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ORIGINAL ARTICLE

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Percutaneous cheilectomy combined with Watermann and Moberg osteotomies for the treatment of hallux rigidus

Queilectomia associada às osteotomias de Watermann e Moberg percutâneo para o tratamento do hálux rígido

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ABSTRACT

Objective: To evaluate the clinical and functional outcomes of patients subjected to surgical treatment of hallux rigidus by the percutaneous cheilectomy combined with Watermann and Moberg osteotomies.

Methods: Between May 2017 and August 2018, the clinical outcomes of 7 patients with a diagnosis of hallux rigidus (HR) treated using the percutaneous technique were assessed using the American Orthopedic Foot and Ankle Society (AOFAS) scale, the visual analogue scale (VAS) for pain and hallux metatarsophalangeal joint range of motion measurements during the pre- and postoperative periods. Clinical and functional outcomes were followed up for a minimum of 6 months (mean of 8 months).

Results: The range of motion of the metatarsophalangeal joint during the pre- and postoperative periods showed the following results: dorsiflexion increased on average from 28.00º (± 15.63) to 44.43º (± 17.33) (p=0.006), demonstrating an effective gain in dorsal articular movement. Plantar flexion ranged on average from 27.43º (± 2.22) to 24.43º (± 5.28) (p=0.228), with no significant difference between the evaluated periods. The AOFAS score increased on average from 52.71 (± 9.63) to 88.00 (± 8.10) (p<0.01), representing important functional improvement. The VAS score decreased on average from 7.00 (± 1.52) to 2.14 (± 2.19) (p=0.002), indicating a significant improvement in patient pain. No patient presented postoperative complications.

Conclusion: The results of the present study demonstrated that cheilectomy combined with percutaneous Watermann and Moberg osteotomies is an effective surgical treatment for hallux rigidus, with satisfactory clinical and functional outcomes.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Hallux rigidus; Metatarsophalangeal joint; Minimally invasive surgical procedures; Osteotomy.

RESUMO

Objetivo: Avaliar os resultados clínicos e funcionais de pacientes submetidos ao tratamento cirúrgico do hálux rígido pela técnica percutânea, através da queilectomia, associada às osteotomias de Watermann e Moberg.

Métodos: Foram comparados, entre maio de 2017 e agosto de 2018, os resultados clínicos de 7 pacientes com diagnóstico de hálux rígido (HR), operados pela técnica percutânea, por meio da mensuração da escala AOFAS *(American Orthopaedic Foot and Ankle Society*), da Escala Analógica Visual de Dor (EVA) e da amplitude de movimento articular metatarsofalangiana do hálux, nos períodos pré e pós-operatório. Os resultados clínicos e funcionais se deram com seguimento mínimo de 6 meses (média de 8 meses).

Resultados: A amplitude de movimento da articulação metatarsofalangiana no período pré e pós-operatório apresentaram os seguintes resultados: a dorsiflexão variou, na média, de 28,00º (±15,63) para 44,43º (±17,33) (p=0, 006), demostrando ganho efetivo de movimento articular dorsal. Já a flexão plantar variou, na média, de 27,43º (±2,22) para 24,43º (±5,28) (p=0,228), sem diferença relevante nos períodos avaliados. Em relação ao AOFAS, variou, na média, de 52,71 (±9,63) para 88,00 (±8,10) (p<0,01), representando importante melhora funcional. Quanto à EVA, na média, de 7,00 (±1,52) para 2,14 (±2,19) (p=0,002), observando melhora significativa no quadro álgico dos pacientes. Nenhum caso apresentou complicações pós-operatória.

Work performed at the Associação Beneficente Nossa Senhora do Pari, São Paulo, SP, Brazil.

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Conclusão: Os resultados do presente estudo demonstraram que a queilectomia associada às osteotomias de Watermann e Moberg, de forma percutânea, são efetivas no tratamento cirúrgico do hálux rígido, auferindo resultados clínicos e funcionais satisfatórios.
Nível de Evidência IV; Estudos Terapêuticos; Série de Casos.

