CHAPTER 6

Rate of Revision Following Cheilectomy Versus Decompressional Osteotomy in Early-Stage Hallux Rigidus

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INTRODUCTION

Hallux rigidus, or localized osteoarthritis of the first metatarsophalangeal joint, is a very common pathological condition that is often painful and disabling. This is the most common form of arthritis in the foot and has been estimated to affect up to 1 in 45 adults over the age of 50 (1). A progression of deformity is involved, beginning with mild impaired function, continuing on to increasingly frequent episodes of painful excursion of the joint, with in situ fusion being the end range of the spectrum.

The etiology is poorly understood and likely multifactorial. Many causes have been proposed, but some of the more comprehensive and well-accepted literature on this subject was published by Root, Orien, and Weed. They claim that 6 factors are correlated: hypermobility of first ray, metatarsus primus elevatus degenerative joint disease, trauma, excessively long first metatarsal, and immobilization of first ray (2). Other potential etiologies include tight Achilles tendon, pronation, atypical morphology of the first metatarsal head and metabolic conditions (3). Regardless of the underlying deformity, the pathological process is the same: the ability of the first metatarsal head to plantarflex in the late stages of gait is compromised. This leads to dorsal jamming against the base of the proximal phalanx and altered joint mechanics. The normal shearing forces for this diarthrodial joint are converted into compressive forces. The result is peri-articular osteophyte formation and chronic inflammatory fluid production that precipitates enzymatic degradation of cartilage (4, 5).

Numerous conservative modalities for treating this condition have been described in the literature. However, a retrospective analysis of 772 patients performed by Grady et al, demonstrated successful outcomes of non-surgical care alone in 428 patients (55%) (6). This suggests up to 45% of patients will require surgery. Should non-surgical treatment fail at controlling symptoms, an equally extensive list of operations has been advocated. These procedures can be broadly grouped into 2 categories: joint sparing and joint-destructive, with the former typically applied to earlier stages of the deformity and the latter reserved for more advanced cases. A recent study (7) compared the outcomes for 3 common procedures used to treat end-stage disease, metatarsophalangeal joint excisional arthroplasty (8-10), implant arthroplasty (11, 12), or arthrodesis (13-15) and no significant difference between them was encountered, indicating that all 3 are viable options.

Many patients will present for treatment prior to developing pronounced arthrosis, and a significant controversy exists regarding what is the most beneficial surgical approach in these cases. Two frequently employed procedures for early stage hallux rigidus are the cheilectomy and the plantarflexory decompressional osteotomy. Despite the fact that both procedures have been in use for decades, there is a dearth in the literature of studies to prove their efficacy, either alone or in comparison to each other. The goal of this study was to compare the rate of revision of the 2 procedures, in an effort to assess which provides superior prolonged outcomes. This would hopefully provide surgeons who treat this deformity a stronger foundation of evidence upon which to conduct surgical planning.

METHODS

This research was designed as a retrospective comparative study, Level III evidence. A systematic review of electronic databases was performed across several facilities in Kaiser Permanente Northern California. All patients with diagnostic codes of hallux limitus or hallux rigidus between 2007 and 2008 were extracted, which included 1,817 patients (Table 1). Patients were included in the study if they had undergone either a cheilectomy or any variation of plantarflexory decompressional metatarsal head osteotomy. This brought the final cohort to 423 patients. These charts were further manually reviewed for evidence of any type of revision forefoot surgery following the index procedure. Demographic information from the time of surgery was collected on the patient, including sex and body mass index (BMI), which was recorded as either >30 or <30. Laterality, time to revision, and type of revision were also collected. Mean follow-up was 3.27 years. A minimum follow-up of 12 months was required after the initial procedure.

This was a study across several facilities with various surgeons so no standardized surgical technique was used

Table 1. List of ICD and CPT codes searched for:

Diagnosis (ICD-9):
- 735.2 - Hallux Rigidus
- 735.8 - Hallux Limitus

Procedure (CPT):
- 77.38 - Foot osteotomy, metatarsal
- 77.51 - Chevron osteotomy
- 77.58 - First ray cheilectomy, First metatarsophalangeal joint arthroplasty
- 77.59 - First ray bunionectomy with distal osteotomy, First ray arthroplasty with Implant
- 77.69 - Foot Cheilectomy
- 81.16 - First ray arthrodesis, first metatarsophalangeal
- 81.57 - Foot joint arthroplasty

ICD-9 procedures
- 77.2 – Wedge osteotomy
- 77.3 – Metatarsal osteotomy
- 77.58 –Other repair of toes
- 81.16 – Metatarsophalangeal fusion
- 81.57 – Replacement of joint of foot and toe
- 77.80-77.89 – Cheilectomy of foot
- 77.51-77.59 – Bunionectomy

