CHAPTER 3

PERPENDICULAR TALAR DOME ACCESS FROM VARIABLE CHEVRON MEDIAL MALLEOLAR OSTEOTOMIES

Cameron L. Eilts, DPM

INTRODUCTION

Perpendicular access to medial talar dome osteochondral lesions may be necessary for treatment of these lesions using methods of osteochondral autologous transplantation or synthetic plug implantation for resurfacing of the talar surface in large defects. The inherent use of the instrumentation used for these techniques requires a perpendicular approach to the talus to provide a smooth articular surface. Several procedures have been described to achieve access to these lesions (1-9). Some studies have shown promising results with various resurfacing procedures (10, 11).

Osteotomies carry a potential risk of increased morbidity compared to arthroscopy or arthrotomy alone. However, the access necessary to adequately treat the osteochondral lesion may not be possible with these approaches. If an osteotomy is necessary, the ideal orientation would allow for adequate access to the lesion for the desired procedure, limited damage to the articular surface and surrounding structures, and stable fixation.

The purpose of this study was to compare the perpendicular talar dome access gained using variable starting points at variable angles of approach in a chevron osteotomy of the medial tibia. An attempt was made to use clinically reproducible methods to provide a correlation with the site of the lesion and the specific location and angulation of the medial malleolar osteotomy necessary to achieve access for treatment of a talar dome lesion.

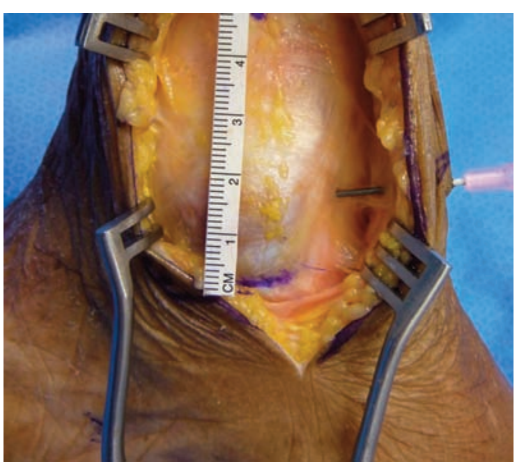

Figure 1. The distal tip of the medial malleolus is marked and used as a reference for the apex of the chevron osteotomy.

MATERIALS AND METHODS

Twelve fresh cadaver specimens were used for this study. Soft tissue dissection consisted of a long, curvilinear incision overlying the distal medial tibia. Dissection was carried to the level of the deep fascia. The starting point of each chevron osteotomy was measured proximally from the distal tip of the medial malleolus using a paper ruler (Figure 1). This area was then marked as the apex of the osteotomy, which was at the midpoint between the medial gutter and the posterior-medial crest of the tibia. The angle of the osteotomy was then determined by using a .045 Kirschner wire (K-wire) as an axis guide at the apex. Using a goniometer, the angle of the axis guide (K-wire) to the leg was measured at an angle to the anteromedial tibial surface (Figure 2).

Figure 2. The angle of the axis guide is formed by the medial tibial surface and the 0.045 Kirschner wire.

Table 1

The column on the left represents the angulation of the axis guide to the leg. The top row represents the distance from the palpable tip of the medial malleolus to the apex of the chevron osteotomy. The resultant exposure is measured in centimeters, and is measured from the medial shoulder of the talus.

	2.5 cm	3.0 cm	3.5 cm	4.0 cm
30°	0.3 (cm)	0.5(cm)	0.8(cm)	1.3(cm)
35°	0.5	0.9	1.1	1.6
40°	0.7	1.0	1.3	1.6

A periosteal incision was then made in line with the chevron osteotomy site. The posterior tibial tendon sheath was incised posteriorly and then extended distally to allow for additional mobility of the malleolus and for retraction of the tendon (Figure 3). Anteriorly, the ankle capsule was incised overlying the medial gutter in line with the periosteal incision to allow for greater mobility of the medial malleolus. Each osteotomy was then performed using a sagittal saw at varying angles and starting points (Table 1). Care was taken to first score the intended line of osteotomy, then proceed directly in line with the axis guide on both the anterior and posterior sides of the wire. The surface of the tibial plafond was felt with the saw blade. It was found to be advantageous to "score" this surface as well, but not puncture through to the ankle joint with the saw blade. A 10 mm osteotome was then used to lightly complete the osteotomy into the ankle joint, without damaging the articular surface of the talar dome.