Descritores: Hálux rígido; Articulação metatarsofalangiana; Procedimentos cirúrgicos minimamente invasivos; Osteotomia.

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INTRODUCTION

Hallux rigidus is a degenerative condition characterized by arthritic involvement of the first metatarsophalangeal joint of the hallux with bone formation, especially on the dorsal side, progressing to range of motion restriction and significant pain. The visible hyperemic aspect of the hallux and dorsal prominence are signs of the synovitis and osteophytes that occur in the disease. The deficit in joint dorsiflexion often precludes the use of high heels by women[1-4].

The disease evolution is progressive and debilitating, causing narrowing of the joint space, flattening of the first metatarsal head and proliferation of osteophytes, especially on the dorsal and dorsolateral sides[3,5,6]. The etiology is multifactorial and is related to heredity, traumatic injuries, the size and shape of the first metatarsal head and hypermobility of the first ray[7,8], among other causes.

Numerous classification methods are available for this condition. In the present study, we used the classification proposed by Coughlin and Shurnas[8] for hallux rigidus, which uses the range of motion of the metatarsophalangeal joint, radiographic evaluation and clinical aspects to classify the condition into 5 subtypes according to the stage of the disease.

Decision-making regarding the surgical treatment of hallux rigidus is based on the degree of joint involvement found on clinical and radiographic evaluation[7-10]. Furthermore, age and functional demand[11] should be considered when choosing the surgical technique.

Numerous open surgical techniques are currently described in the literature, and there is still no consensus on the best treatment. Methods that preserve the joint, such as cheilectomy and osteotomies, are typically reserved for mild and moderate cases[9,10]; however, in advanced cases, hemiarthroplasty[12] or bone fusion[13] are the best techniques indicated.

Minimally invasive surgeries have been widely disseminated. They preserve the soft tissues and promote a reduction in recovery time and morbidity associated with the disease process and surgical intervention[14-16].

The aim of the present study was to evaluate the clinical and functional outcomes of the percutaneous cheilectomy combined with Watermann and Moberg osteotomies in cases of hallux rigidus (grades I, II and III).

METHODS

This study was approved by the Research Ethics Committee with registration in the Brazil Platform under CAAE number: 08373018.4.0000.5670.

This retrospective study collected data from the medical records of patients with hallux rigidus who underwent surgical treatment using the percutaneous technique between May 2017 and August 2018.

Only patients classified with subtypes I, II and III according to the modified classification proposed by Coughlin and Shurnas[8] were included in the study.

Patients with peripheral sensory neuropathy, severe vasculopathy and advanced metatarsophalangeal joint osteoarthritis (subtype IV) were excluded from the study. Thus, the study sample consisted of 7 patients.

The American Orthopedic Food and Ankle Society (AOFAS) score[17] for the clinical evaluation of hallux rigidus was applied during the preoperative period and postoperatively after a minimum follow-up of 6 months (mean of 8 months). This scale has a maximum score of 100 points, divided into a 45 points for functional evaluation, 40 points related to pain and 15 points related to the alignment of the first ray.

In addition, we used the visual analog scale (VAS) for pain[18] to evaluate the pain progression of patients after the surgery.

The range of motion of the metatarsophalangeal joint was always measured by the same examiner with the patient seated. The fixed bar of the goniometer was placed medially along the axis of the first metatarsal, and the movable bar was placed above the proximal phalanx of the hallux, which is associated with dorsiflexion and plantar flexion. The joint was passively positioned for measurement during the pre- and postoperative periods.

At the end of the follow-up period, the patients were asked about their degree of satisfaction with the surgery (satisfied, partially satisfied, dissatisfied).

