CHAPTER 9

CALCANEOCUBOID JOINT DISTRACTION ARTHRODESIS

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The surgical management of adult acquired flatfoot deformity is challenging. Detailed clinical and radiographic examination, appropriate patient and procedure selection, and a comprehensive understanding of the etiology of the deformity are essential. An appropriate stabilizing procedure should preserve mobility whenever possible. "To create stability at the least possible cost to mobility" should be the basic tenant in the selection of appropriate surgical management of symptomatic collapsing flatfoot conditions and posterior tibial tendon dysfunction.

Mueller classifies posterior tibial tendon dysfunction into four categories. This classification describes the appearance and location of the tendon rupture. The hallmark of posterior tibial tendon dysfunction is a resultant collapsing pes valgo planus deformity of varying degrees.

Calcaneocuboid distraction arthrodesis is a relatively new approach in the surgical management algorithm of severe adult acquired collapsing pes valgo planus deformity. The condition is characterized by a transverse plane dominant deformity; a lateral (abductory) peritalar subluxation is evident both clinically and radiographically. Disabling pain and progression of symptoms is evident in more severe acquired flatfoot deformity and also in conjunction with end-stage posterior tibial tendon dysfunction.

Relocation of the midtarsal joint by distraction arthrodesis at the calcaneocuboid joint redirects and aligns the subluxed talonavicular joint, and has a stabilizing effect on the subtalar joint. This addresses the apex of the deformity and also provides stabilization of the medial column of the foot. The procedure also preserves protective motion at the subtalar and talonavicular joint, which is necessary for absorption of ground reactive forces encountered in ambulation and athletic endeavors. This procedure and technique is introduced as an arthrodesing alternative in the management of severe posterior tibial tendon dysfunction and acquired (non-neurogenic) collapsing adult pes valgo planus deformity.

PATIENT SELECTION

An appreciation of the pathomechanics involved in the development of the adult flatfoot deformity is prerequitsite. Determination of gastrocnemius-soleus equinus deformity and its contribution to the acquired flatfoot condition is important to the successful management of the disorder in adults. If present and determined to be significant, appropriate posterior lengthening is indicated. An evaluation to exclude neurogenic conditions and disease states such as arthritis is also important prior to proper surgical intervention. Relative indications for this reconstructive procedure are summarized in Table 1.

Table 1

RELATIVE INDICATIONS

Progressive pain / symptoms / fatigue
Postural compensatory symptoms
Severe posterior tibial tendon dysfunction
Inability to invert against passive resistance
Severe transverse (sagittal) plane subluxation (MTJ)
- "Too many toes sign"
- Inability to perform single heel raise

Soft tissue reconstruction / augmentation deemed inadequate
Arthrodesing procedure indicated

These patients are recalcitrant to conservative treatment and continue to have considerable disability and pain. Posterior tibial tendon rupture or relative dysfunction is evident clinically. Moderate to severe talonavicular joint subluxation is evident, however, no clinical, radiographic or significant arthritic changes are noted at the subtalar or midtarsal joint. Additionally, surgical candidates for this procedure are generally candidates for an arthrodesing procedures, and therefore are informed of the expected outcomes and possible functional limitations. Soft tissue

augmentation of the dysfunctional posterior tibial tendon may be contributory and performed as an adjunctive procedure.

TECHNIQUE

The technique described is the author's modification of the surgical technique taught by Sigvard T. Hansen, Jr., M.D., Harborview Medical Center, Washington (personal communication and observation). A lateral approach for exposure to the calcaneocuboid joint is employed using the principles of anatomic dissection. Incision placement is planned to avoid injury to the sural nerve and to maintain the deep fascia and peroneal tendons.

Exposure of the calcaneocuboid joint and appropriate removal of adjacent cartilaginous surfaces is performed. A posterior iliac bone block is harvested from the ipsilateral posterior iliac crest. Care is taken to distract the calcaneocuboid joint intraoperatively, which realigns the subluxed talonavicular joint, and recreates a relative rectus alignment of the midtarsal and subtalar joint. While distracting the calcaneocuboid joint, an appropriately-sized autogenous bone graft is then fitted and incorporated to serve as a distraction bone block, hence, serving as a resistive mechanical block correcting the lateral peritalar subluxation at the talonavicular joint.

