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First Metatarsophalangeal Joint Arthroscopy of 36 Consecutive Cases

Artroskopie I. metatarzofalangeálního kloubu – soubor 36 po sobě jdoucích případů

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ABSTRACT

PURPOSE OF THE STUDY

In this study, we retrospectively reviewed a consecutive case series of first metatarsophalangeal (MTP) joint arthroscopies performed in our department over a span of six years. This study aimed to evaluate the efficacy and safety of arthroscopic treatment for various first MTP joint pathologies.

MATERIAL AND METHODS

A total of 36 patients that underwent first MTP joint arthroscopy between January 2014 and December 2019 were reviewed. The mean age at the time of surgery was 38.3 years (range, 14–65), with no gender predominance (19 males). All arthroscopies were performed by a single surgeon using a 2.7 mm arthroscope with a 30° viewing angle as well as other standard instruments with a diameter equal to or smaller than 3.5 mm. Postoperative results were assessed by a satisfaction questionnaire obtained during the telephone interview. For patients with sesamoid bone pathology ability to return to sports activities was also evaluated.

RESULTS

The far most common indication, in even twenty-nine patients, was hallux rigidus, five patients were treated for nonunion of sesamoid bone fracture, one patient had an osteochondral defect of the first metatarsal head and one was treated due to the development of arthrofibrosis following the open corrective procedure of hallux valgus. The mean follow-up was 31.2 months. Thirty-four patients responded to the satisfaction questionnaire. Thirty patients (88.2%) were either satisfied or very satisfied with the procedure and thirty-one (91.2%) of them stated that they would undergo the same procedure again. The satisfaction rate for patients with early stages of hallux rigidus (grade 1 and 2) was 90.4%. Only one patient in this group (2.8%) required open revision surgery due to recurrence of pain and joint stiffness. All patients with nonunion of sesamoid bone fracture were very satisfied with the procedure, and three out of four patients (75%) who were also competitive athletes resumed their sports activity at the same or improved level after the arthroscopy. Regarding arthroscopy-related complications we observed four cases (11.1%) of iatrogenic injury to dorsal sensory nerves of the great toe, resulting in only one permanent sensory impairment.

DISCUSSION

Considering the high satisfaction rate and low rate of complications in our study, as well as those published in the literature, we can suggest that arthroscopy of the first MTP joint is a safe and effective procedure.

CONCLUSIONS

Arthroscopy of the first MTP joint certainly has a place in the treatment of some pathological conditions of the first MTP joint, and in our opinion, it should be first-line surgical therapy for the initial stages of hallux rigidus and sesamoid bone pathology.

Key words: arthroscopy, metatarsophalangeal joint, great toe, hallux rigidus, cheilectomy, sesamoid bone, sesamoidectomy.

INTRODUCTION

The development of arthroscopic equipment for small joints, in addition to ever-improving surgical technique and education, paved the road for the introduction of the first metatarsophalangeal (MTP) joint arthroscopy. In 1988, Bartlett was first to publish a successful use of first MTP joint arthroscopy, treating an adolescent patient with first metatarsal (MT) head osteochondritis dissecans (OCD) (2). Since then, only a hand full of case reports and clinical studies have been published describing the arthroscopic treatment of various first MTP joint disorders (1–5, 7, 8, 10–13, 15, 19, 20).

In this retrospective study, we analysed a series of first MTP joint arthroscopy cases performed in our department by a single surgeon. The study aimed to present our experience with arthroscopic treatment for several first MTP joint pathologies. We wanted to assess the functional recovery and patient satisfaction with the first MTP joint arthroscopic surgery.

MATERIAL AND METHODS

This study evaluated 36 consecutive patients who had undergone first MTP joint arthroscopy at our department between January 2014 and December 2019. The present study was approved by the Institutional Review Board and has been conducted according to the Declaration of Helsinki.

The preoperative evaluation performed by the senior author (I.B.) included a complete history and a physical examination. The patients' preoperative anteroposterior and laterolateral radiographs of the first MTP joint were obtained and assessed. Available medical records were retrospectively reviewed by an independent examiner (I.L.) who was not involved in the patients' care. Patients with hallux rigidus were graded according to Coughlin and Shurnas classification system based on preoperative radiographic and clinical findings (6).