Regarding the criteria for performing the percutaneous osteotomies, it was assumed that all the arthritic joints required mechanical rebalancing (decompression) by means of cheilectomy and osteotomies. Thus, in the present study, all patients underwent cheilectomy, Moberg osteotomy and Watermann osteotomy[14-16], regardless of whether they were classified as grade I, II or III.

In addition to shortening the first ray, both osteotomies promote the relaxation of the capsular, tendinous and ligamentous structures; reorient the axis of the proximal phalanx of the hallux in the sagittal plane; and dorsiflex the distal metatarsal articular surface. These changes facilitate hallux extension, which is essential for the gait push-off phase.

Surgical technique

The patients underwent the surgical procedure under spinal anesthesia, in dorsal decubitus and without the use of a tourniquet. The operating room was equipped with an image intensifier, an electric motor and the instruments necessary for percutaneous surgery (shavers, drills, and cutters)[14,15].

The first surgical step was percutaneous cheilectomy of the dorsal and dorsolateral osteophytes[19] on the first metatarsal head (Figure 1) through a 1-cm incision. Bone debris was removed by compressing the hallux and forcing the bone debris to exit through the incision, followed by cleaning with saline using a syringe inserted into the portal[14,15].

Next, through the same portal created on the distal and medial sides of the first metatarsal, a distal osteotomy with a dorsal base, called a Watermann osteotomy[14,20], was performed to decompress the metatarsophalangeal joint and elevate the first metatarsal head[15].

The last step of the procedure was the osteotomy of the dorsal base of the proximal hallux phalanx, known as a Moberg osteotomy[3,14,21], which was performed through a 1-cm medial portal (Figure 2).

Each procedure was monitored with the aid of an image intensifier.

The incisions were sutured with 4.0 monofilament nylon thread, and then conventional dressing was performed with additional taping of the hallux to maintain a degree of dorsiflexion[14].

During the postoperative period, the patients were allowed to walk with full weight-bearing immediately while protected by a rigid orthopedic shoe, which was worn for 6 weeks[14,15].

Figure 1. Dorsal osteophyte of the first metatarsal and proximal phalanx (A) and postoperative outcome (B).
Source: Author's personal archive.

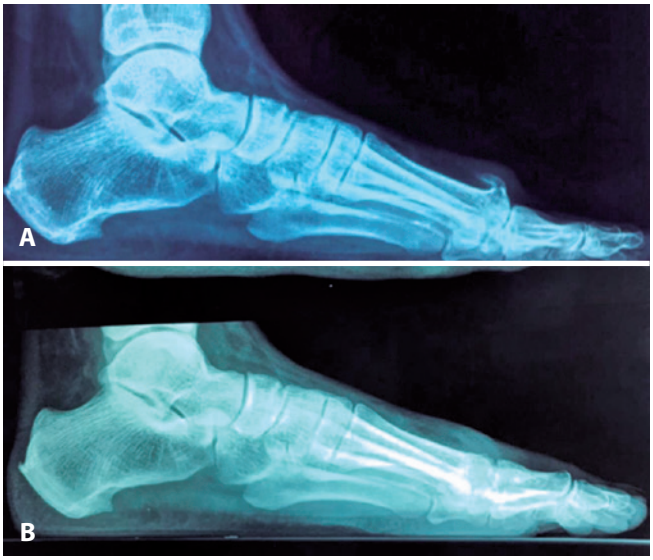

Figure 2. Profile radiographs before (A) and after (B) the procedure.
Source: Author's personal archive.

Taping of the hallux was discontinued 3 weeks after surgery. After 6 weeks, the patients were no longer required any special protection and were oriented to begin using conventional footwear.

The t and Wilcoxon tests were used to compare the pre- and postoperative measurements. The level of significance adopted was $p<0.05$.

RESULTS

The study sample consisted of 7 patients with a mean age of 51.5 years.

The range of motion of the metatarsophalangeal joint assessed in the pre- and postoperative period showed the following results: dorsiflexion increased from 28.00º to 44.43º on average, showing an effective gain in dorsal joint movement. In contrast, plantar flexion varied on average from 27.43º to 24.43º, with no significant difference between the evaluated periods.