AUTHOR'S ILLUSTRATED TECHNIQUE

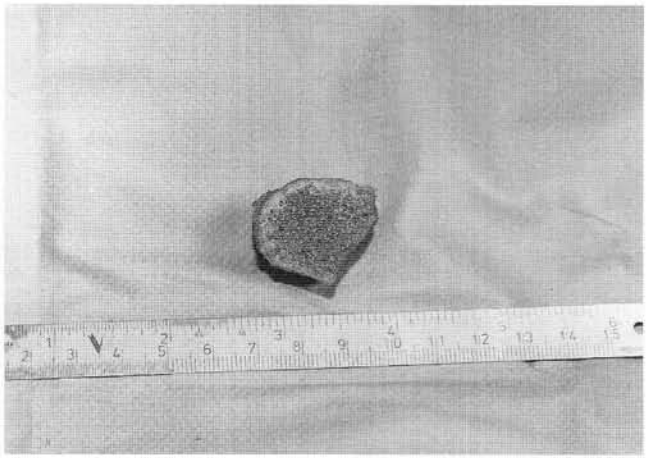

Figure 1. A sizable autogenous posterior iliac bone graft that is well-suited for interposition at the calcaneocuboid joint. It possess strong cortical bone and a generous cancellous component thus providing both osteoinduction and osteoconductive components.

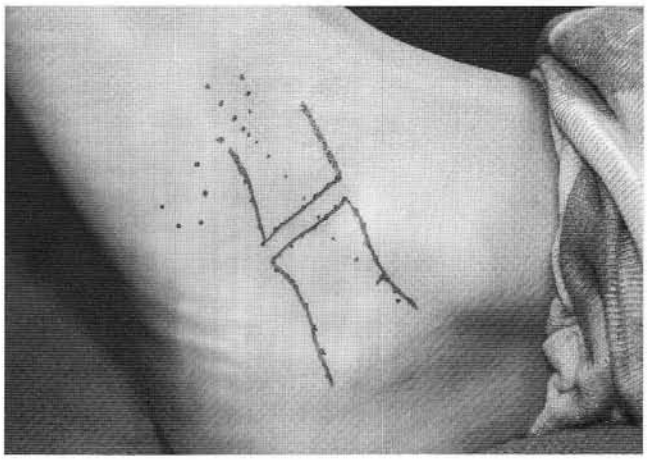

Figure 2. Incision approach to the calcaneocuboid joint region. The sural nerve is inferior to the incision and should be avoided.

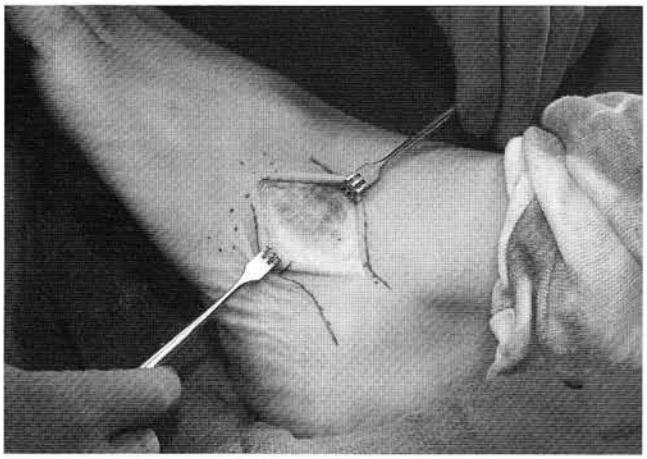

Figure 3. The incision is deepened to the level of the deep fascia covering the EDB muscle and peroneal tendons.

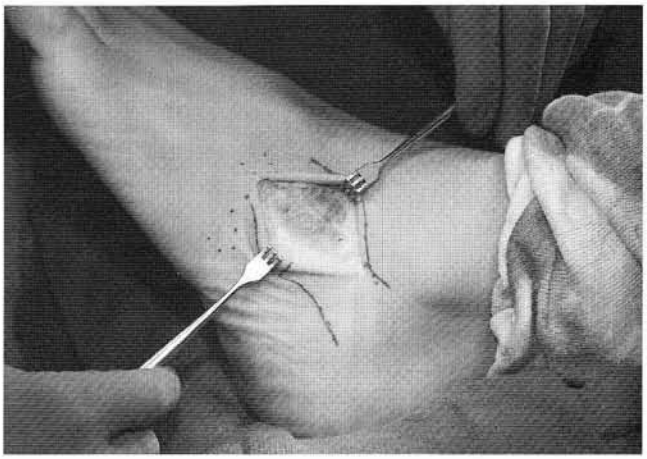

Figure 4. The deep fascia is identified. The incision is placed superior and parallel to the peroneal tendons at the level of the extensor digitorum brevis muscle.

