

# INTERPOSITIONAL TENDON GRAFT FOR THE REPAIR OF HALLUX RIGIDUS ARTHROPATHY

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## INTRODUCTION

The initial description of degenerative arthritis of the first metatarsophalangeal joint was by Davies-Colley in 1887.<sup>1</sup> A year later the term “hallux limitus” was coined by Cotterill.<sup>2</sup> It has a reported incidence of 1 in 40 adults older than 50 years of age.<sup>3</sup> The disorder is characterized by restriction of motion at the first metatarsophalangeal joint, although its natural course reflects a progression of osteoarthritic changes which lead to osteophyte formation, further limitation of motion, and interference with function.<sup>4,6</sup> Many etiologies for hallux rigidus have been proposed and discussed at length (Table 1) however, they are not endemic to this paper. Treatment is usually sought when the joint becomes painful.

## TREATMENT

Treatment options range from benign neglect to surgical intervention. The goal is primarily to relieve pain, and secondarily to improve function of both the joint and the foot. Conservative measures (Table 2) include a pharmacologic approach, protective padding, shoe recommendations of modifications, and mechanical modalities to influence foot function.<sup>4,5,7</sup> When conservative treatment fails to achieve adequate relief, surgical correction can be implemented (Table 3). The once attractive implant arthroplasties have encouraged the search for alternative procedures.<sup>8</sup> It is not within the scope of this article to discuss all the surgical approaches for the relief of painful hallux rigidus, however a procedure which is a modification of the Keller, Mayo, cheilectomy and interpositional arthroplasty procedures will be presented.

## SURGICAL PROCEDURE

A dorsal incision is made over the first metatarsophalangeal joint at the medial edge of the EHL tendon. The capsule is opened longitudinally and reflected from the dorsal, medial, and lateral edges

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**Table 1**

### PROPOSED ETIOLOGIES OF HALLUX RIGIDUS

Poor foot wear  
Long narrow foot  
Pronated foot  
Osteochondritis dissecans  
Long first metatarsal  
First metatarsal elevatus  
Imperfect articulation  
Abnormal gait  
Obesity  
Age  
Trauma  
Sex  
Occupation

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**Table 2**

### CONSERVATIVE TREATMENT FOR HALLUX LIMITUS

Protective padding  
Modification of activities  
Low-heeled shoe  
Stiff-soled shoe  
Rocker-soled shoe  
Larger toe box  
Custom molded orthotic  
Morton extension  
Prefabricated insole  
Joint distraction/manipulation  
Physical therapy modalities  
NSAID medication  
Intraarticular steroid injection

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**Table 3**

**SURGICAL PROCEDURES  
FOR HALLUX LIMITUS/RIGIDUS**

JOINT PRESERVATION	JOINT DESTRUCTION
Cheilectomy	Resection arthroplasty
Decompression	Interpositional
osteotomy	arthroplasty
Osteotomy to DF hallux	Implant arthroplasty
Osteotomy to DF	Arthrodesis
metatarsal head	
Osteotomy to PF	Valenti procedure
metatarsal	
Regnauld procedure	

of the joint. Osteophytes are removed from all three margins of both sides of the articulation. Using an osteotome or power saw, approximately 75% of the head of the first metatarsal and base of the proximal phalanx are resected at an angle of 35°-45° into the joint. An inspection is made of the sesamoids and, if necessary, a McGlamry elevator is gently passed under the metatarsal head to free plantar adhesions.

At this point, an interpositional graft is fashioned from a freeze-dried Achilles tendon allograft to fit in between the resected joint ends. It usually measures 1.5-2.0 cm square. A 3-0 braided polyester suture (e.g. Mersilene, Tevdek) is passed through the inferior edge of the graft and then the flexor hallucis brevis tendon, and tied in order to draw the graft down into the joint. The same suture material is used to attach the tendon graft to the joint capsule medially and laterally. The dorsal capsule is then closed with absorbable suture of choice and the skin coapted in layers. If the extensor hallucis longus tendon is notably taught, dorsiflexing the great toe at rest, then it should be lengthened to prevent post-operative hallux extensus (Figures 1A-1F).

