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Functional Outcome Analysis of Hallux Rigidus Patients Undergoing Cheilectomy vs. Cheilectomy and Proximal Phalanx Osteotomy: A Patient's Perspective

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Abstract

Background: The primary aim of this study is to evaluate the functional outcomes of two surgical treatment groups with hallux rigidus. Our goal was to better understand the post-surgical outcomes between the two treatment groups from a practical, patient-centered point of view.

Methods: A retrospective case series of 63 patients with hallux rigidus undergoing cheilectomy (C group) or a cheilectomy plus proximal phalanx osteotomy (CPP group) over a 4-year period with a minimum clinical follow up of 12 months. Evaluation of the study was based on satisfaction scores, VAS score, functional outcomes, and radiographs.

Results: There were 32 patients in the C group and 31 in the CPP group. The median months to "100% recovery" was 3.5 months in the C group vs. 9 months for the CPP group. Time to normal shoes and overall satisfaction with either surgery was nearly identical in both groups (30 days for C vs. 28 days for CPP and a mean satisfaction score of 8.4 for group C and 8.2 for group CPP). Both treatment groups had similar percentages of patients report less post-operative pain than expected (34% C vs. 33% CPP). A higher percentage of patients in the C group (56%) reported more pain than expected compared to the CPP group (40%). Also in both groups the VAS pain level decreased significantly.

Discussion: In our study, we found that although CPP is a longer procedure, patients had an earlier return to full weight bearing but a much longer subjective, patient reported "100% recovery." However, the time to regular shoes remained the same in each group and overall means satisfaction score was similar. Interestingly, more patients in the cheilectomy only group reported their post-op pain to be higher than expected suggesting patients were underestimating their post-op course or receiving sub-optimal pre-operative counselling.

Keywords: Hallux Rigidus; Cheilectomy; Moberg Osteotomy; Proximal Phalanx Osteotomy; Hallux Limitus

Introduction

Hallux rigidus is marked by pain and decreased range of motion at the first MTP joint, particularly in dorsi-flexion. The loss of motion is mostly due to osteophyte formation on the dorsal articular surface of the first metatarsal head [1-3]. It is the most common osteoarthritic joint in the foot, estimated to affect 1 in 40 adults over the age of 504 and second only to hallux valgus for great toe orthopaedic pathology. Patients often report some history of trauma prior to developing unilateral hallux rigidus [4,5]. Other non-traumatic factors, most involving altering the normal kinematics, have been postulated as causes and associations with hallux rigidus. These include having a long first metatarsus [6,7], flat metatarsal head [8,9], and pronated foot [6,7] among others.

Clinically, patients typically report pain at the great toe, mostly with ambulation and worsened with high-heeled shoes and during push off with gait. The most common grading system used to classify disease and treatment options was developed and popularized by Hattrup and Johnson [2]. The disease progression mirrors the advancement of osteoarthritis. The MTP joint space narrows, then osteophytes form at the dorsal surface of the metatarsal head, and then they eventually spread to the plantar surface [3,4,10].

Several treatment options have been proposed throughout the years from non-operative treatment, MTP fusion [11-18], MT head resection [19-23], base of first proximal phalanx resection [19-23] arthroplasty [24-32] cheilectomy [27,33-38] proximal phalanx closing wedge osteotomy (i.e., Moberg osteotomy) [39] and combined cheilectomy and proximal phalanx osteotomy [40] For patients with grade I disease that have failed conservative treatment, non-operative measures or a cheilectomy is often the treatments of choice [41].

For those with more advanced disease in younger, active patients the treatment options become more difficult and controversial. A dorsal closing wedge osteotomy of the proximal phalanx can be used [40-42] in addition to a cheilectomy to increase dorsiflexion (Figures 1 and 2). This procedure was first popularized in 1979 after Moberg published his technique [42] however Bonney and Macnab are attributed with first describing the procedure [43]. Citron and Neil et al performed a 22 year follow up study on adolescent patients receiving just a Moberg osteotomy with good results; 5 feet were asymptomatic and 4 patients has no pain with ambulation [44]. The goal of the Moberg osteotomy is to improve the functional range of motion of the first MTP joint and is rarely used without a concomitant cheilectomy [40]. With the dorsal closing wedge osteotomy, the joint is moved to a more dorsiflexed position to improve function. The procedure can be viewed as "stealing" plantar flexion in exchange of more dorsiflexion, and is indicated for patients who have stiff and painful range of motion of the first MTP joint [41].