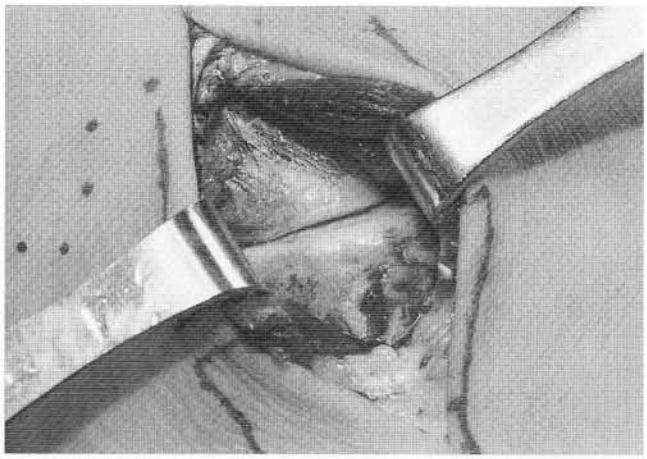

Figure 5. Anatomic dissection is completed and the joint visualized and exposed.

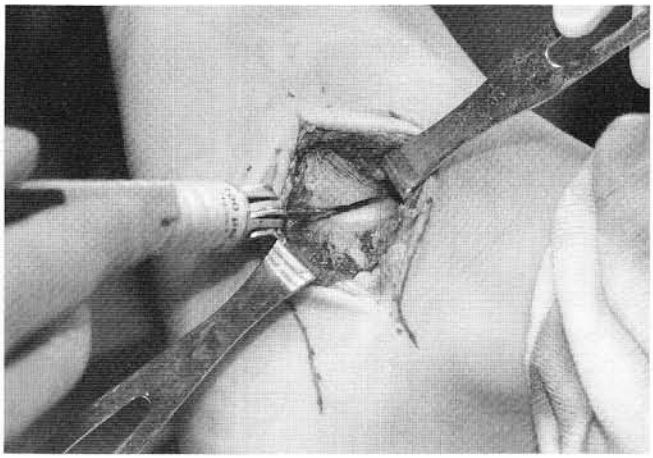

Figure 6. Minimal bone resection is performed parallel to the adjacent joint surface to preserve length.

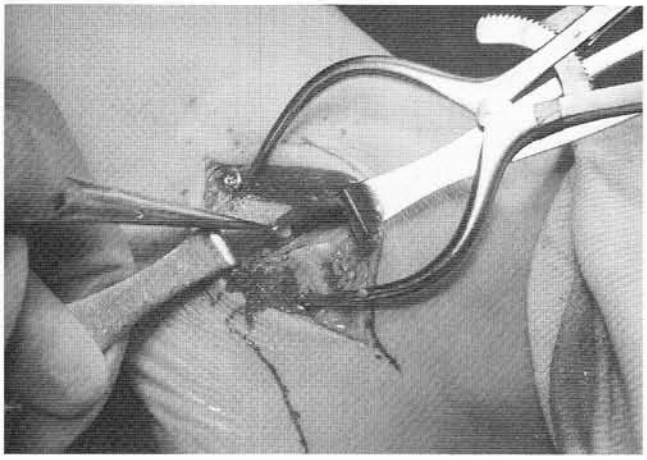

Figure 7. The curettage technique is employed to remove any remaining articular cartilage and assist with preservation of length of the calcaneus and cuboid segment.