### DISCUSSION

The usual indication for this procedure is the painful grade III or even late grade II hallux rigidus as described by Hattrup and Johnson<sup>9</sup> (Table 4), when it has failed to respond to nonoperative measures. It has been observed that, even in grade III rated

**Table 4**

**RADIOGRAPHIC CLASSIFICATION  
OF HALLUX LIMITUS**

Grade I -	Mild to moderate osteophyte formation with good joint space preservation
Grade II -	Moderate osteophyte formation with joint space narrowing and subchondral sclerosis
Grade III -	Marked osteophyte formation and loss of visible joint space. Possible subchondral cyst formation

hallux limitus, the plantar 75% of the articular cartilage in the joint is often in good condition while only the dorsal 25% of the metatarsal head is eroded. That leaves the inferior surfaces in good condition to continue the articulation.

When resection of the dorsal metatarsal head increased from 25% to 50% for a cheilectomy, Heller and Brage demonstrated improved dorsiflexion of the great toe. However, the result is reduced translation of the proximal phalanx dorsally with abnormal pivoting which shifts the instant center of gravity plantarly. At the end of dorsiflexion the remaining articular surfaces are significantly compressed.<sup>10</sup> With this procedure it is felt that the decompression of the joint will make the risk of further articular degeneration minimal.

In general, cheilectomy is a relatively simple surgical procedure with a low morbidity risk. The success of cheilectomy, as reported in the literature, has been variable, dependent upon a number of factors.<sup>7,11-14</sup> Feltham et al demonstrated that patients 60 years or older had better subjective and functional results with cheilectomy than younger patients, presumably due to the lower activity demands for their feet.<sup>15</sup> Although most studies showed satisfactory results when used for grade III hallux limitus, Hattrup and Johnson revealed 30% unsatisfactory outcomes for grade III hallux limitus compared with only 15% unsatisfactory outcomes in grades I and II.<sup>9</sup> Geldwert et al also found that cheilectomy worked better for grade I and early grade II hallux limitus, even when removing one-



Figure 1A. Preoperative radiograph exhibiting grade III hallux rigidus.

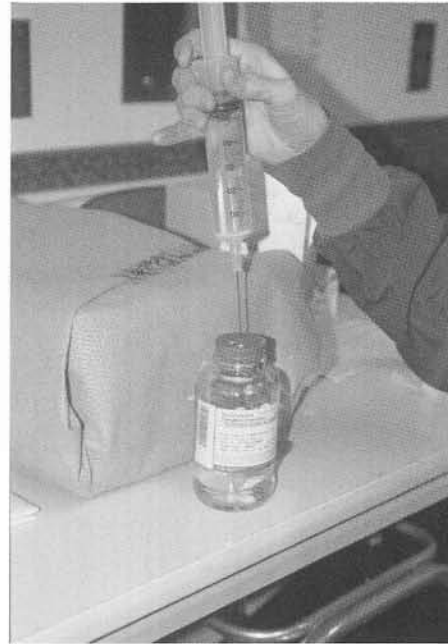


Figure 1B. Hydrating the tendon allograft with normal saline solution.

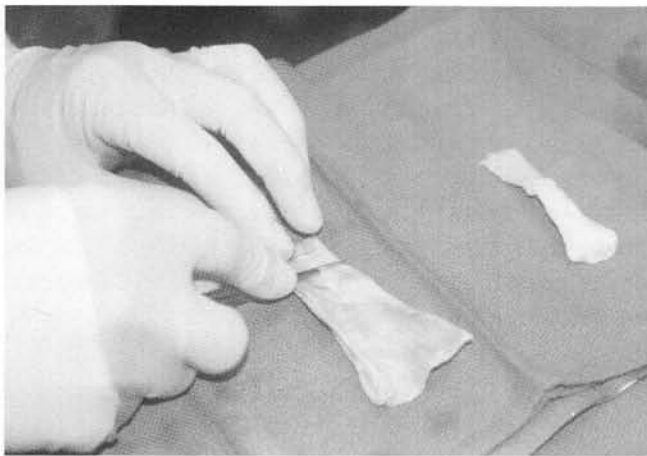


Figure 1C. Fashioning the tendon allograft.

