



## Evaluation of the treatment of hallux rigidus by percutaneous surgery

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**This longitudinal prospective study of 22 patients (26 feet) aimed to evaluate the effectiveness of percutaneous surgery in the treatment of hallux rigidus, and to assess patient satisfaction with the result of this surgical approach. Pain levels (VAS), quality of life (SF-12) and clinical stage (AOFAS) were scored prior to surgery and 18 months after surgery. Pain relief was noted in all cases, with mean pain scores falling from 7.44 before surgery to 1.69. Perception of quality of life also improved, while AOFAS scores rose from 58.45 to 92.36. These results suggest that percutaneous treatment of hallux rigidus, consisting in capsular release, resection of bony spurs and dorsal wedge osteotomy of the first metatarsophalangeal joint, is effective in terms of both clinical outcome and patient satisfaction, as the scores for both measures were noted to be higher than reported using conventional techniques.**

**Keywords :** hallux rigidus ; treatment ; outcome ; percutaneous surgery.

This condition was initially described by in 1881 by Nicoladini and later, in 1887, by Davies-Colley, who defined hallux flexus as a plantarflexed posture of the first phalanx relative to the first metatarsal head. In 1888, Cotterill first used the term "hallux rigidus", which is the term most commonly used in the medical literature (16).

The aims of treatment are to eliminate pain, improve the range of motion, and normalise the distribution of plantar pressure. Although this disorder is occasionally treated using conservative methods, surgical treatment is commonly preferred (3). Treatment options and prognosis vary considerably depending on the stage at which the disorder is diagnosed.

It is widely held that during the early stages of development of hallux rigidus, usually involving young individuals, a more conservative treatment may be sufficient to maintain joint integrity ; in older patients, however, more aggressive techniques may be required. Various treatments have

### INTRODUCTION

Hallux rigidus is the second most common disorder of the first metatarsophalangeal (MTP) joint in the general population, after hallux valgus, and the most common among athletes. It is a form of degenerative arthritis affecting both adolescents and adults, and is characterised by pain and stiffness of the big toe, which becomes increasingly difficult to bend.

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been tested, including cheilectomy (3,13), metatarsal osteotomy (9) – either distal or proximal (14) – osteotomy of the first phalanx (17), resection arthroplasty (7), MTP arthrodesis and implant arthroplasty (4,12,15).

There are no reports in the literature regarding the treatment of hallux rigidus by percutaneous surgery. The present study sought to determine the effectiveness of this treatment and to evaluate patient satisfaction 18 months after surgery.

### PATIENTS AND METHODS

In this prospective longitudinal study, parameters were measured prior to surgery and 18 months after surgery. The study population comprised 22 patients (17 women, 5 men) aged between 37 and 86 years (mean age :  $58.36 \pm 10.42$ ). Twelve patients were over 60 (mean age :  $65 \pm 7.27$ ) and ten were under 50 (mean age :  $50.4 \pm 7.73$ ). All patients had hallux rigidus, diagnosed and operated on in 2004 ; the same surgical approach was used regardless of the type or stage of development of the disorder. Four patients had bilateral hallux rigidus ; thus 26 feet (14 right and 12 left) underwent surgery.