The medial malleolus was then retracted medially using a self-retaining retractor. A 0.062 K-wire was used to create holes in the talar dome perpendicular to the articular surface while everting the foot (Figure 4A). The total area contained within these margins was then measured using a paper ruler and digital caliper from the medial shoulder of the talus extending laterally (Figure 4B). The entire anterior-to-posterior area of the medial talar dome was accessible by dorsiflexing or plantarflexing the ankle as needed.

RESULTS

The measured perpendicular access for each osteotomy is presented in Table 1. Each measurement represents the distance from the medial shoulder of the talus to the hole created by the K-wire. The distances show a predictable linear relationship. Generally, as the angle of the osteotomy measured from the medial surface of the tibia increases, so does the accessible perpendicular surface area of the dome of the talus. The same is true for the apex of the osteotomy measured as the distance from the tip of the medial malleolus. As the apex of the osteotomy begins more proximal, the surface area of the dome of the talus that is available for perpendicular access increases. The anterior-to-posterior access was consistent in that the entire surface was accessible due to the nature of the chevron osteotomy. The apex of the "V" allowed the K-wire to be in a perpendicular orientation for the entire anterior-to-posterior medial surface simply by plantarflexing and dorsiflexing the ankle.

DISCUSSION

The concept of a medial malleolar osteotomy for treatment for osteochondral lesions of the talus is not new, nor is it always necessary. Several authors have discussed the accessibility of the medial talus. In a study examining arthrotomy and osteotomy with resultant talar surface area exposed, Muir et al found that the majority of the talar dome can be accessed without osteotomy (12). They used 9 cadavers with 7 different procedures performed on each specimen. The talus was divided into segments using a grid system in the sagittal and transverse planes. The medial osteotomy was then assessed in its effectiveness by its resulting exposure of the medial one-third of the talus. Their method of osteotomy was a medial tibia cut-down as described by Alexander and Watson (8). This consists of a biplanar step-cut osteotomy where the medial component is oblique, aiming inferior and lateral.

The second component is a vertical arm that then joins the oblique cut at the level of maximum concavity on the medial tibial plafond. After osteotomy, these authors found the entire medial one-third of the talar dome was accessible. The exact measurements of the access were not given, nor were the dimensions of the osteotomy itself; so that it may be difficult to replicate the step-cut and guarantee adequate exposure for a medial talar lesion.

With advanced imaging studies such as magnetic resonance imaging (MRI) and computed tomography (CT), the exact location and depth of a talar osteochondral lesion can be located within millimeters. The efficacy of MRI to locate these lesions was shown in a retrospective evaluation of 424 patients with osteochondral lesions of the talus. The location of the lesion was allocated to 1 zone of a 9-zone grid system on the talar dome using MRI. Nearly 63% of all total lesions were located within the medial one-third zone of the talar dome surface, with most (82%) of these in the central "equator" portion of the medial shoulder. Lesions in the medial third were significantly larger in surface area and deeper than the

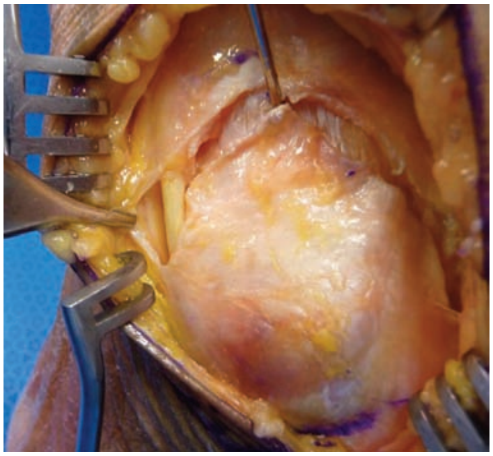

Figure 3. The incisional approach to the periosteum and posterior tibial tendon is demonstrated. Also, the anterior ankle capsule is incised to allow for reflection of the medial malleolus inferiorly and free from the medial talar dome.

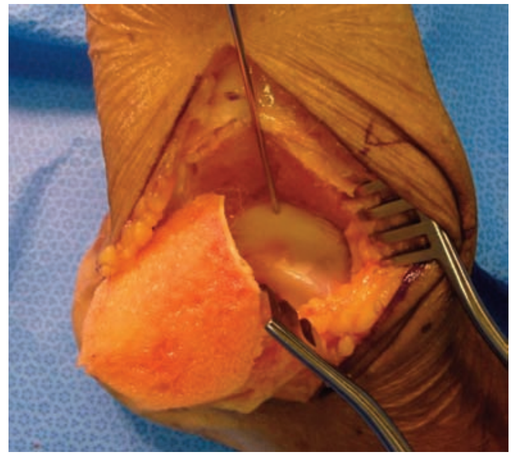

Figure 4A. After the chevron osteotomy, the malleolus is retracted and a 0.062 Kirschner wire is used to simulate perpendicular access to the talar surface.