Table 2. List of Facilities

- Santa Rosa
- Vacaville
- Roseville
- Sacramento
- South Sacrament
- Vallejo
- San Rafael
- San Francisco
- South San Francisco
- Redwood City
- Richmond
- Oakland
- Hayward
- Fremont
- Santa Clara
- San Jose
- Antioch
- Walnut Creek
- Stockton
- Modesto
- Fresno

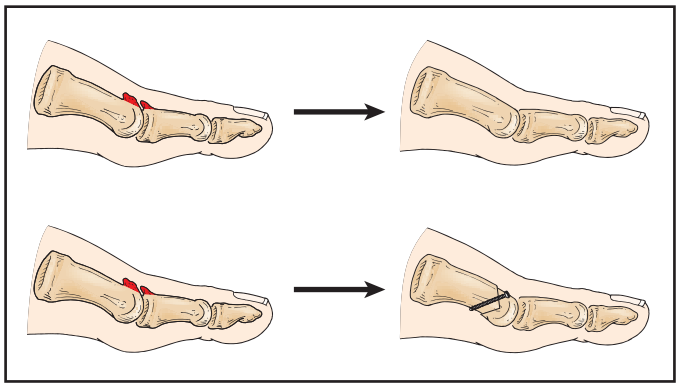

Figure 1. Diagram of the cheilectomy and osteotomy. A. Cheilectomy, which involves a simple excision of the dorsal exostosis and degenerative portion of the first metatarsal head. B. Decompressional osteotomy, which shortens and plantarflexes the metatarsal.

(Table 2). The cheilectomy as described in the operative notes involved a dorsal linear capsulotomy followed by resection of all abnormal osteophytes about the dorsal, medial and lateral aspects of the first metatarsophalangeal joint, as well as microfracture down to subchondral bone in areas of denuded cartilage. In some cases a release of adhesions to the plantar aspect of the joint was performed using a McGlamry elevator. The decompressional osteotomy procedure involved either a dorsomedial linear or inverted-L type capsulotomy. Osteophytosis about the first metatarsophalangeal joint was resected in similar fashion to the cheilectomy procedure. The osteotomies identified in this study featured either Mau, Watermann-Green, as well as Youngswick type orientation of cuts, with the shared result being a shortening and plantarflexion of the first metatarsal head. Stabilization for the osteotomy procedure was then achieved with either pin or screw fixation. Closure was performed in standard fashion and patients were allowed to bear weight immediately in a postoperative shoe.

RESULTS

A total of 341 cheilectomy and 82 decompressional osteotomy procedures were identified over the study time period. There was an even distribution of sex ($2 = 3.423$, $P = 0.181$), laterality ($2 = 1.312$, $P = 0.519$) and BMI ($2 = 0.277$, $P = 0.599$) across both groups (Figure 1). In the cheilectomy group, there were 124 males and 206 females. In the decompressional osteotomy group, there were 25 males and 56 females. Cheilectomy was performed on 120 left, 200 right, and 10 bilateral feet, whereas the decompressional osteotomy was performed on 33 left, 47 right, and 1 bilateral foot. There were 201 patients with a BMI <30 and 129 with a BMI >30 for the cheilectomy group. There was 52 patients with BMI <30 and 29 patients with a BMI >30 for the decompressional osteotomy group. The average time to revision was 615.68 days for the cheilectomy and 637 days for the decompressional osteotomy.

The rate of revision procedures was found to be dramatically higher in the cheilectomy group, 28 of 341 (8.21%) compared to 1 of 82 (1.22%; $z = 2.681$, $P < 0.01$). It should be noted that 2 patients required hardware removal for the decompressional osteotomy and this was not counted as a true revision (Figure 1). When a revision procedure was performed, the overwhelming majority of the time, a first metatarsophalangeal fusion was selected as the operation of choice. Resection arthroplasty with and without osteotomy and arthrodiastasis were performed as well (Figure 2).

Surgery	Number	M/F	Laterality (L/R/BL)	BMI (<30, >30)	Time to Revision (average, std dev)	Rate of Revision	*p* value
Cheilectomy	330	124/206	120/200/10	210, 129	615.68, 306.10	**29 (8.79%)**	< 0.05
Decompressional Osteotomy	81	25/56	33/47/1	52, 29	637	**1 (1.23%)**	< 0.05

Figure 2. Results.