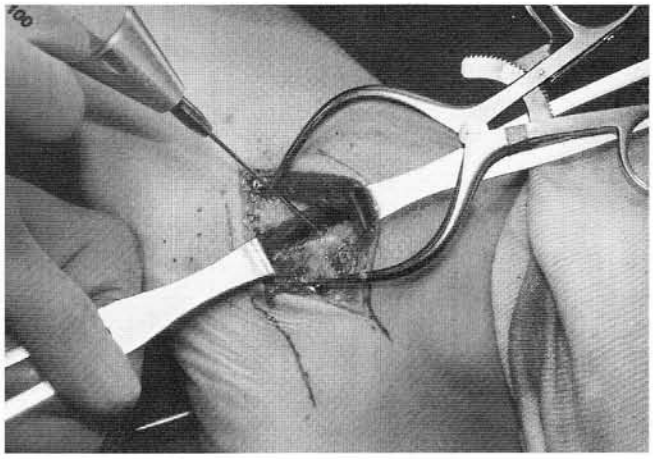

Figure 8. Subchondral drilling is used to promote primary graft healing.

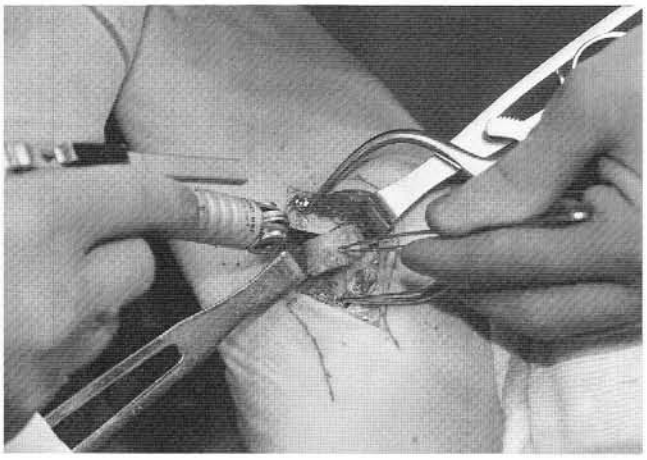

Figure 9. Initial interposition of the bone graft and reciprocal planning technique to preserve the length and insure proper fit.

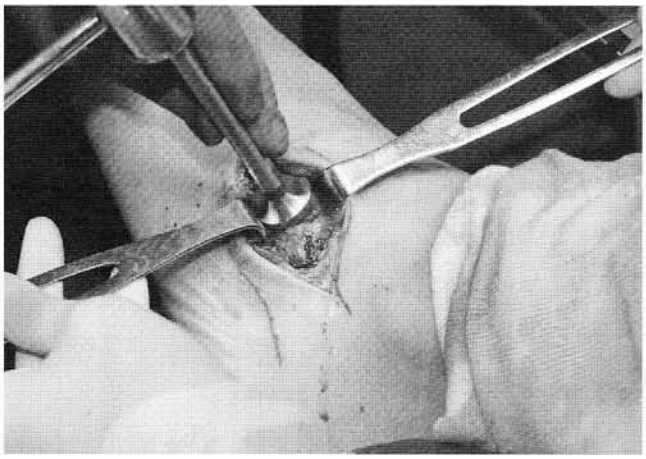

Figure 10. The graft is impacted to the lateral surface of the calcaneocuboid joint.

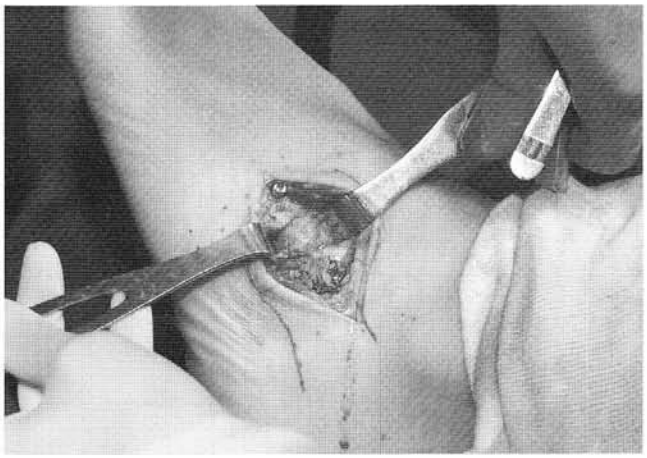

Figure 11. Appearance of graft prior to application of plate fixation. Note interfragmentary compression with one screw.