The pre- and postoperative AOFAS scores increased considerably, representing significant functional improvement after surgery. The VAS scores revealed a significant decrease in the patients' pain. These results are shown in table 1.

All patients who underwent percutaneous surgery for the treatment of hallux rigidus showed an overall improvement after the procedure; they returned to their occupational and recreational activities with little or no restriction in the use of footwear.

Complications related to surgery, such as joint stiffness, surgical wound infection and dorsomedial cutaneous nerve injury, were not reported in the present study.

After the follow-up period, all patients stated that they were satisfied with the outcome of the procedure.

DISCUSSION

The concept of percutaneous surgery is innovative and changes several paradigms, which has generated some resistance on the part of specialists. The greatest advantages of the technique are the early rehabilitation, lower infection rate and cosmetic satisfaction due to the smaller surgical access[13-16].

The need for specific training, an electric motor and the appropriate materials are factors that limit the reproducibility of the surgical technique[22].

One possible complication found in cheilectomy using the percutaneous surgical technique is dorsomedial cutaneous nerve injury, which occurs in up to 15% of cases according to a cadaveric study[23]. However, in the present study, no signs of hypoesthesia were observed in any operated patient.

There are no studies comparing the level of postoperative pain in patients undergoing open or percutaneous hallux rigidus surgery, but a prospective randomized study by Lee et al.[23] showed a significant reduction in postoperative pain in hallux valgus cases treated with percutaneous Chevron and open Scarf osteotomies.

The AOFAS scores before and after surgery corroborated data found in the literature[17], which implies improvement in joint function.

Postoperative dorsiflexion of the metatarsophalangeal joint, achieved via percutaneous osteotomy of the first metatarsal, showed a significant increase, similar to the results reported with the open technique[20]. Plantar flexion decreased after the procedure due to the joint reorientation provided by the Watermann osteotomy, which alters the range of motion by raising the first metatarsal head. This restriction in plantar mobility did not result in any clinical repercussions that were perceived by the patients.

We observed that compared to the conventional open surgical technique, once the surgeon was habituated to the surgical maneuvers of the percutaneous technique, he or she could perform the procedure in a significantly shorter time and with much less damage to the soft tissues, which in theory leads to a less painful postoperative period with the possibility of earlier rehabilitation. A possible criticism of postoperative aspects of the percutaneous technique is the need to tape the hallux to immobilize the hallux metatarsophalangeal joint for 3 weeks, which contradicts the

Table 1. Clinical and functional progression

	AOFAS pre-op/post-op	VAS pre-op/post-op	Dorsiflexion pre-op/post-op	Plantar flexion pre-op/post-op
Means	52.71 88.00	7.00 2.14	28.00 44.43	27.43 24.43
Standard deviation	9.639 8.103	1.528 2.193	15.631 17.338	2.225 5.287
P-value	p<0.01	0.002	0.006	0.228

Source: Prepared by the author based on the results of the research.

principle of early mobilization after hallux rigidus surgery. Future studies using internal fixation may demonstrate an even greater benefit in the final mobility gain.

In this case series, the results obtained were encouraging, although the sample size was small and the follow-up period was short.

CONCLUSION

The results of the present study demonstrate that percutaneous cheilectomy combined with Watermann and Moberg osteotomies is effective in the surgical treatment of hallux rigidus, producing satisfactory clinical and functional outcomes.

Authors' contributions: Each author contributed individually and significantly to the development of this article: JFA *(https://orcid.org/0000-0001-6975-7763) conceived and planned the activities that led to the study, wrote the article, interpreted the results of the study, participated in the review process, approved the final version; ADB *(https://orcid.org/0000-0002-5991-1701) wrote the article, participated in the review process, approved the final version. *ORCID (Open Researcher and Contributor ID).

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