Figure1: Pre-operative lateral X-ray demonstrating Grade II hallux rigidus with decreased joint space and dorsal osteophytes of metatarsal head.

Figure 2: Post-operative X-ray showing healed cheilectomy and proximal phalanx osteotomy with decompression of joint space.

The goal of the investigation is to provide answers to common questions from patients encountered by the treating surgeon for hallux rigidus. The study examines the patients' post-op course of hallux rigidus undergoing two similar procedures from a patient centered point-of-view; e.g., patients care less about their Hattrup and Johnson score per se and more about when they can return to their "usual" shoewear and routine lifestyle (as defined by the patient). As surgeons, we typically focus on clinical and imaging outcomes, but this study attempts to answer the questions that are often more important to the patient. When surgeons counsel patients on which procedure to consider, they need practical advice and predictions to provide to patients. While the aim of study is to demonstrate outcome data from patients undergoing two distinct procedures in parallel, there is some comparison between the two groups that can be made, however the statsicial conclusions are limited. Overall the purpose of this study is to provide answers to some of the common questions patients ask their surgeons when considering a cheilectomy vs. cheilectomy with Moberg osteotomy.

Materials and Methods

A retrospective chart review was performed of patients who underwent corrective surgery for hallux rigidus by one foot and ankle fellowship trained orthopaedic surgeon at Huntington Hospital and its affiliate institution, Congress Medical Associates from the years 2009 to 2012. Patients were identified from an existing operating logbook using "cheilectomy" and "proximal phalanx osteotomy" as search words and the CPT code for hallux rigidus. A brief chart review (a review of "history and physical") was conducted on these patients to confirm the diagnosis and operative procedure. Those patients identified within this subset with a minimum of one year of clinical follow-up were marked for further chart and radiographic review. Once the diagnosis and procedure was confirmed, patients were contacted by telephone for an interview. All patients were informed that their participation was voluntary and wouldn't influence their subsequent patient care and gave informed consent. Data was collected and analyzed through a brief questionnaire. Patients were asked six questions: 1) How many days until you were 100% weight bearing in your post-op shoe? 2) How many days until you were 100% weight bearing in your "normal" shoes? 3) On a scale of 1 to 10, 1 being very displeased and 10 very pleased, how would you rate your satisfaction? 4) On a scale of 1 to 10, 1 being very little pain and 10 the worst pain you've experienced, how would you rate your post-op pain? 5) Did you need to use an assistive device (cane, walker, crutches) post-operatively and if so, for how long after surgery? 6) How long did it take until you were back to normal lifestyle and pain free? 7) How was your pain post-operatively: less, equal, or more than expected?

Patient's radiographs were also identified and randomized and assigned a number. Three independent observers in orthopaedics (an orthopaedic surgeon, medical student, and orthopaedic resident) then graded the severity of the hallux rigidus using the Hattrup and Johnson scale. Discrepancies were then averaged out and assigned the appropriate grade.

	Average Age	Age Range	Males	Females	Prior Foot Surgery	Follow-up Range (Months)
C Group	62.6	27-82	12	20	6	Dec-68
CPP Group	61.4	38-82	8	23	4	Dec-39

Table 1: Patient demographics were matched and evenly distributed among each group. Particularities of surgeries described in Methods.

A total of 75 patients were identified through the years 2009-2012 as having corrective surgery for hallux rigidus that did not involve an arthrodesis of the first MTP joint. Patients were excluded if they had prior hallux rigidus surgery, concomitant hallux varus or valgus corrections, or metatarsal osteotomies. Of these 75 patients, 63 were able to be contacted and agreed to be included in the study. Average follow-up was 18.5 months and minimum follow-up was 12 months. 32 were treated with cheilectomy and 31 were treated with cheilectomy and proximal phalanx osteotomy (19 with Plaple device and 12 with K-wires alone). Only patients who agreed to the telephone interview were included in the study. Additionally, some subjects were unreachable due to out-dated contact information. Patients' age, weight, sex, race and other demographics were matched and evenly distributed between the two groups (Table 1). An anonymous medical

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student who had never met the patients contacted the patients via telephone. The senior author performed the physical exam.

All of the statistics were computed using the Kaplan-Meier method at UCLA Dept of Biomathematics. The p values for comparing the distributions of the variables in C group vs. CPP group were computed using the non-parametric log rank test. The p values for prior surgery and use of assistive device were computed using Fishers exact test. The data for the pain quantification score and X-ray grade were calculated using the Kruskal-Wallis test.