Surgery	No Revision	Arthroplasty	Fusion	Implant	Osteotomy	Arthrodiastasis
Cheilectomy	301	3	19	0	2	2
Decompressional Osteotomy	80	0	0	1	0	0

Figure 3. Revision procedures.

DISCUSSION

Two commonly utilized procedures for early-stage hallux rigidus are the cheilectomy and the plantarflexory decompressional metatarsal head osteotomy. A cheilectomy, as popularized by Duvries in the 1950s, involves a simple excision of the dorsal exostosis and degenerative portion of the first metatarsal head. The main advantages are: it is a technically easy procedure to perform, patients are able to resume normal activities and shoe gear in fairly rapid fashion, there is a low associated rate of complications, and if it does not work, there is still the option of a revision procedure. In terms of disadvantages, there historically has been a wide variety of outcomes with an isolated cheilectomy, even in early stage disease. As the condition progresses, there is even more variability in pain relief.

There are different types of decompressional metatarsal osteotomies, such as Mau, Waterman-Green, and Youngswick. The uniting theme among these is that they attempt to decompress the first metatarsophalangeal joint by shortening and decreasing its cubic content. The capital fragment is moved proximal and plantar for all 3 procedures. Declinating the capital fragment decreases the metatarsus elevatus and allows more normal weight bearing under the first metatarsal head. The shortening osteotomy is created to allow a "slack in the line" to increase the range of motion. As with the advantage to the cheilectomy, the decompressional osteotomy can be used as a staging procedure to prolong the lifetime of the joint. It theoretically corrects the underlying etiologies by plantarflexing and shortening the first metatarsal, unlike the cheilectomy. This potentially provides a more long-term solution. However, osteotomies are technically more difficult to perform. There are increased associated potential side effects of sesamoiditis

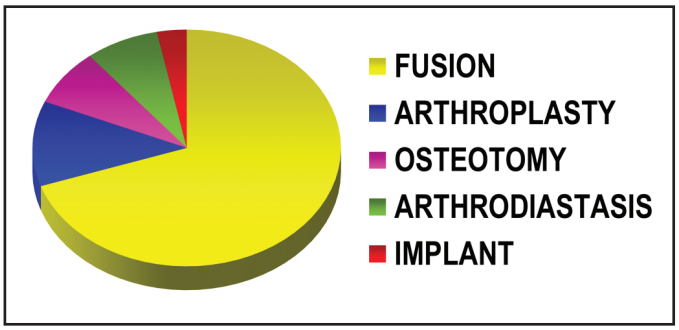

Figure 4. Revision procedures.

due to over-plantarflexion or lesser metatarsal overload (metatarsalgia, stress fractures) from shortening the first ray. There is potential for malunion or nonunion or issues regarding hardware.

A systematic review was undertaken by Roukis in 2010 to better understand the need for surgical revision after isolated cheilectomy for hallux rigidus. A total of 23 studies, which included 706 procedures with at least 12-month follow-up met the inclusion criteria. The total number of patients that eventually underwent a revision procedure was 62 (8.8%) (16). Roukis later published another systematic review in an effort to determine the clinical outcomes and need for surgical revision after isolated periarticular osteotomy of the first metatarsal. Only 4 studies were included, which consisted of a total cohort of 93 patients who had at least 12-month follow-up. It was documented that 21 patients (22.6%) underwent revision, which seems fairly high (17). However, if the data is stratified, 8 revisions were for symptomatic hardware removal, 7 were for intractable metatarsalgia, and 3 were unlisted, which leaves only 3 that were actual revisions of the first metatarsophalangeal joint. In our current study, the revision rate for cheilectomy was

found to be 8.79%. This number is fairly consistent with other reports that list an approximate 90% success rate of the procedure. The decompression osteotomy group had a significantly lower rate of revision at 1.23%.

CONCLUSION

In the absence of research studies comparing the effectiveness of the 2 procedures, this has led many practitioners to favor cheilectomy for early-stage hallux rigidus. Decompressional metatarsal osteotomies are technically more difficult, involve more risks, and require greater restrictions on postoperative weightbearing compared to cheilectomy. Our data, however, shows that within the first 5 postoperative years, the osteotomy resulted in a dramatically lower rate of revisional surgery in comparison to cheilectomy. This lends credence to the theory that the osteotomy decreases the pathologic forces at the joint. This potentially provides a more sustainable option for treating early stage hallux rigidus relative to the isolated cheilectomy. As such, the enhanced prolonged benefits of the osteotomy may outweigh its increased associated risks. Our results suggest the decompressional metatarsal osteotomy may limit the need for revision following surgery for early stage hallux rigidus compared to cheilectomy.

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