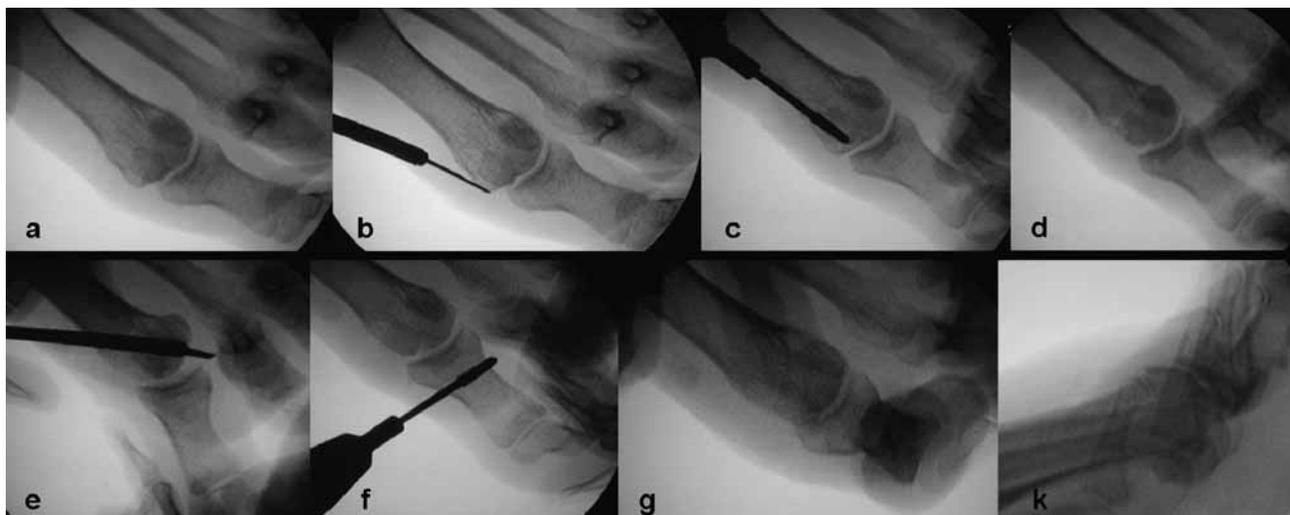
### Surgical technique

A regional ankle block (50-50 mixture of 1% mepivacaine and 0.5% bupivacaine without epinephrine) was used in all cases. Neither the standard Esmarch bandage nor a pneumatic tourniquet was employed. Under fluoroscopy, the joint capsule was detached medially and laterally from the first metatarsal head using a Beaver scalpel. A Weil oblique osteotomy of the first metatarsal head was performed in index-plus cases (fig 1).

Following surgery, patients were given an open-ended, stiff-soled shoe with a straight, wide toe-box, and were advised to walk around outside and generally resume their daily activities. One week later, stitches were removed, and the initial dressing was replaced by an elastic bandage which was kept on for a further three weeks.

For all patients, pain was self-assessed prior to surgery and 18 months after surgery using a visual analogic scale (VAS) from 1 to 10.

Patient perceptions of quality of life were also assessed before and 18 months after surgery, using the SF-12™ survey (Short Form-12 Health Survey, Medical Outcomes Trust and QualityMetric Incorporated). The SF-12 Health Survey is a self-administered, patient-based scoring system consisting of 12 questions eliciting



**Fig. 1.** — First, a Beaver scalpel is inserted into the medial aspect of the foot, 2.5 cm from the MP joint line, and is moved along the metatarsal to detach the joint capsule (b). The metatarsal exostosis is removed using a conical reamer at 7,000 rpm, producing a bleeding bed (c) and conserving the spherical morphology of the metatarsal head (d). Using a point incision on the dorsum of the foot, 1.5 cm from the interdigital groove, and at an angle of 45°, the Beaver scalpel is inserted into the medial aspect of the MP joint, sectioning the intersesamoid ligament (e). Finally, using a third approach via the medial aspect of the base of the big toe, a transverse osteotomy of the dorsal phalanx is performed (f). Finally, the toe is kept in maximum dorsal flexion (g-h).

the patient's perception of his/her physical and mental health. Clinical assessments were performed before surgery and 18 months after surgery using the American Orthopaedic Foot and Ankle Society (AOFAS) scale (11).

### Statistical analysis

Data obtained were analysed using a statistical software package (SPSS 11.0 for Windows). Dependent and independent variables were subjected to univariate and multivariate analysis.

## RESULTS

Of the 22 patients undergoing surgery, 77.3% had an associated general disorder. The main disorders detected were arterial hypertension (36.4%), vascular failure (9.1%), anaemia and ischaemic heart disease.

Seven feet (27%) were of the "Egyptian foot" type (long big toe), seven (27%) were classified as "Peasant foot" (three or more toes the same length) and 12 (46%) as "Greek foot" (second toe longer than all the others). There were no cases of index plus, 17 (65.4%) of index minus and 9 (34.6%) of index plus minus.