Surgical Technique

In both surgeries, the patient is positioned supine on the operating table (Table 2) with a thigh tourniquet. An ankle tourniquet is avoided so that the long flexors or extensors are not tethered. The procedure is performed under a local ankle block with intravenous sedation or a Largyneal Mask Airway (LMA). A small bump under the ipsilateral hip may be used to bring the lower extremity in neutral rotation [45].

	Median Months to 100% subjective recovery	Median days to 100% weight bearing in post-op shoe	Median days to 100% weight bearing in regular shoes	Overall mean satisfaction score	Percent of patients with less post-op pain than expected	Percent of patients with more post-op pain than expected	Percent of patients requiring an assistive device post-op	Mean improvement in VAS score
C Group	3.5 months	14 days	30 days	8.4	34%	56%	47%	5.5
CPP Group	9 months	8 days	28 days	8.2	33%	40%	77%	5.8

Table 2: What patients can expect in their post-op course after Cheilectomy only vs. Cheilectomy Plus Proximal Phalanx Osteotomy.

Cheilectomy: A dorsomedial incision is made over the first MTP joint. The extensor hallucis longus is retracted laterally and the dorsomedial nerve medially. A capsulotomy is made under the skin incision and the edges retracted, exposing the MTP joint. Next, the 1-2 mm of the medial osteophyte is removed with a reciprocating saw. The cheilectomy is then made by removing up to 30% of the dorsal edge of the metatarsal head depending on the extent of the disease [40].

Cheilectomy with Moberg: After performing the cheilectomy as above. A K-wire is then placed in the proximal phalanx close and parallel to the MTP joint to guide the osteotomy cut and is confirmed with fluoroscopy. The osteotomy is made just distal to the K-wire and close as possible to the joint but leaving enough proximal bone stock for fixation. An oscillating 0.5 cm blade is used to make the first cut parallel to the joint. The cut is stopped just short of the plantar cortex, which prevents the FHL tendon from being injured. Next the second cut is made obliquely 2-4 mm distal to the first cut and angled to converge with the first cut at the plantar cortex. The intact plantar cortex is weakened with successive K-wire drill holes until it can be "greensticked" and the osteotomy approximated (Figure 3) [40,45].

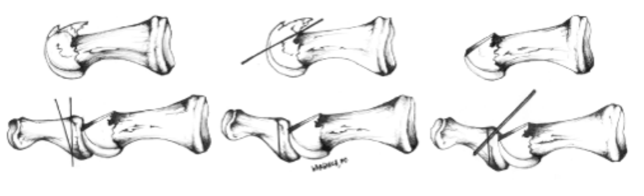

Figure 3: Illustration of an arthritic metatarsal with dorsal osteophytes. The cheilectomy is performed first followed by the proximal phalanx osteotomy with an oscillating 0.5 cm blade. A Kirschner wire inserted parallel to the joint surface guides the first cut. The second cut is made obliquely 5 mm distal to the first cut, and a wedge of bone is resected. After the osteotomy is completed, the reduction is reduced and provisionally held with a Kischner wire until secured with fixation of choice.

Multiple options exist for fixation of the osteotomy site including: mini-fragment screws, K-wires, staples, or threaded screws alone. The authors of this paper prefer using the Plaple (Arthrex, Naples, FL), which is a hybrid between a plate and staple (Figures 4-6). This avoids potential infection with percutaneous K-wires or fragmenting the proximal fragment with a screw. Many cases involving the osteotomy were also fixed with percutaneous K-wires (either sized 0.054" or 0.062") [40,45].

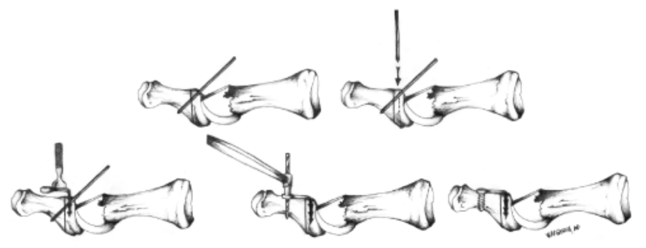

Figure 4: Illustration of the author's preferred method of treatment using a Plaple (Arthrex, Naples, Florida). A Kirschner wire holds the reduction as the Plaple is tamped down a hole pre-drilled into the proximal fragment. The Plaple is oriented with the thinner staple side in the subchondral bone of the narrow proximal fragment and a compression screw for the distal fragment. The screw path is pre-drilled with a 1.7 mm drill through the eyelet of the Plaple. The appropriate screw length is measured and the screw is advanced while maintaining reduction of the fracture site and achieving compression.

