Long Term Follow up of the Cheilectomy for Degenerative Joint Disease of the First Metatarsophalangeal Joint

Nicole Nicolosi DPM[1], Chris Hehemann DPM[1], James Connors DPM[1], Allan Boike DPM, FACFAS[2]

[1]Podiatric Medicine and Surgery Resident, Mercy Health, Cleveland Ohio, NOFA Foundation Member
[2] Dean- CEO; Professor, division of Podiatric Surgery, Kent States University- College of Podiatric Medicine, Independence Ohio

Introduction

Hallux rigidus is a symptomatic degeneration of the first metatarsophalangeal joint (1). Symptoms result from first metatarsophalangeal joint range of motion in a cartilage denuded joint, usually in the dorsal half to third of the joint, with concomitant irritation of a dorsal prominence in footwear (Figure 1) (2). These symptoms are aggravated by activities that require first metatarsophalangeal dorsiflexion such as squatting, wearing high heel shoes, ascending an incline, running, or cross-country skiing (3). The etiology of hallux rigidus is secondary to multiple predisposing factors including congenital flattening or squaring of the metatarsal head, an elevated first ray, trauma, and acquired through repetitive cyclic loading of high-impact exercises such as running or dancing (4,5,6). Hallux rigidus is fairly common and occurs in about 1 in 40 people over the age of 60 (7). Average age of onset is 43 years old and average age of surgical correction is 50 years old (6). Although there are several hallux rigidus classifications, including Regnauld's classification and the Drago, Orloff, and Jacobs scale, Coughlin and Shurnas created a classification of hallux rigidus which correlated radiographic and clinical parameters with a recommended surgical procedure (8,9,10). They concluded grades 1 and 2 and select grade 3 are treated successfully with a cheilectomy and stage 4 with an arthrodesis (10).

Treatment of hallux rigidus includes conservative and surgical options. Conservative treatment options include shoe gear modifications (rocker-bottom shoes, stiff-soled shoes, metatarsal roll bar), nonsteroidal anti-inflammatory drugs, cortisone injections, analgesics, activity modification, orthotics modified with a Morton's extension, and carbon fiber inserts (4,11). There have been several proposed surgical treatments for hallux rigidus which include excision arthroplasty (Keller osteotomy), interpositional arthroplasty, decompression osteotomies, cheilectomy, and arthrodesis (2).

There are several advantages of the cheilectomy procedure, which involves resection of 20-30% of the dorsal metatarsal head. The surgery provides the patient with an alternative to joint destructive surgical procedures and the post-procedural joint can easily be converted to an arthrodesis at any time without "burning any bridges" (2,6). A cheilectomy preserves and restores the first metatarsophalangeal range of motion, unlike an arthroplasty or arthrodesis (6,12). Following a cheilectomy, the first metatarsophalangeal joint passive range of motion has been cited to increase between 17 and 46 degrees (3). The procedure also preserves the length of the first ray and respects the sesamoid apparatus and intrinsic pedal musculature, maintaining the stability of the first metatarsophalangeal joint (13). The Valenti procedure is a type of cheilectomy technique named after the Italian surgeon Valente Valenti who initially utilized the procedure in 1976 (13). The Valenti procedure resects the metatarsal head and proximal phalanx at an angle of 80 degrees, creating a "V" resection of the dorsal two-thirds of the joint and preserving the joint space (13).

Fig. 1: Dorsal osteophyte formation noted to the first metatarsal head.

Controversy exists as to which hallux ridigus grade is indicated for a cheilectomy procedure while arthrodesis remains the gold standard for advanced disease (6). Some authors state that a cheilectomy should be preserved for lower hallux rigidus grades (1,3,7,14), while others have reported high patient satisfaction with higher hallux rigidus grades (15,16,17,18). Although the severity of degenerative arthritis is the most important consideration in determining the correct procedure for the patient, choosing a procedure is based on many variables including the patient's age, activity level, expectations, and prior treatment history (6). Clinical variables influencing procedure choice are recommended in the Coughlin and Shurnas classification including first metatarsophalangeal joint dorsiflexion limitation and pain with range of motion (10). The primary concern with performing a cheilectomy versus an arthrodesis is the recurrence of a dorsal exostosis and progression of chondrolysis and joint deterioration which may result in the return of joint pain and functional limitation (6).

The authors present a retrospective study evaluating an aggressive cheilectomy in addressing different grades of hallux rigidus. To the knowledge of this author, no study has evaluated long-term functional or satisfactory outcomes of this post-procedural joint in correlation with foot type and pre-operative radiographic hallux rigidus parameters. This study also contains the second longest cheilectomy follow-up of a mean of 7.4 years (39 weeks to 14 years) behind Coughlin and Shurnas landmark study in 2004 of a mean 9.6 year follow-up (10). The intention of this study is to analyze patient satisfaction and functional variables related to a long term follow-up after a cheilectomy in order to make recommendations for future surgical utilization. This study will also establish the incidence of subsequent first metatarsophalangeal arthrodesis following recurrence of first metatarsophalangeal degenerative joint disease after a cheilectomy.