In 15 cases, hallux rigidus was unaccompanied by other disorders, and pain was limited to the big toe ; in 5, patients had metatarsal pain ; 5 cases were associated with clawing of the second toe, and 1 case with clawing of the second, third and fourth toes.

Six cases were clinically classified as stage I, and the other 20 as stage II.

Two cases were radiographically classified as grade I, 11 as grade II and 13 as grade III. Three were secondary to prior first-radius surgery.

Analgesic treatment was continued for a mean of  $6.82 \pm 0.58$  days.

Analysis of responses to the SF-12 state-of-health survey showed improvements for almost all parameters ; the most notable improvements were for items 8, 9 and 10, i.e. patients noted significant relief from pain in daily activities, and felt significantly more relaxed, with greater energy and vitality. Only items 1 and 7 elicited a slightly negative perception (table I).

Pain relief was confirmed using the visual analog scale (VAS), scores falling from mean 7.44 before surgery to 1.69 eighteen months after surgery. More detailed analysis by clinical stage and radiographical class revealed that VAS scores for clinical stage 1 patients fell from 8.00 to 1.67, while scores for stage II patients dropped from 7.38 to 1.62. Scores for radiographic class I patients declined from 8.5 to 1.0 ; those for class II from 7.40 to 1.38 and those for class III from 7.5 to 1.6.

Range of motion was severely limited (i.e. to less than 30%) in 10 patients, moderately limited (30° to 74°) in 13 and over 75° in only 3 patients. After surgery, all except one of the patients showed improved range of motion. This improvement was quantified on the American Orthopaedic Foot and Ankle Society (AOFAS) scale, the overall mean score rising from 58.45 before surgery to 92.36 after surgery. Scores for patients classed as clinical stage 1 ("hallux dolorosus") rose from 62.33 to 94.50, while those of stage 2 ("hallux limitus") patients rose from 57 to 91.56.

Scores for radiographical grade I raised from 43 to 100, those for grade II from 63 to 93 and those for grade III from 57 to 90.

Younger patients displayed lower AOFAS scores (mean 55.6) than older patients (60.8), although the improvement was greater in patients under 60 (93.6) than in those over that age (91.3).

Only two patients still displayed paraesthesia 18 months after surgery ; no patients required repeat surgery.

## DISCUSSION

Hallux rigidus affects women more than men (16) ; this was the case in the group studied here.

It has been reported that where the first metatarsal is longer than the rest ("index plus"), there is increased stress on the first MTP joint, favouring the development of hallux rigidus. Gintz *et al* (8), in a study of 65 patients, found that 65% had Egyptian, 14% peasant and 19% Greek foot. The predominant metatarsal formula was index minus (55%), followed by index plus (30%) and index plus minus (15%). By contrast, Besse *et al* (2)