Post-operatively, patients were placed into a hard-soled shoe and allowed to weight bear on their heel only when able and avoid applying weight to the operative site of the foot. After the first post-op visit at post-op day 7-10 they were allowed to be weight bearing as tolerated on their entire foot. Sutures were removed at two-three weeks post-operatively.

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Figure 5: Pre-operative lateral X-ray demonstrating Grade III hallux rigidus with severe joint space narrowing and dorsal osteophytes of metatarsal head.

Figure 6: Post-operative X-ray showing cheilectomy and healed proximal phalanx osteotomy stabalized with the Plaple.

Results

A total of 75 patients were identified as suffering from hallux rigidus who were treated with surgery at a private institution. Only patients who agreed to be interviewed by phone and who could be contacted were included (63 patients). The same orthopaedic surgeon fellowship trained in foot and ankle surgery treated all patients. 32 patients were treated with cheilectomy and 31 were treated with cheilectomy with a concomitant proximal phalanx osteotomy. Post-op x-rays were assessed for osteotomy healing and there were no malunions or nonunions but one delayed union that healed completely at 5 months. There were a total of 5 superficial infections (2 in the C group and 3 in the CM group), all of which cleared with short course of oral antibiotics alone.

The mean patient age at the time of surgery in the C group was 62.6 (range, 27–82) and mean age in the CPP group was 61.4 (range, 38-82). The median months to 100% recovery (subjectively reported by patients) was 3.5 months in the cheilectomy only group vs. 9 months for the cheilectomy plus proximal phalanx osteotomy group (p value 0.2342). It is important to note that the "100% recovery" was purely patient described and patient specific; i.e., it was not clinically or radiographically based, but recorded from an individual patient's subjective assessment. There was however a similar range for 100% recovery: C group consisting of 0.75 months to 40 months vs. the CPP group with a range of 1 month to 39 months. Median days to 100% weight bearing in a post-op shoe was actually lower in CPP group than the cheilectomy only group (8 days vs. 14 days p = 0.9560). Time to regular shoes was nearly the same in both groups: 30 days for C patients and 28 days for CPP patients (p = 0.3698).

Overall satisfaction scores were very similar in both groups with a mean score of 8.4 for C group and 8.2 for CPP group. Pain relief as measured by a VAS scale was similar in both groups as well. In the C group the mean pain level was 7.5 pre-op and 2.0 post op. In the CPP group the mean pain level was 8.1 pre-op and 2.3 post-op.

More patients used an assistive device after the surgery in the CPP group (77%) than the cheilectomy only group (47%). This is an interesting finding since the assistive device shouldn't decrease the recovery range or pain relief, but is a useful patient centered outcome. Surgeons are often asked by patients how long they can expect to need crutches, a walker, post-op shoe, etc. Both treatment groups had approximately the same percentage of patients (34% vs. 33% for C group vs. CPP group respectively) who had less post-operative pain than expected, even though the cheilectomy and proximal phalanx osteotomy group have the additional procedure. Interestingly, a higher percentage of patients in the cheilectomy only group, 56%, reported more pain than expected compared to the combined procedure group, 40% with a p value of 0.4521 (Figure 7). Lastly, looking at the grades of disease, 31% of patients receiving a cheilectomy and proximal phalanx osteotomy had grade 3 hallux rigidus vs. only 19% in the cheilectomy alone (Figure 7).

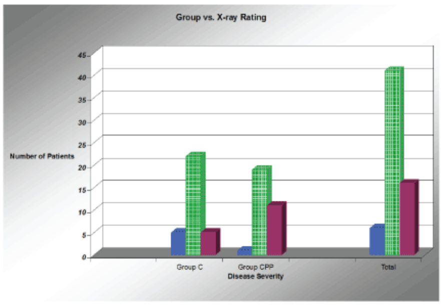

Figure 7: The majority of patients with Grade III disease were treated by cheilectomy plus proximal phalanx osteotomy 11/16 (69%) vs. 5/16 (31%).

Discussion

Of the surgical options, cheilectomy alone has been shown to provide good pain relief while preserving range of motion and is often used in grade I and occasionally grade II disease [22]. First described by DuVries in 1959 [46], 2 cheilectomy alone has been widely accepted and reported to have favorable results. In 1988 Mann et al reviewed 28 patients and found 25 of 28 had relief of pain and an average improvement of 20 degrees of range of motion [27]. For patients with grade II or III disease who are young and still highly active, it becomes a much more controversial and difficult surgical decision. A combined cheilectomy and proximal phalanx osteotomy can be performed [40]. In some reports the combined procedure of cheilectomy and proximal phalanx osteotomy gave better post-operative results than a cheilectomy alone [47]. Cheilectomy alone has the advantage of a shorter procedure with no retained hardware while a cheilectomy with a proximal phalanx osteotomy has some additional possible complications such as possible intra-operative damage to soft tissues, tendons, ligaments, valgus deformity, malunions, and nonunions. Some authors have reported that early surgical intervention does not correlate with better patient outcomes [43] and therefore conservative treatment and activity modification are viable options for most patients.