Postoperative results were assessed by a telephone interview performed by the independent examiner (I.L.). During the interview, patients were asked to evaluate their satisfaction level with the procedure using the 5-point Likert scale, ranging from very satisfied to very dissatisfied (14). They were also asked if they would undergo the same process again. Patients with sesamoid bone pathology were evaluated for the ability to return to sports activities. Those who had successfully returned to sports were additionally queried about the perceived postoperative level of sports performance. Likewise, patients were also asked about a reason for the cessation of sports activity.

Surgical technique

A 2.7 mm arthroscope with a 30° viewing angle and gravity irrigation system as well as standard mechanical, motorised and electrosurgical instruments with a diameter equal to or smaller than 3.5 mm, were used for all arthroscopies. When better visualisation and an increase of working space in the joint was desired, a gauze was used in a finger trap fashion for the manual distraction of the joint.

The procedure was performed by the senior author (I.B.) in a standardised manner. All patients underwent spinal anaesthesia and were positioned supine on the operating table with the heel of the foot placed at the edge of the table. To facilitate the approach to the operated toe, the ipsilateral hip and leg were raised by the placement of a cushion to ensure that the operated foot is vertical and slightly above the contralateral leg.

Before portal placements, an important anatomic landmark, the course of extensor hallucis longus (EHL) tendon, was marked. At the joint line of the first MTP joint, dorsolateral and dorsomedial portals were marked 5 mm lateral and 5 mm medial to the EHL tendon, respectively. The position of an additional medial portal was marked on the medial side of the joint line, halfway between the dorsal and plantar borders of the first MT head. When surgery on the lateral sesamoid bone had been expected, an additional arthroscopic portal, located in the web-space between the first and the second toe, was marked.

At the start of the procedure, the first MTP joint was expanded with 2 to 3 mL of normal saline through the site of the dorsolateral portal. Then, with a No. 15 blade, a longitudinal skin incision was made for the dorsolateral portal. Using the "nick and spread" technique, the joint was penetrated with a small haemostat followed by the insertion of a small switching stick. The switching stick was used as a guide for a cannula and a small joint arthroscope to be inserted into the joint. The dorsomedial portal was then established under direct arthroscopic visualisation by introducing an intramuscular needle (Fig. 1). After confirmation of its adequate position, the needle was removed, and the dorsomedial portal was created using the "nick and spread" technique. Both portals were used for visualisation and as a working portal. After proper portal placement, intra-articular structures of the first MTP joint were thoroughly examined. According to the preoperative diagnosis and intraoperative findings, an appropriate procedure was executed. In cases involving hallux rigidus, starting with partial joint synovectomy allowed better visualisation of dorsal osteophytes. The extent of arthroscopic cheilectomy was in accordance with the technique described by Iqbal and Chana (10), thereby dorsal osteophytes were resected to the point at which 70° of dorsiflexion of the first MTP joint could be achieved. To perform partial or complete sesamoidectomy in patients with sesamoid bone pathology, an additional medial portal as well as lateral web-space portal were established under direct arthroscopic visualisation. The presence of the first MT head OCD required additional debridement and microfractures of the osteochondral defect. First MTP joint arthrofibrosis prompted synovial scar tissue excision. Upon finishing the arthroscopic procedure no drainage was placed and the wounds were closed with a 3-0 non-absorbable monofilament suture.

Postoperative care

On the third postoperative day, all patients started with gentle passive range of motion (ROM) exercises for the first MTP joint, including active ankle ROM exercises. At the end of the second postoperative week, the patients started with active and active-assisted ROM exercises for the first MTP joint. Strengthening and ROM exercises were initiated at the fourth postoperative week. For the first three postoperative weeks, the patients walked with the aid of two crutches and were allowed to weight-bear as tolerated in a removable short-leg walking splint with a rocker sole. For the next six weeks, the patients were instructed to wear rocker bottom shoe. At that time, we recommended gradual weaning and starting to wear regular shoe. Patients returned progressively to sports three to six months after the surgery.

