

Original Article

Therapeutic option for patients with severe hallux rigidus

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Abstract

Objectives: Subclassify grade III of Hattrup and Johnson classification into two groups, according to the remaining percentage of plantar articular cartilage, and propose a treatment option other than arthrodesis for some of these patients.

Methods: Twenty-one patients with grade III hallux rigidus were operated on between February 2015 and January 2020. The radiographic Hattrup and Johnson's classification was used, and grade III patients were submitted to frontal, lateral, and oblique radiographs. Eventually, a computed tomography (CT) was performed. The viable surface of the plantar cartilage and the percentage of the total joint was determined: if there is up to 50% of remaining plantar articular cartilage, the joint was preserved, indicating Weil osteotomy of the first metatarsal, associated with wide dorsal cheilectomy (type 3A); if less than 50%, metatarsophalangeal arthrodesis was indicated (type 3B). Patients with the first metatarsal at least 5 mm shorter than the second on frontal radiograph were excluded from the study.

Results: A mean postoperative American Orthopaedic Foot & Ankle Society (AOFAS) score of 91 was obtained. To date, no patient has needed arthrodesis, and all patients have increased joint range of motion. Shortening the central metatarsals was not necessary as a second procedure due to transfer metatarsalgia.

Conclusion: Some joints classified as grade III can be treated with an osteotomy without needing arthrodesis.

Level of Evidence IV; Therapeutic Study; Case Series.

Keywords: Hallux rigidus; Metatarsal bone; Metatarsophalangeal joint; Osteotomy.

Introduction

In a normal situation, the hallux presents a range of motion of 110° (75° dorsal and 35° plantar) in the metatarsophalangeal (MTP) joint⁽¹⁾.

Hallux rigidus is a pathology of the first MTP joint, which begins with pain, initially limited to dorsiflexion, and over time evolves with progressive stiffness until ankylosis in the most severe stages. Pain worsens with walking, especially in the initial support phase or when standing on tiptoe; this can lead the patient to overload the central metatarsals due to forefoot supination to compensate for the lack of hallux mobility⁽²⁾. The causes of this pathology may vary and have been described over time⁽³⁾; they are classified as primary,

idiopathic, or secondary, which might be a consequence of systemic processes (gout, rheumatoid arthritis, or psoriasis), iatrogenic, post-traumatic or osteochondritis dissecans.

The joint anatomical conditions, such as the long first metatarsal⁽⁴⁾ and/or elevation⁽⁵⁾, the hypermobility of the first ray, and finally, the retraction of the sesamoid⁽⁶⁾ that has been increasingly highlighted in hallux rigidus⁽⁷⁾ are predisposing and determining factors to define the surgical conduct.

The clinical aspects include joint pain in different degrees and painful limitations in active and passive mobility. In addition, it could be episodes of edema and plantar hyperkeratosis developed over time due to hyper support under the central metatarsals.

Study performed at the Sanatorio de la Trinidad Ramos Mejía, Ramos Mejía, Buenos Aires, Argentina.

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Many authors have classified this pathology differently based on subjective, objective, or radiographic concepts. Given the frequent clinical-radiological dissociation, Hatstrup and Johnson's classification⁽⁶⁾ was chosen (Table 1), subdividing it into three evolutionary degrees based on radiological changes.

The purpose of this study is:

- Describe two subtypes of grade III severe hallux rigidus based on Hatstrup and Johnson's classification.
- Demonstrate that for some patients with severe hallux rigidus, and up to 50% of remaining plantar articular cartilage, Weil osteotomy of the first metatarsal can be indicated, associated with dorsal cheilectomy and extensive joint debridement.

Methods

A prospective study with a level of evidence IV was conducted. The study was approved by the ethics committee.

Hatstrup and Johnson's classification⁽⁶⁾ was used (Table 1), subdividing the pathology into three evolutionary degrees and is based on the radiological changes that develop in the articulation with the progression of the degenerative process.

We propose to subdivide type III severe hallux rigidus by studying the percentage of remaining viable plantar cartilage measured on an oblique foot radiograph or a joint computed tomography (CT), even in cases with joint lumen loss (Figures 1 and 2). Technically, the measurement consists of locating the proximal dorsal limit and the plantar limit of the metatarsal head articular cartilage on the oblique foot radiograph. Then a central point between them following the edge of the joint metatarsal head should be identified. This point will allow the definition of hallux rigidus severity, analyzing its irregularity, subchondral sclerosis, or severe osteochondral lesion, with or without a residual joint lumen. If the cartilage lesion crosses this point towards the plantar point, then we consider the joint infeasible (3B). Otherwise, we consider that the joint can be treated with an osteotomy (3A).

Grade III was subclassified, according to these images, into two subtypes (Figure 3):

- A: up to 50% remaining viable plantar cartilage.
- B: less than 50% of remaining viable plantar cartilage.