For those patients who have failed conservative management, surgery is a good option that can afford improvements in range of motion and pain relief. There are, however, many surgical options available depending on the grade of the disease, patient preference, and surgeon training. Cheilectomy alone has been advocated for mild cases, usually grade I or II. Cheilectomy plus proximal phalanx osteotomy has traditionally been used for younger, more active patients will slightly more severe disease, i.e., grades II and III. Some surgeons have expanded the indications for the proximal phalanx osteotomy to include more severe cases with good results and patient satisfaction. O'Malley et al have recently reported good results with combined cheilectomy and proximal phalanx osteotomy for advanced hallux rigidus, including grade III disease [48].

The goal of this study was to give patients and surgeons a practical, tangible, real-life understanding of what a patient can expect post-operatively. In our two study groups, we found that patients in the combined cheilectomy and proximal phalanx osteotomy procedure had a shorter time to full weight bearing. This may be opposite to one's expectation. The exact reason is unclear, however the authors speculate the pain relief from the decompression of the joint in the CPP group is significant enough to offset the additional pain associated with the added procedure. However, the median months to subjective 100% recovery was nearly three times as long in the CPP group than the C group (9 months vs. 3.5 months). The overall mean satisfaction score, VAS score and time to regular shoes were approximately the same in each group. This suggests that even though the proximal phalanx osteotomy is an additional procedure and increases the operative time, this doesn't translate to patient dissatisfaction or increased time to regular shoes. Additionally, more patients in the CPP group had higher grades of disease. More than double the patients in the CPP group had a grade III disease (12 vs. 5) compared to the C group. Additionally, the cheilectomy group had more patients with a milder disease (5 patients vs. 1 with a grade I). These are possible confounding variables, but would likely bias the data against favorable outcomes in the CPP group. Therefore, any good outcomes of the CPP group are possibly better than reported if these confounding variables were stratified out. Of note, more patients reported that their post-operative pain was higher than expected in the C group than the CPP group.

This study has many limitations. First, the only results with statistically significant p values are the grading of pre-operative radiographs and percentage of patients requiring post-operative assistive devices. All other data points had p values >0.05. However, the authors of this paper feel that the information is still useful for patients, even if not statistically significant. The results of the study are not aimed to shift the surgical treatment or guide the decision between cheilectomy vs. proximal phalanx osteotomy, but aimed more to give patients and physicians a practical idea of what to expect post-operatively when facing certain types of hallux rigidus surgery. This may help surgeons specifically counsel their patients and give them an idea of their post-op course. Additionally, one surgeon performed the surgeries. While this serves as an advantage in eliminating surgeon-to-surgeon variability, it could represent a confounder and different results could be attained with different surgeons or techniques. Also, since this is a retrospective study and is subject to recall bias by the patients. Furthermore, there were not defined, or validated outcome measures (other than the VAS score) and the patients defined the satisfaction, which is subject to inter-person variability. This is noted by the wide variety in time ranges when patients were asked when they had reached "100% recovery." It is important to underscore the purpose of this study, namely that the outcomes were not objective or clinically based, but rather subjectively based on the patients' subjective post-op experience. The "100% recovery" was determined by the patient and not the surgeon, hence the wide variability. The study attempts to answer the question often encountered by the treating surgeon, "when will I be back to 100%?" This question has a different meaning to different people, but the hope is that the variables average out with the sample size.

Summary

The cheilectomy plus proximal phalanx patients in some ways had favorable outcomes when compared to cheilectomy alone patients. Even though the CPP group had much longer time to full recovery, these patients had a shorter time to 100% weight bearing, less pain than anticipated, and the same time to regular shoes. It is important to remember the potential downsides of the proximal phalanx osteotomy, such as added time, added cost of implants, as well as potential malunions. We believe that this article underscores the importance of potential discrepancies between what the surgeon may think are important outcomes (post-operative imaging, range of motion, surgical time, etc.) and what the patient perceives are important (time to return to normal shoes, time to full weight bearing, and time to "full recovery").

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