadaveric study was performed on six pairs (4 female) of isolated human lower leg-foot specimens. Until utilization, the specimens were stored at approximately −18 °C. The mean age of the deceased was 78.8 (range, 71–88) years. The specimens showed no evidence of prior trauma or any other prior bone disease or deformation, specifically the feet did not show any hallux valgus deformity Written consent of cadaveric donors for medical research/academic purposes was available. The Ethics Committee approved this human specimen study.

All surgeries were performed by an experienced foot and ankle surgeon who was equally familiar with both techniques. As in the procedure by Lin et al. [3] the length of incision was selected according to the principles of combined distal and proximal procedures. Using one of the two methods described below, the goal of the distal soft-tissue procedure was to release the following structures on each specimen: the oblique and transverse head of the adductor hallucis muscle, the lateral MSL and the joint capsule.

At the end of each procedure the great toe was brought into varus to prove sufficiency of the release. If 30° of varus angulation at the MTP joint could not be achieved manually, the steps of the release were repeated.

2.1. Release by elevating a dorsal flap over the extensor tendons (Fig. 1)

This procedure was performed in accordance with the procedure by Lee et al. [7]. First, the first metatarsal was located. The skin incision stretched across the entire metatarsal from the first tarso-metatarsal (TMT) joint to the MTP joint. To this end, the incision was carried across the dorso-lateral border of the first metatarsal and ended medio-dorsally over the MTP joint, therefore deeper dissection was then done as it is done in the commonly used dorsal approach. Therefore a scissor was used to expose the first intermetatarsal space. By retracting the lateral wound edge and the extensor tendons using a tissue retractor, both the common insertion of the transverse and oblique head of the adductor hallucis muscle and the lateral sesamoid bone of the first ray were exposed. Next, the adductor hallucis muscle and the deep TML were released using a scalpel (proximal to distal), taking care to carefully identify and minimize injury to the neurovascular bundles of the first interspace. A horizontal medial capsulotomy of the first MTP joint was performed, and the medial exostosis on the first metatarsal head was ablated using LEXA®-Blades (Wright Medical Deutschland GmbH, Raisting, Germany).

If 30° of varus angulation at the MTP joint could not be achieved manually, the steps of the release were repeated.

2.2. Transarticular release (Fig. 2)

This procedure was performed in accordance with the procedure by Lin et al. [3]. The incision was carried from the plantar aspect medially along the inferior border of the first MT and again extended from the first TMT joint as far as the MTP joint. As the first step, horizontal medial capsulotomy of the first MTP joint was performed and a medial exostosis ablated in the manner detailed above. The next step was the transarticular severing of the MSL and lateral soft-tissue release with a no. 15 scalpel blade above the lateral sesamoid bone approaching from the plantar aspect of the foot. Subsequently, a McGlamry elevator was used to further release the lateral MTP joint capsule. If a 30-degree inward (varus) turning of the big toe was not achieved, the release was repeated.

Next, the anatomic structures were exposed. To this end, the neurovascular bundles were mapped and marked in color. Next, the distal first metatarsal was removed. The quality of both examined procedures was assessed based on the potentially complete release of the lateral capsule of the first MTP joint, the lateral MSL, and both insertions of the adductor hallucis muscle. In addition, damage to joint cartilage and neurovascular bundles due to surgery was determined.

Completeness of the lateral joint capsule release was defined as followed: the capsule was dissected from the lateral wall of the metatarsal one in a range of ≥75°.

3. Results

The results are summarized in Table 1. A complete release of the transverse and oblique heads of the adductor hallucis muscle was achieved with the transarticular technique in five of six specimens (Fig. 3). In the comparative technique employing dissection superficially to extensor tendons, release was achieved in only two of six cases. None of the specimens presented a separate insertion of the adductor hallucis muscle in the proximal phalanx.

The lateral MSL was completely severed in five of six cases using the transarticular approach, and in four of six cases using the dorsal technique. The lateral joint capsule was completely released in three of six specimens treated with the transarticular approach, and in none of the cases treated with the dorsal release. None of the studied methods caused macroscopic injury to the surfaces of the first MTP joint.

Regarding damage to the neurovascular bundle, the transarticular method fared better. In all specimens treated with the transarticular approach, the examined arteries, veins, and nerves remained intact, whereas in the dorsal release, damage to the first metatarsal artery and its concomitant veins was documented in one case (Fig. 4).

4. Discussion

The potential advantages of the medial approach were summarized as follows by Dayton et al. [9]: (1) good access to both sesamoid bones; (2) superior range of motion of the MTP joint