Patients and Method

This is a 14 year retrospective review with a follow-up phone survey to determine various factors related to the success of a cheilectomy procedure. Patients were treated with a cheilectomy procedure by one surgeon, A.B., within the Podiatric section of Orthopaedics between March 1999 and May 2013 at the Cleveland Clinic, in Cleveland, OH. Patients who underwent a cheilectomy procedure performed by surgeon A.B within the identified time period were identified utilizing an electronic medical record database and included for review. Patients were excluded based on the following criteria: if they declined the telephone survey, failure to respond to the telephone survey, incomplete documentation, or were lost to follow-up. Patients who later underwent a first metatarsophalangeal joint arthrodesis were recorded but excluded from the final statistical analysis. Following a letter outlining the purpose of the research and request for consent for their participation, a telephone survey was conducted with a written script. After obtaining a list of consenting participants, the authors reviewed these patients' electronic medical records for the date of the procedure, number of weeks of follow-up since their surgery date, and the instance of additional procedures to the first metatarsophalangeal joint following the procedure. Other co-morbidities included for review were diabetes mellitus (DM), diabetes mellitus with peripheral neuropathy (DMPN), peripheral vascular disease (PVD), hemoglobin A1C, and tobacco use. Incidence of post-surgical complications of infection, dehiscence, neuritis, deep vein thrombosis, and pulmonary embolism, as well as demographics of age, sex, and body mass index (BMI) were also recorded. Electronic medical records were reviewed by three investigators (NN, CH, and JC). The electronic medical record assessors were not blind as they did participate in surgery, but did not participate in patient care. All pre-operative radiographs were evaluated to consensus by the same three investigators (NN, CH, and JC). The radiographic grade of degenerative joint disease of the first MPJ was based on the classification by Coughlin and Shurnas 2004 (10).

Statistical Analysis
Categorical variables were described using counts and percentages, and continuous variables were described using with means and standard deviations or medians and interquartile ranges. Comparisons of arthritis grade between foot types were done using the Kruskal-Wallis rank sum test. All summaries and analyses were done using R software (version 3.1.1, Vienna, Austria). A 5% level of significance was used for all testing.

Fig. 2. The aggressive cuts of the Valenti modification of the Cheilectomy are visualized.

Fig. 5: Post-cheilectomy, increased range of motion of the first MPJ is visualized.
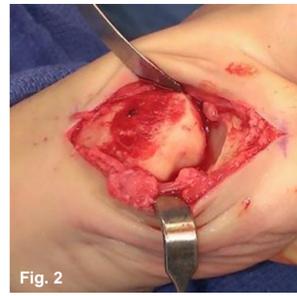

Fig. 3A: Pre-operative anterior-posterior radiograph of a hallux limitus grade 3 patient
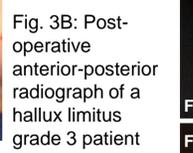
Fig. 3B: Post-operative anterior-posterior radiograph of a hallux limitus grade 3 patient

Fig. 4A: Pre-op lateral radiograph
Fig. 4B: Post-op lateral radiograph

Results

The mean follow-up was 374.33 weeks or 7.14 years (range: 39 weeks – 14.87 years). Of the 179 patients contacted for telephone survey, 60 patients wished to participate in the survey. Subsequent arthrodesis was performed in only 2/60 (3.33%) patients and these patients were excluded from review. Radiographic records were missing for 9 of the remaining 58 patients but their satisfaction surveys were not excluded. The average patient age was 55.71 ± 9.51 and 37/58 (65%) were female. Approximately 43% of patients (25/58) had a BMI between 25 and 30mg/kg[2] and 4/(58) 6.89% were active smokers, while >90% (54/58) were former smokers or never smoked. Only 2/58 (3.45%) of patient had diabetes mellitus with peripheral neuropathy while 2/58 (3.45%) have diabetes mellitus without peripheral neuropathy. There was only 2/58 (3.45%) complications of transient neuritis which resolved within 2-3 months. There was no incidence of infection, dehiscence, deep vein thrombosis, or pulmonary embolism. The results are summarized in tables 1 and 2.

Table 1	Factor Variable	Total	Percentage
Radiographic stage	1	8/49	16.33%
	2	17/49	34.69%
	3	20/49	40.81%
	4	4/49	8.16%
Sesamoid arthritis	No	28/49	57.14%
	Yes	21/49	42.86%
Foot type	Rectus	30/49	61.22%
	Pes Planus	12/49	24.49%
	Pes Cavus	7/49	14.29%
Dorsal flag sign	No	2/49	4.08%
	Yes	47/49	95.92%