RESULTS

The cohort had no significant gender predominance with a mean age of 38.3 years (range, 14–65). A majority of patients (80.5%) were operated on due to hallux rigidus. Demographic data distributed according to indi-

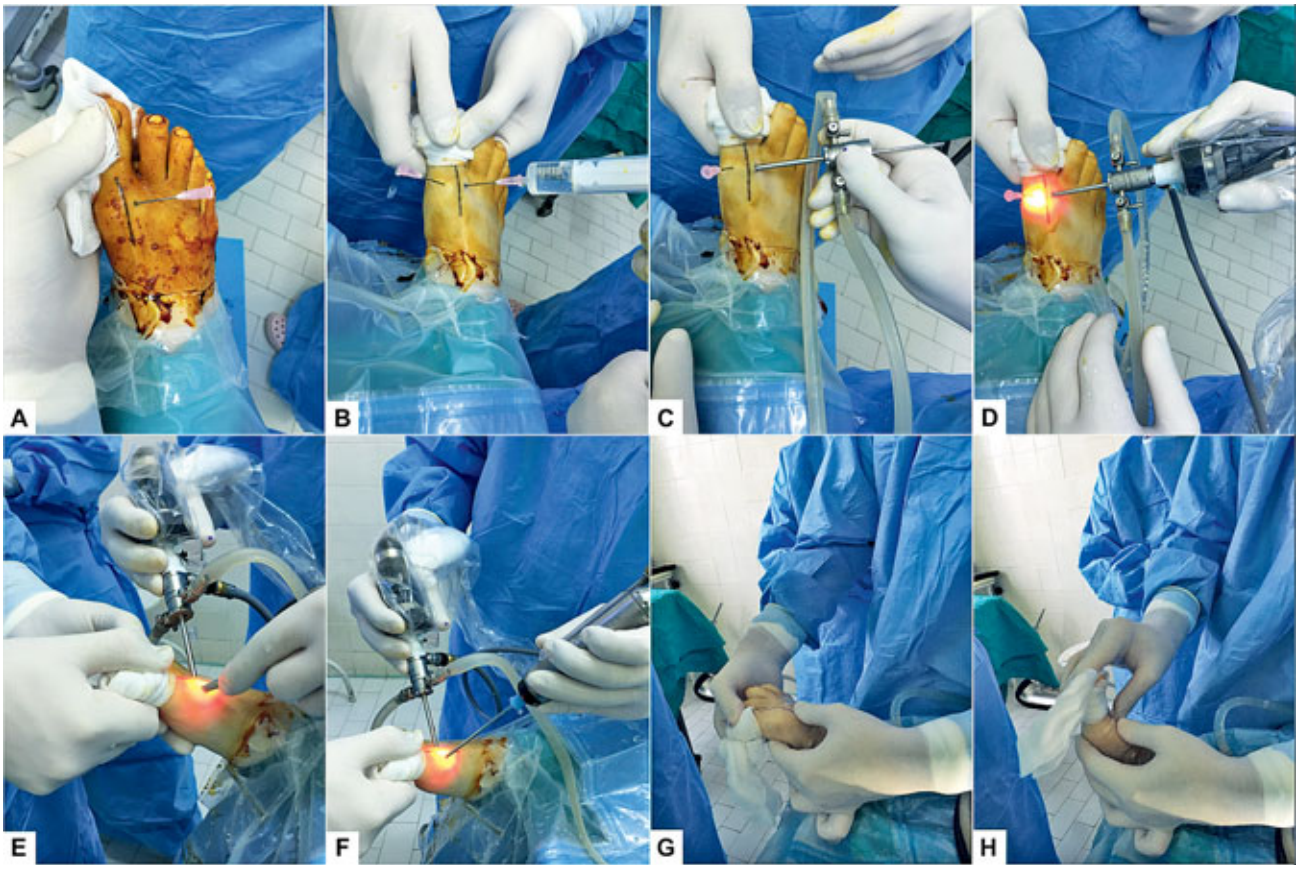

Fig. 1. Intraoperative images of first metatarsophalangeal (MTP) joint arthroscopy.
A – The course of extensor hallucis longus is marked with a dark sterile pen. Intramuscular needle is placed into the joint marking the site of the dorsolateral portal.
B – Second intramuscular needle is placed into the joint marking the site of the dorsomedial portal. The first metatarsophalangeal joint is then expanded with 2 to 3 mL of normal saline through a needle placed at the site of the dorsolateral portal. The flow of saline throughout the needle placed at the site of the dorsomedial portal confirms the intra-articular position of both needles.
C – Arthroscopic cannula is inserted over a switching stick and through the dorsolateral portal into the joint.
D – A 2.7 mm arthroscope with a 30° viewing angle is inserted into the joint. The camera is rotated in the dorsomedial direction so that the intramuscular needle inserted through the site of the dorsomedial portal is visualised.
E – Under direct arthroscopic visualisation the joint capsule is penetrated with the small haemostat at the site of the dorsomedial portal.
F – Arthroscope is inserted through the dorsolateral portal which is used as a viewing portal and the 3.5 mm arthroscopic shaver is inserted through the dorsomedial portal which is used as a working portal.
G and H – After arthroscopic cheilectomy range of motion of the first MTP joint was assessed; 50° of plantar and 70° of dorsal flexion have been achieved.

cations for first MTP joint arthroscopy is presented in Table 1. A tourniquet was used in 29 out of 36 cases.

Thirty-four patients (94.4%) were available for a telephone interview. Thirty patients (88.2%) were satisfied or very satisfied with the performed procedure, two patients (5.9%) were neither satisfied nor dissatisfied, and two patients (5.9%) were dissatisfied. Thirty-one patient (91.2%) stated that they would undergo the same procedure again. Two patients with a preoperative diagnosis of hallux rigidus were not available for the telephone interview, but they both underwent a regular postoperative examination six months after the surgery. The mean follow-up was 31.2 months (range 3–68 months).