Table 1. Hatstrup and Johnson Classification

Grade	Radiology
I	Mild osteophyte Good joint lumen preservation
II	Moderated osteophyte Decreased joint lumen Subchondral sclerosis
III	Accentuated osteophyte No visible joint lumen Geodes



Figure 1. Difference between grade II (left) and grade III (right), with joint lumen loss.



Figure 2. Frontal and oblique radiographs and sagittal computed tomography of the joint. The remaining plantar articular cartilage and the possibility of joint salvage are visualized.

Between 2015 and 2020, 21 patients with grade III hallux rigidus were operated on; 13 were female and eight male. The mean age was 52 years.

All patients were evaluated with frontal, lateral, and oblique radiographs, eventually, with CT, the first two with monopodial support.

Inclusion criteria

1. Grade IIIA hallux rigidus;
2. Pain and stiffness are present but of varying intensity.

Exclusion criteria

1. Short first metatarsal compared to the second (more than 5 mm);
2. Grade IIIB hallux rigidus;
3. Previous surgeries;
4. Simultaneous shortening of the central metatarsals.

Patients were evaluated with pre- and postoperative American Orthopaedic Foot & Ankle Society (AOFAS) scores, considering the hallux mobility compared to the preoperative score and the return to sports activity.

The mean follow-up was 22 months (range 13-35).

The anatomical location of the first metatarsal is important. In addition, the radiographic measurement of its length and elevation to the second metatarsal indicates the surgical technique presented.

The elevation of the first metatarsal is easy to identify. The simplest form was proposed by Monteagudo de la Rosa and Viladot-Pericé⁽⁹⁾ (Figure 4). Two lines were drawn, one parallel to the dorsal cortical of the first metatarsal and the other in the dorsal cortical of the second metatarsal. Normally it should form an angle between 0° and 5°. However, when there is a clear elevation of the first metatarsal the angle formed exceeds this value.

The Meary line break should be considered on the lateral radiograph, indicating a true elevation of the first ray. If the line remains constant, the elevation of the first ray is not real and is related to a midfoot pronator component (Figure 5).

The first metatarsal length was measured on a frontal radiograph with monopodial support. Two parallel lines were drawn tangent to the most distal point of the first and second metatarsals (Figure 6). A Weil osteotomy was only performed if the first metatarsal did not show a shortening by more than 5mm to the second metatarsal head, taking this value arbitrarily.



Figure 3. Type IIIA (superior) and 3B (inferior) present different treatment alternatives.



Figure 4. Profile radiograph of the foot with monopodial support: two lines were drawn, one parallel to the dorsal cortical of the first metatarsal and the other in the dorsal cortical of the second metatarsal.



Figure 5. The Meary line break confirms the first ray elevation and discards the pathology with a midfoot pronator component.

Surgical Technique

All patients were operated on in dorsal decubitus with local ankle anesthesia. The capsule is incised through a medial approach centered on the first metatarsal head, a dorsal cheilectomy was performed, and the osteophytes were removed from the metatarsal head and phalanx. The metatarsal Weil osteotomy was parallel to the floor and distal to proximal, and the reference was the upper marginal joint border. From there, the cut direction and the displacement cause the metatarsal head to descend, the controlled shortening and reorientation of the remaining plantar cartilage. Two 2.7mm screws were used to stabilize it. Sesamoid adhesions were released. The capsular plane's closure was tension-free, and the skin was closed with separate stitches. In the postoperative period, the patients used postsurgical shoes for four weeks, starting early with active joint mobilization according to the pain. Physiotherapy is indicated from the fourth week onwards.



Figure 6. The first metatarsal length is measured by tracing two parallel lines tangent to the most distal point of the first and second metatarsals.

Results

The mean forefoot AOFAS score in the preoperative period was 57 (range 42-72). The MTP joint mobility improved in all cases compared to before surgery. An AOFAS score of 91 (range 67-100) was obtained postoperatively.

All patients reported pain as the main preoperative symptom. The other symptoms were decreased mobility in twelve patients (58%), inability to perform physical activity in five patients (23%), and forefoot deformity in the remaining four (19%) (Figure 7).

Almost all patients had pain improvement in the late postoperative period (Figure 8). In addition, all patients resumed their previous daily living activities and sports; the return to usual sports activity occurred before six months for 16 patients (76%), between six and nine months for three patients (15%), and after nine months for only two patients (9%).

No patients had to be reoperated, and there was no evidence of MTP arthrodesis. This corroborates with the study by Malerba et al.⁽¹⁰⁾ in 2008.

Discussion

Hallux rigidus is a very common pathology of the forefoot, described as pain in the MTP joint of the first ray, decreased or loss of mobility, and formation of periarticular osteophytes, predominantly dorsal.