Table 2	Factor Variable	Total	Mean / Percentage
Current Pain [a]		58	1.10
Improvement [a]		58	87.11
Return to function [a]		58	88.07
Footwear [a]		58	79.62
Pain relief [a]		58	87.68
Recommend [b]	No	3/58	5.17%
	Yes	55/58	94.83%
Pain [b]	Non-Existent	38/58	65.52%
	Mild/Occasional	13/58	22.41%
	Moderate/Daily	5/58	8.62%
	Severe/Constant	2/58	3.45%
Range of motion [b]	Better	35/58	60.34%
	Unchanged	20/58	34.48%
	Worse	3/58	5.17%
Limitations [b]	No Limitation	44/58	72.41%
	Some Limitation	7/58	12.07%
	Daily Limitation	7/58	12.07%
	Severe Limits	0/58	0%
Fashionable shoe [b]	No	27/58	46.55%
	Yes	31/58	53.45%
Conventional shoe [b]	No	14/58	24.14%
	Yes	44/58	75.86%
Comfort shoe [b]	No	33/58	58.62%
	Yes	25/58	43.10%
Modified Shoe [b]	No	53/58	91.37%
	Yes	5/58	8.62%
Pain Activity Limit [b]	No pain	37/58	63.79%
	Slight/occasional	13/58	22.41%
	Moderate	8/58	13.79%
	Significant limit	0/58	0%
	Severe pain	0/58	0%
Appearance [b]	Like it	35/58	60.34%
	Mostly like it	11/58	18.96%
	Not sure	8/58	13.79%
	Mostly do not like it	3/58	5.17%
	Definitely dislike it	1/58	1.72%
Frequency [b]	Wear any shoes, continuously	25/58	43.10%
	Wear any shoes, most of the time	21/58	36.20%
	Wear only walking shoes	12/58	20.69%
	Wear only athletic or casual shoes	0/58	0%
	Wear only orthopaedic or custom shoes	0/58	0%
Limp [b]	No	55/58	94.82%
	Yes	3/58	5.17%

Discussion

The satisfaction rate of the cheilectomy procedure seen in this study (87.69%) is consistent with satisfaction rates in the literature which range from 72-90% (6). In the largest cheilectomy study on 93 patients, Coughlin and Shurnas reported 97% of patients had good or excellent results (10). They concluded that patients with extensive degeneration of the joint or grade 3 joints involving greater than 50% of the articular surface should be treated with an arthrodesis (10). In our study, the highest mean satisfaction rates were in reported in radiograph stages 2 and 4 of 93.53% (n=17) and 93.75% (n=4), respectively. Despite the low number of patients, having a high long term satisfaction rate following a cheilectomy in grade 4 patients is contrary to current evidence. Hattrup and Johnson, using their own classification system, had a cheilectomy failure rate of 37.5% in patients treated with a cheilectomy for grade III hallux rigidus (1). The mean satisfaction rate of grade 3 patients was 84.8% (n=20) in our study. The literature reveals discrepancy on the duration of symptomatic relief from a cheilectomy (6). Easley et al reported that at a 2 year follow-up after a cheilectomy procedure, 38/75 (50.67%) patients worsened at least 1 grade (18). Coughlin and Shurnas, in the longest follow-up study to date, with a mean follow-up of 9.6 years, reported 97% of patients with good or excellent results (10).

In a study by Smith et al in 2012 they evaluated 17 patients with grade I or II hallux rigidus treated with a cheilectomy (19). Smith et al reported patients' AOFAS scores increased from 62 to 81, pre- and post-operatively respectively (19). On average, first metatarsophalangeal range of motion increased 16.7 degrees (33.9 degrees pre-operatively to 50.6 degrees post-operatively) (19). At an average of 7.4 year follow-up, our study reported 60.34% of patients reported improved range of motion in their first metatarsophalangeal joint than prior to the surgery. O'Malley et al in 2013 conducted a study on 81 patients treated with a cheilectomy and great toe proximal phalangeal extension osteotomy for Hattrup and John hallux rigidus grade III (5). After a mean follow-up of 4.3 years, dorsiflexion and AOFAS scores increased from 32.7 degrees and 67.2 pre-operatively to 59.7 degrees and 88.7 post-operatively, respectively (5). Approximately 85% of patients were satisfied with the procedure and only 4.9% of patients went on to arthrodesis (5). In our study, only 3.33% of patients went on to an arthrodesis.

Complications with the procedure have been cited to include transfer metatarsalgia cited to occur in 6% by Curvale et al, Harisborne et al reported 9% pain or stiffness in the joint, Sexena and Grady and Axe reported 25% and 86% sesamoiditis, respectively (13,23,24). However these complications are generally temporary and resolve in less than 6 months (13). Satisfaction rates for the Valenti procedure have been cited to range from 48-61% (13). Perler et al state that there is a 30% recurrence rate of dorsal osteophytes following a cheilectomy (25).

There were several limitations of this study including the nature of a retrospective review. Potential bias is created by excluding incomplete or missing records and only 60/179 (33.52%) patients contacted for the study wished to participate. The number of patients in this review is small, limiting stronger statistical analysis. More advanced, higher-powered, prospective or randomized control trials are necessary to further evaluate this procedure versus a first metatarsophalangeal arthrodesis.

In conclusion, an aggressive cheilectomy for the treatment of hallux rigidus yields favorable satisfaction outcomes after a long term follow-up (average 7 years) of hallux rigidus grades 1 through 3. It was found that the likelihood that this procedure necessitates a subsequent first metatarsophalangeal joint arthrodesis is low (3.33%). An aggressive cheilectomy is powerful and valuable procedure for a patient with hallux rigidus and should not be underutilized.

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