The mean preoperative duration of symptoms for the group of patients with hallux rigidus was 2.5 years

Table 1. Demographic data distributed according to indications for first metatarsophalangeal joint arthroscopy presented in the study

Indication	Number of patients (male/female)	Mean age in years at the time of surgery (range)
Hallux rigidus	29 (19/10)	41.8 (16–65)
Nonunion of sesamoid fracture	5 (0/5)	21.2 (14–39)
Osteochondritis dissecans of the first metatarsal head	1 (0/1)	31
Arthrofibrosis	1 (0/1)	29
Total	36 (19/17)	38.3 (14–65)

Table 2. Demographic data, treatment specifics and survey results for patients with nonunion of sesamoid fracture

Gender* / Age (years)	Sports activity	Preoperative diagnostic imaging±	Arthroscopic procedure	Arthroscopic portalsx	Follow-up (months)	Level of satisfaction with the procedure[1]	Level of sports performance achieved after surgery[2]
F / 17	basketball	X-ray, MRI	partial medial sesamoidectomy	DL, M	54	very satisfied	better
F / 39	jogging	X-ray, MRI	total lateral sesamoidectomy	DL, DM, M, WS	25	very satisfied	did not return°
F / 18	dancing	X-ray, MRI, CT	total medial sesamoidectomy	DL, DM, M	14	very satisfied	equal
F / 14	basketball	X-ray, CT	total lateral sesamoidectomy	DL, DM, M	6	very satisfied	returned to running~
F / 18	basketball	X-ray, MRI	total medial sesamoidectomy	DL, DM, M	4	very satisfied	equal

* F – female
± MRI – magnetic resonance imaging, CT – computed tomography
x DL – dorsolateral, DM - dorsomedial, M – medial, WS – web space
[1] Level of satisfaction with the procedure using 5-point Likert scale (5 – very satisfied, 4 – satisfied, 3 – neutral, 2 – dissatisfied, 1 – very dissatisfied)
[2] Level of sports performance achieved after surgery in comparison to the level of sports performance before the injury
° Patient ceased her preoperative sport activity due to reasons unrelated to the status of her first metatarsophalangeal joint
~ Patient was still in a rehabilitation process at the last follow-up. She did not yet return to basketball, but she returned to running without any difficulties.