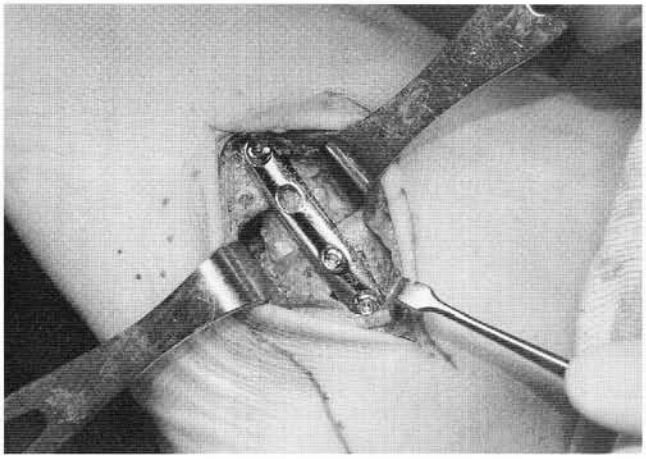

Figure 12. Application of a one-third tubular neutralization plate (eccentric screw is placed at the cuboid for axial compression).

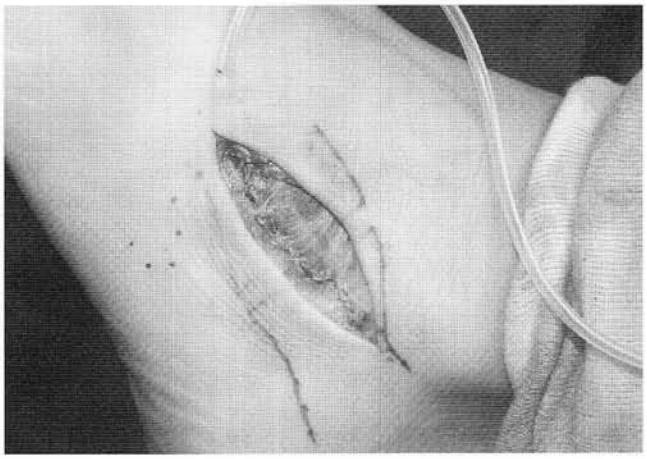

Figure 13. The EDB muscle and deep fascia are reapproximated. A small surgical drain is placed beneath the deep fascia layer.

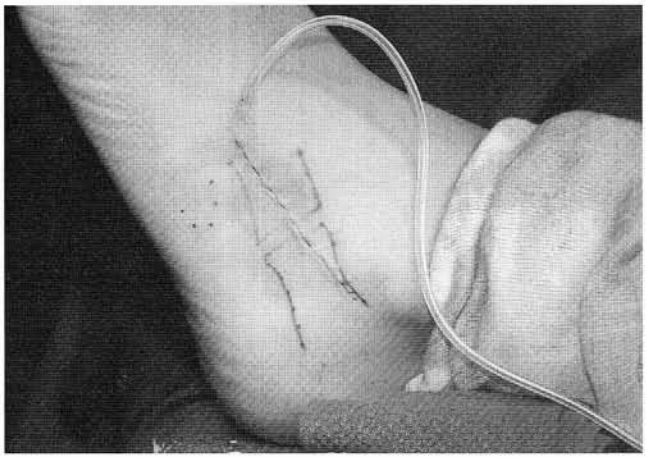

Figure 14. Appearance following skin closure.

POSTOPERATIVE MANAGEMENT

Postoperative management following calcaneocuboid distraction arthrodesis requires non-weight-bearing status for a period of 10 to 12 weeks, along with serial radiographic follow-up. The area is well-secured with appropriate internal fixation, however, the forces of weight bearing must be neutralized for successful graft healing and consolidation.

Rehabilitation including joint mobilization and passive range of motion exercises at the ankle and subtalar joint are begun on postoperative day three. A bivalved short-leg cast, or short-leg removable boot is used to accommodate bathing. At 10 to 12 weeks postoperative, the patient is placed in a short leg CAM-type walking device, with protected weight bearing continued for an additional four weeks.

Full return to complete weight bearing, normal ambulation, and return to normal shoes is obtainable at four months, barring any healing complications. Complete recovery and activity levels are conservatively anticipated to occur at 6 to 8 months postoperative.

RESULTS

Four cases have been performed and followed by the author. Three cases had satisfactory, uneventful outcomes with resolution of pain and satisfactory objective results. Subjective evaluation by all four patients resulted in satisfactory results.