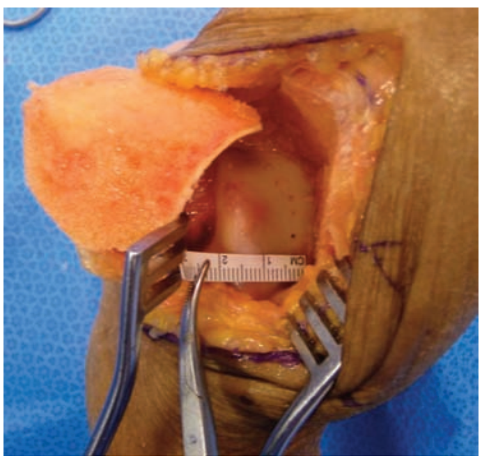

Figure 4B. The distance from the medial shoulder of the talus to the holes is measured with a paper ruler then confirmed with a digital caliper.

Figure 5. Intraoperative use of goniometer and axis guide.

lesions in the lateral portion. The mean area of these lesions was 93.1 mm2 and the mean depth was 6.3 mm (13). Clearly, a large percentage of talar osteochondral lesions may require open access for treatment, whether that treatment consists of drilling, autologous transplant systems, allograft, or synthetic plug implantation.

If surgical treatment is the choice, and perpendicular access is needed, then adequate exposure is fundamental. Ideally, a medial malleolar osteotomy would be non-traumatic to the weight-bearing surface of the ankle joint, technically easy to perform, allow for perpendicular screw fixation, and provide adequate exposure for treatment. The results of this study show that starting the osteotomy more proximal and at a larger angle relative to the leg results in more perpendicular surface area, which is available to a point, after which the medial cortex of the tibia will hinder access, unless a more proximal location is used. Once the distance of the osteotomy reached 4 cm proximal to the tip of the medial malleolus, there was very little if any increase in the amount of the talar dome that was available for perpendicular access despite changes in the angle of the osteotomy. This is demonstrated by the same amount of exposure gained, despite increasing the angle of the osteotomy when starting 4 cm proximally. The author believes this is secondary to the curved surface of the distal portion of the medial malleolus.

Approximately 3.0-3.5 cm above the distal tip of the malleolus the tibia begins to flatten as it enters the diaphyseal portion of bone such that a more proximal apex for osteotomy would have little effect on available access to the talar dome. From the results shown above, the ideal placement of the apex could be 3.5 cm above the palpable tip of the medial malleolus at an angle of 35 degrees from the medial surface of the tibia. The dimensions of this osteotomy will provide approximately 1.0 cm of perpendicular access from the medial shoulder of the talus extending laterally. This degree of exposure would provide access for most medial lesions since the talus is approximately 3 cm wide (13). Starting the osteotomy 4.0 cm proximally from the medial malleolus will result in more perpendicular surface area, but this also results in the osteotomy extending further laterally on the weight-bearing portion of the articular surface. If the osteochondral lesion does not extend laterally beyond 1 cm from the medial shoulder of the talus, then the apex of the osteotomy does not need to be more than 3.5 cm proximal to the tip of the medial malleolus on a 35 degree angle from the leg. The advantage of the chevron osteotomy in this application is the shape: the apex of the "V" provides a natural opening for perpendicular access without the need of a transverse or step-cut osteotomy which could potentially cause more damage to the main weightbearing surface of the ankle joint.

Disadvantages of this study include a relatively small sample size. Ideally, multiple osteotomies of the same measurements would be performed on several subjects of varying dimensions themselves. It is possible that the cadaver specimens would allow for more or less mobility than a live subject. Also, the amount of soft tissue present could potentially alter the measured angle from the leg. In an obese patient, the increased soft tissue covering over the tibia could result in some variation in the angle of the osteotomy compared to a leg with less girth. It would appear in this circumstance, the angle of the axis guide could be shifted medially, in essence increasing the angle of the osteotomy. This potential problem could be circumvented by confirming placement with fluoroscopy intraoperatively.

The results of this study show a predictable area of exposure of the medial talar dome which can be achieved by using a precise location and angulation of an osteotomy which can be reproduced in a surgical setting. Preoperative imaging studies can demonstrate the exact location of an osteochondral lesion, and the surgeon can then perform the osteotomy at accurate measurements, knowing how much exposure will be available for perpendicular access of the medial talar dome.

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