(range from 6 months to 10 years). Eight patients (27.6%) had a history of preceding great toe trauma. According to Coughlin and Shurnas classification system, eleven patients (37.9%) had a grade 1, twelve patients (41.4%) had a grade 2 and six patients (20.7%) had a grade 3 hallux rigidus. The satisfaction rate for those with grade 1 hallux rigidus was 77.8%, 100% for those with grade 2, and 83.3% for those with grade 3. Overall, 24 patients (88.9%) were satisfied or very satisfied with the arthroscopic cheilectomy, and 25 patients (92.6%) in this group stated that they would undergo the same procedure again.

Demographic data, treatment specifics and survey results for a group of patients with

sesamoid fracture nonunion are presented in Table 2. All patients with sesamoid pathology were involved in strenuous sports activities before the onset of symptoms without a history of trauma. This group of patients were very satisfied with the procedure, and three out of four patients who were involved in competitive sports activity made a full return after the arthroscopy. All of them confirmed they would undergo the same process again if needed.

The patient with the first MT head OCD was very satisfied with the procedure and would undergo the same process again. Patient with arthrofibrosis, following the open corrective procedure of hallux valgus, reported being painful and dissatisfied after the arthroscopy stating that she would not undergo the same process again.

No intraoperative complications were noted. No skin complications or infections were encountered after the arthroscopy. In the early postoperative period, three patients (8.3%) developed transient sensory disturbances, while one patient (2.8%) developed a permanent loss of sensation on the dorsal aspect of the great toe. One patient with hallux rigidus required open revision surgery six months after the arthroscopy due to the persistence of pain and joint stiffness.

DISCUSSION

The results of this study confirmed that the arthroscopy of the first MTP joint is an effective method, with low complication rates and high postoperative satisfaction. They also attest the possibility to multipurpose use of the arthroscopic method in treating various common conditions affecting the first MTP joint.

Regarding postoperative satisfaction levels, Ahn et al. (1) reported, in the most extensive study to date, that 56 out of 59 patients (94.9%) were satisfied with the arthroscopic procedure of the first MTP joint. Iqbal et al. (10) had a 100% satisfaction rate in their study involving 15 patients. Similarly, research published by Debnath et al. (8) showed 19 out of 20 patients (95%) were satisfied with the results. Our study shows a satisfaction rate of 88.2%.

Hallux rigidus is a fairly common form of osteoarthritis of the foot. Surgical treatment is indicated in cases when conservative measures such as NSAIDs, activity and shoe modifications fail. Early stages of hallux rigidus, especially patients with grade 1 and 2 according to Coughlin and Shurnas classification system, require cheilectomy as a surgical method of choice. Long-term results of an open cheilectomy, first described in 1959 by DuVries (9), are favourable. With an average follow-up of 9.6 years, Coughlin and Shurnas (6) reported that 92% of cheilectomy procedures were successful in terms of pain relief and restoration of function. Nicolosi et al.

(16) have published the study with a mean follow-up period of 7.1 years. They reported that after an open cheilectomy procedure, 87.9% of patients experienced no limitations in their daily activities. Success rates in literature similarly range from 72% to 90% (17, 18).

A tendency to perform arthroscopic cheilectomy is increasing. In 1998, Iqbal and Chana (10) published a first case series of 15 patients who underwent arthroscopic cheilectomy. At a mean follow-up of 9.4 months, ten patients (67%) experienced complete relief of pain, and all were either satisfied or very satisfied with the procedure. Van Dijk et al. (19) reported 2-year follow-up results of arthroscopic cheilectomy performed in 17 patients divided into two groups according to the extent of degenerative changes of the first MTP joint. In a group of patients with dorsal osteophytes without significant degenerative joint changes, 8 out of 12 patients (66.7%) had good or excellent results. However, only 2 out of 5 patients (40%) with hallux rigidus and established arthrosis had satisfactory results. Debnath et al. (8) reported that 12 patients in the early stages of hallux rigidus treated arthroscopically, were pain-free for a mean of 24 months before they had a recurrence of symptoms. Three of these patients (four cases) required first MTP joint replacement surgery at a mean of 2 years after arthroscopy. Consistent with published results, 88.9% of our patients who underwent arthroscopic cheilectomy were either satisfied or very satisfied with the procedure, and only one patient (2.8%) required open revision surgery due to recurrence of pain and functional impairment six months after the arthroscopy.