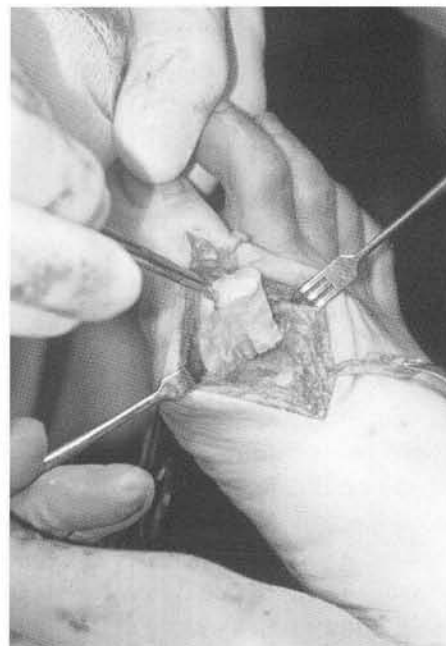


Figure 1D. Interposing the tendon allograft and checking the fit.

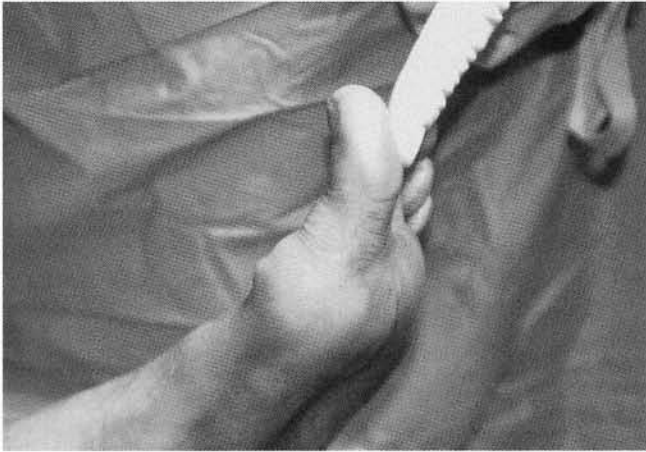


Figure 1E. Preoperative restricted great toe joint range of motion.

quarter to one-third of the dorsal metatarsal head.<sup>16</sup>

Nilssonne<sup>17</sup>, and Bonney and McNab's<sup>18</sup> early reports on the cheilectomy were disappointing due to inadequate resection of dorsal bone. Recommendations have been made for removing up to 50% of the metatarsal head, which allows for more dorsiflexion and further decompresses the joint. Still, intraarticular changes remain a problem. In the procedure described in this paper, 75% of the head is removed which has all three advantages, removes degenerative changes, increases motion, and decompresses the joint structure.

Another advantage of the procedure described here is that it leaves the plantar portions of the articulation intact including the sesamoid apparatus. This prevents dysfunctions seen with the Keller procedure such as transfer metatarsalgia,<sup>19,20</sup> lack of toe purchase, varus or valgus deviation, loss of the windlass mechanism, and shortening of the great toe. Interpositional capsule has been used with the Keller procedure and extensor hallucis brevis augmentation with good success.<sup>3</sup> Although less reliable than cheilectomy, a detailed study by Lau et al showed satisfactory results using this procedure.<sup>21</sup>

Barca applied the interposition of a plantaris tendon autograft where a standard cheilectomy was performed in conjunction with a 20°-30° osteotomy to remove the base of the proximal phalanx, leaving the flexor hallucis brevis attachment intact.<sup>22</sup> He produced satisfactory results in 12 feet. The tendon packet, inserted to act as biological spacer, was



Figure 1F. Postoperative increased range of motion at the first metatarsophalangeal joint.

shown to adapt and remodel itself to the new joint function. During healing, he used an articulated external mini-fixator to maintain diastasis while allowing dorsiflexion and plantarflexion. Experimentation has shown that tendons used in this fashion become gradually collagenized and finally hyalinized to act as a good spacer.<sup>23</sup> This rationale was applied to the current procedure with the hypothesis that the same physiological adaptation would occur with an interpositional tendon allograft.

## CONCLUSION

The advantages of using the interpositional tendon allograft and modified arthroplastic cheilectomy to correct hallux limitus have been well illustrated in the discussion section. The disadvantages include a risk for immunologic reaction to the tendon allograft (not seen in 10 cases) and the possibility for compromise of function (seen in one case with lack of purchase). Its allowance for maintaining ambulation during healing makes it an excellent choice for patients older than 60 years of age, although its functional preservation permits application in younger patients where the joint has degenerated.

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