Table I. – Scores for SF-12 questionnaire administered pre- and post-surgery

Question 01		Question 02		Question 03		Question 04		Question 05		Question 06		Question 07		Question 08		Question 09		Question 10		Question 11		Question 12	
Pre	Post																						
3	4	2	2	2	2	1	1	1	1	2	1	2	1	4	1	5	1	2	1	5	6	5	3
3	3	3	3	1	3	2	2	1	2	2	2	1	1	3	1	4	1	2	1	4	6	1	5
4	3	1	2	1	1	1	1	1	1	1	1	1	1	3	1	3	4	2	3	4	2	2	1
2	4	3	3	3	3	2	2	2	2	2	2	2	2	2	1	2	1	2	1	4	5	5	5
3	3	3	3	3	3	2	2	2	2	2	2	2	2	3	1	4	1	2	1	5	6	5	5
3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	2	1	2	1	4	6	5	5
4	3	2	1	1	2	1	2	1	2	2	2	2	2	3	1	6	3	2	2	6	6	4	4
3	4	3	3	3	3	2	2	2	2	3	1	3	1	2	1	1	1	1	1	6	6	4	5
3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	5	1	1	1	6	6	5	5
3	4	2	2	1	3	1	1	2	2	2	2	2	2	2	1	3	1	4	1	4	6	3	5
3	3	1	2	2	2	2	2	2	2	1	2	2	2	2	1	2	1	2	1	4	5	5	5
3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	4	1	2	1	4	5	4	5
3	3	2	3	3	3	2	2	2	2	2	3	2	3	2	1	2	1	1	1	6	5	5	5
3	3	2	2	2	2	1	2	1	2	2	2	2	2	4	4	2	2	2	2	4	5	3	5
4	4	2	2	2	2	1	1	1	1	2	1	2	2	4	3	4	4	4	4	2	2	3	4
3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	6	1	6	1	6	6	5	5
4	4	2	2	2	2	2	1	2	1	2	1	2	1	3	2	4	4	6	4	5	4	5	5
3	2	2	3	1	3	1	2	2	2	1	2	1	2	1	1	3	2	3	1	4	6	3	5
3	3	3	3	3	3	2	2	2	2	2	2	2	2	3	1	4	1	1	1	3	6	2	5
2	3	3	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	6	6	5	5
4	4	1	1	1	1	1	2	1	2	1	2	1	2	4	1	4	1	4	2	4	5	2	5
3	2	3	3	2	2	1	2	1	2	1	2	1	1	3	2	4	2	2	2	6	4	5	5
3.14	3.23	2.36	2.5	2.18	2.5	1.59	1.77	1.64	1.82	1.82	1.82	1.82	1.77	2.59	1.32	3.41	1.64	2.45	1.54	4.45	5.27	3.86	4.64

reported index plus and plus minus as predominant. In the present study, the predominant foot type was Greek (46%), followed by Egyptian and peasant (27%). There were no cases of index plus, 17 cases (65.4%) of index minus and 9 (34.6%) of index plus minus.

The percutaneous approach to surgery of the first MTP joint has a number of clinical advantages, allowing immediate walking and earlier resumption of daily activities, with a low complication rate, complications being mild (2 cases of paraesthesia).

It is important to approach the phalanx between the dorsal digital and plantar nerves, and to perform wedge rather than flat osteotomy, thus reducing the risk of nerve injury.

The literature contains no reports on the capsule release performed here. Proximal detachment of the capsule is considered essential since, following the resection of first-metatarsal bony spurs, phalanx osteotomy and positioning of the toe in dorsal

flexion, the capsule can be brought forward to reduce intra-articular pressure.

Overall results for pain relief are considerably better than those reported by Beertema *et al* (1), who recorded a mean VAS score of 1.8 compared to 1.69 here (table II).

Analysis by surgical technique and radiographic grade shows that the results obtained here were better than those reported for grade I-II patients undergoing cheilectomy, and also than those recorded for grade III patients treated by the Keller technique or arthrodesis. By contrast, better VAS scores than those obtained here have been reported for grade I and II patients treated by Keller resection osteotomy (0.4 and 1.6, respectively).

Only the new titanium prostheses appear to provide greater pain relief (5), although with a patient satisfaction score of only 60% two years after treatment, considerably lower than that recorded here. Taranow *et al* (15), however, report satisfaction rates of 93%.

Table II. — VAS scores pre- and post-surgery

		VAS	
		Pre	Post
Clinical stage	1	8.00	1.67
	2	7.38	1.62
Radiographic stage	I	8.50	1.00
	II	7.40	1.80
	III	7.50	1.60

The mean improvement in clinical assessment using the AOFAS scale was 33.91 points, the highest found in the literature ; lower figures are reported by other authors, including Keiserman *et al* (10) and Beertema *et al* (1), the latter recording scores of 73 for grade III patients undergoing metatarsal arthrodesis and 94 in grade I patients treated using the Keller technique. The results obtained here were also better than those published by Lau *et al* (16) following cheilectomy (77.3) or resection arthroplasty (71.6).

The AOFAS scores published for arthrodesis are noticeably lower than those reported for any other technique, ranging from 53 (6) to 73 (11).

Despite the limitations of the present study in terms of number of cases, it appears that the percutaneous surgical treatment of hallux rigidus by capsular release, resection of bony spurs and dorsal wedge osteotomy of the first phalanx of the big toe without the use of osteosynthesis, is more effective, in terms of both clinical results and patient satisfaction, than most other published techniques.

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