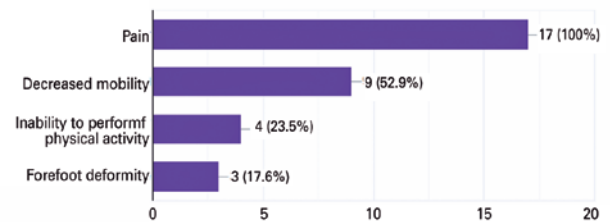


Figure 7. Main preoperative symptoms.

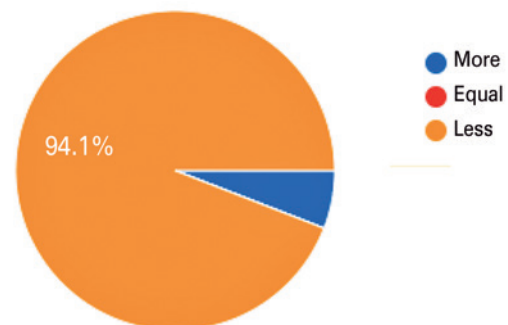


Figure 8. Postoperative pain.

The causes of this pathology are not clear. However, the most common presentation is primary, idiopathic, or secondary, produced by damage to the articular cartilage due to direct trauma of short/long duration or systemic disease as the most probable causes⁽¹¹⁾.

The treatment options are for the initial stages, conservative⁽¹²⁾ consisting of non-steroidal anti-inflammatory drugs for the acute phase, followed eventually by orthosis and, if necessary, a change of activities, especially those that need extreme hallux dorsal flexion. For more advanced stages, or failure of conservative treatment, the surgical options can preserve the articular cartilage (osteotomies, cheilectomies) or sacrifice it (arthrodesis, resection arthroplasty, and replacement arthroplasty).

The objective of surgical treatment is to correct the deformity, relieve the pain, and, if possible, prevent the recurrence of the pathology. Etiopathogenic anatomical conditions are recognized, such as the first long metatarsal and its elevation to the second metatarsal. Either the cheilectomy or the MTP arthrodesis, focus on these factors and does not prevent the disease recurrence. The osteotomy presented decompresses the joint and improves the anatomical situation of the first metatarsal, trying to avoid this recurrence^(13,14).

The therapeutic options for patients with grade III hallux rigidus are dorsal cheilectomy (resection of one-third of the joint) and MTP arthrodesis; it is important to define the percentage of remaining articular cartilage to subclassify this group into type A and B (Figure 9).

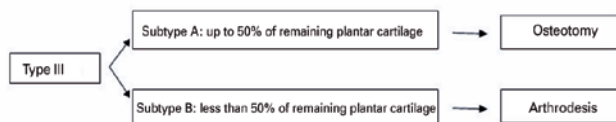


Figure 9. Hattrup and Johnson’s classification and protocol for type III.

For subtype B, the accepted treatment is MTP arthrodesis, while for subtype A we must consider the first metatarsal’s anatomical situation. The radiographic measurement of its length and elevation to the second metatarsal indicate the surgical technique presented.


The most frequent complication in hallux rigidus surgery is metatarsalgia and, in more complex cases, stress fractures of the second metatarsal due to overload because of excessive shortening. The choice of surgical technique is very important to avoid these situations. The first metatarsal length was crucial in elaborating this study and choosing the patient to perform a Weil osteotomy.

Other complications described are metatarsal-phalangeal and interphalangeal pain, avascular metatarsal head necrosis due to injury to the cephalic vessels, pseudarthrosis, infection, and the need for material removal due to intolerance⁽¹⁵⁾.

The study has some limitations. First, the number of 21 operated feet is not sufficient to reach definitive conclusions about this type of pathology, but it demonstrate no complications in the short term and no need to reoperate any patient. Second, the hallux assessment was performed using radiographs and not by CT, and the measurement of cartilage percentage and the metatarsal length is less accurate with this method. Finally, the follow-up time is very short, and the conclusions reached are only short-term. Therefore, continuing this line of study, it is important to reassess these patients to provide med/long-term information.

Conclusion

This study offers a new therapeutic option and shows the good short-term evolution of Weil osteotomy of the first metatarsal in patients with grade III hallux rigidus, subtype A, whenever the length and elevation to the second metatarsal are respected.

Authors’ contributions: Each author contributed individually and significantly to the development of this article: DY ^{*}(<https://orcid.org/0000-0002-9542-6914>) Conceived and planned the activities that led to the study, performed the surgeries and bibliographic review.; IM ^{*}(<https://orcid.org/0000-0002-9452-0175>) Statistical analysis, interpreted the results of the studies and data collection; FA ^{*}(<https://orcid.org/0000-0001-6577-8911>) performed the surgeries, participated in the review process and formatting of the article; SS ^{*}(<https://orcid.org/0000-0003-0432-8102>) clinical examination, interpreted the results of the study and approved the final version; JD ^{*}(<https://orcid.org/0000-0002-5733-6766>) performed the surgeries, clinical examination, and formatting of the article. All authors read and approved the final manuscript.*ORCID (Open Researcher and Contributor ID) .

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