Follow-up has ranged from 14 to 22 months. One case involved a non-compliant patient (28 year-old male) with disruption of the internal fixation which required removal secondary to irritation five months following the initial surgical intervention. The bone graft healed slowly (delayed union) and required approximately one year to achieve final consolidation. Examination of radiographs and clinical follow-up revealed probable motion at the graft-host interface and disruption of the primary bone healing process. At 14 months postoperative, the patient returned to full activity, with occasional mild pain localized to the area following physical exertion and long-standing activity. An orthotic device has alleviated these symptoms by a reported 50% and the patient is subjectively satisfied.

DISCUSSION

The axiom "create stability at the least cost to mobility" is the author's basic tenant for surgical intervention for foot and ankle conditions in a general sense, and applicable in the management of the hypermobile and symptomatic adult acquired flatfoot.

The foot and ankle consists of a multiple joint complex responsible for the dual role of providing stability to withstand the forces generated through standing and activity, while simultaneously allowing adequate adaptation to those forces for efficient mobility. This hierarchy of joint function relative to the lower extremity was expressed by Hansen in his "Essential Joint Theory" (personal communication October, 1993).

The ankle, subtalar, talonavicular, and metatarsophalangeal joints are considered to be "essential joints" of the foot and leg, which are preserved for as normal function as possible. The foot and ankle function efficiently when these joints are free of disease. In contrast, "non-essential" joints are those which are relatively flatly-shaped, such as the calcaneocuboid joint, and the small joints of the lesser tarsus. These joints by architectural design contribute to stabilization of the foot against ground reactive forces and gravity. Should these joints be affected by disease or injury, arthrodesis of these joints maintain stability with minimal loss to mobility. Arthrodesis of the "essential joints" may limit efficient mobility and function, and may lead to restriction of activity. This essential joint theory is the basis for exploration and development of the calcaneocuboid distraction arthrodesis as an alternative to subtalar and triple arthrodesis.

Careful joint positioning and normal joint position relationships are paramount in performing arthrodesising procedures of the foot, and have been proven to result in long-term satisfaction when performed correctly and final position is satisfactory.

The author's use of this procedure is limited to a defined criteria as outlined previously and in this context has rendered satisfactory results in the short-term. Triple arthrodesis has gained widespread acceptance as an appropriate surgical method to provide stabilization to the adult collapsing flatfoot deformity. A well-positioned triple or isolated subtalar arthrodesis can render

satisfactory long-term results. Often, selection of triple arthrodesis or isolated subtalar joint arthrodesis in the management of a flexible adult flatfoot deformity will involve destruction of non-diseased joint surfaces as these joints are essentially sacrificed for their contribution toward overall stability.

Calcaneocuboid joint distraction arthrodesis creates stability at relatively minimal cost to these essential joints. This procedure is unique in that stabilization of the dysfunction medial column can be achieved while still maintaining, albeit limited protective mobility at the subtalar and talonavicular joint. Avoidance of arthrodesis of a normal subtalar and/or talonavicular joint is theoretically desirable. Distraction arthrodesis of the calcaneocuboid joint maintains a limited degree of motion at the subtalar and talonavicular joint, and thus may be an appropriate alternative. This reduced but protective quality of motion may benefit a patient who desires to continue an active lifestyle.

The author's limited experience with this alternative arthrodesing procedure has created a level of personal enthusiasm in a select patient population with severe flatfoot pathology. Soft tissue augmentation of a dysfunction posterior tibial tendon has yielded satisfactory results in the literature, however, in severe and long-standing deformity, consideration of soft tissue augmentation of a dysfunctional posterior tibial tendon is generally reserved as an adjunct to fusion. Long-term outcomes are needed to evaluate soft tissue augmentation of a dysfunctional posterior tibial tendon and comparative studies on arthrodesing procedures versus soft tissue augmentation are necessary before recommendations are offered.

Properly positioned isolated subtalar and triple arthrodesis are appropriate surgical procedures in select patients with severe symptomatic collapsing flatfoot deformity and posterior tibial tendon dysfunction. Preservation of normal joint structure and function should be maintained as possible. Appropriate diagnosis, critical patient selection, and an appreciation for the technical components and potential complications involved in the described procedure should be well understood prior to surgical intervention.

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