Van Dijk et al. (19) reported the first successful arthroscopic removal of the lateral sesamoid bone in 1998. A year later, Carro et al. (4) reported on successful arthroscopic removal of the medial sesamoid bone. Ahn et al. (1) evaluated 69 arthroscopic procedures of the first MTP joint in which they had successfully treated three patients with nonunion of the medial sesamoid bone. Two cases included an arthroscopic excision of the distal fragment, while the third case involved a whole medial sesamoidectomy. All patients were satisfied with the procedure, and the mean American Orthopaedic Foot and Ankle Society (AOFAS) score improved from 71 preoperatively to 94 at the last follow-up. Vega and Dalmao (20) reported nine cases of sesamoid bone necrosis treated with arthroscopic partial sesamoidectomy. Lateral sesamoid was affected in six patients and medial sesamoid in the other three. After a minimum 1-year follow-up, six patients were pain-free, and the other three patients reported persisting pain during prolonged walking or standing. As opposed to published papers, the majority of our patients (80%) underwent total resection of the affected sesamoid bone instead of partial sesamoidectomy. Furthermore, four out of five patients (80%) were female adolescent athletes, and they were all very satisfied with the procedure. Three of them returned to their previous sport activity at the same or improved level. These results suggest that arthroscopic sesamoidectomy is a safe and effective procedure for young athletes who want to resume their sport activity.

Hallux valgus is the most common first MTP joint pathology, and interest in treating this condition by either arthroscopy alone or combined with open or endoscopic corrective procedures, is increasing. Arthroscopy can be used for a release of lateral structures to achieve the reduction of sesamoids, or it can be used for synovectomy and cheilectomy in patients with elements of hallux rigidus. In recent literature, arthroscopic treatment of hallux valgus was reported only in two studies. Lui (13) analysed the arthroscopic findings of 121 first MTP joint arthroscopies in 107 patients treated for hallux valgus. Of those with preoperative first MTP joint pain, 90% had complete or significant pain relief following arthroscopic synovectomy. They concluded that first MTP joint arthroscopy is an effective tool to control joint pain. Ahn et al. (1) reported similar results in 25 patients with hallux valgus and concomitant dorsolateral tenderness of the first MTP joint. They were treated with chevron metatarsal osteotomy and arthroscopic resection of inflamed synovium with 84% of these patients reported diminished pain in the dorsolateral area of the joint.

Postoperative complications of first MTP joint arthroscopy are rare but include injury to the dorsomedial or dorsolateral digital nerve, wound healing complications, superficial or deep wound infection and iatrogenic cartilage injury. The most commonly reported complication is an injury of the dorsolateral or dorsomedial digital nerve resulting in temporary or permanent sensory impairment. Van Dijk et al. (19) reported two patients (8.3%) with a transient loss of sensitivity. Debnath et al. (8) reported two patients (10%) with paraesthesia over the medial aspect of the great toe who recovered within two months after the surgery. Ahn et al. (1) reported a complication rate of 2.9% in a series of 69 procedures. There was a case of superficial wound infection and an example of transient neurapraxia of the dorsolateral digital nerve. Consistent with published literature, we encountered four cases (11.1%) of iatrogenic injury to dorsal sensory nerves of the great toe, resulting in only one permanent sensory impairment (2.8%).

The limitation of this retrospective study is a relatively short follow-up period of 33.1 months. To observe the natural course and the impact of treatment of degenerative joint diseases such as hallux rigidus, long-term follow-up is needed. Another limitation is that we tested patients' satisfaction which is prone to subjectivity. As with all retrospective studies, there may be other systematic effects that may tend to bias the results.

CONCLUSIONS

Considering the results of this study and the published results in the literature, arthroscopy of the first MTP joint certainly has a place in the treatment of various pathological conditions of the first MTP joint, primarily for the initial stages of the hallux rigidus and sesamoid bone pathology. Further prospective research is needed to compare the results of open and arthroscopic surgery.

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