The Valenti technique in the treatment of hallux rigidus

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**KEYWORDS**
Metatarsophalangeal joint osteoarthritis; Hallux rigidus; Cheilectomy; Arthrodesis

**Summary**
Introduction. — Metatarsophalangeal joint osteoarthritis of the great toe (hallux rigidus) is a frequent condition for which numerous surgical techniques have been proposed. The most used ones are cheilectomy and arthrodesis. The objectives of this retrospective study are to present the midterm results of the Valenti procedure and to compare these results with those from other recognized surgical techniques.

Materials and methods. — We conducted a retrospective analysis of a continuous group of 32 patients (41 cases) presenting hallux rigidus and treated using the Valenti technique from November 1999 to July 2004. The mean age of these patients at the time of surgery was 57 years. Forty-one percent of these patients also presented a static disorder of the foot. One or several additional procedures were undertaken, at the time of surgery, in 24% of these cases. Patients were assessed using the AOFAS score completed by the walking distance test, the gait test, the tiptoe test and self-evaluation of patient satisfaction. The radiographic work-up before surgery and at follow-up showed the progression of the joint space changes and allowed us to evaluate plantar subluxation at the base of the first phalanx under the metatarsal head.

Results. — Twenty-four patients (32 cases) were reviewed and evaluated with a mean follow-up of 5.5 years. Two cases of reflex sympathetic dystrophy were observed as complications. The mean final score was 81 out of 100 from a preoperative score of 47 out of 100. Pain was absent or only occasional in 94% of the cases. Discomfort wearing shoes was absent or moderate in 91% of the cases. Joint range of movement was greater than 30° in 72% of the cases and the toes were stable. Walking distance was unlimited in 79% of the cases. A mean 30% plantar subluxation at the base of the first phalanx was noted at follow-up, with no clinical consequence. The results were comparable irrelevantly of the hallux rigidus grade being treated.

Discussion. — The numerous techniques proposed achieve comparable results both in terms of pain relief and functional result but each one has its own limitations. Only arthroplasties with silastic implants and the Keller technique give less satisfactory results. Arthrodesis remains
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Introduction

Hallux rigidus is the clinical manifestation of osteoarthrosis of the metatarsophalangeal joint of the great toe. It was described for the first time in 1887 by Davies-Colley (hallux flexus) [1] and then by Cotteril in 1888 [2] as hallux rigidus. Its clinical progression begins with intermittent joint pain during gait (grade I), it continues with painful limitation of joint range of movement (grade II) and ends in ankylosis (grade III). For more than a century, many surgical techniques have been developed to relieve pain and restore function in the great toe in patients suffering from this condition.

The Valenti procedure [3] is a partial arthrectomy, a technique designed by the Italian surgeon Valente Valenti, who began using it in 1976 and presented it at the Hershey Seminar in Pennsylvania in 1987. This procedure involves an 80° angular V resection of the metatarsal head and the proximal phalanx of two-thirds of the joint height, while preserving the plantar joint space. Thus, the length of the first ray and the intrinsic plantar musculature from the metatarsal-sesamoidal joint is not altered by the resection.

The objectives of this retrospective study were to present the midterm results of the Valenti procedure in the treatment of hallux rigidus and to demonstrate the clinical or radiographic factors that can influence these results. Starting with a review of the literature, the authors compared their results with other recognized surgical techniques in the treatment of hallux rigidus to establish a better understanding of the role and indications for the Valenti procedure.

Material and methods

Patients

This retrospective, descriptive and continuous study collected 32 patients (41 feet) presenting osteoarthritis of the first-ray metatarsophalangeal joint operated on with the Valenti procedure from November 1999 to July 2004. During this period, all patients suffering from hallux rigidus operated in our unit underwent this technique. One patient who had had an additional bone procedure on the first ray was excluded from the study.

The study included 25 women and seven men, with hallux rigidus on the right side in 19 cases and on the left side in 22 cases (nine patients presented bilateral hallux rigidus treated during the same operative time). The mean age at surgery was 57 years (range: 22–78 years).

In 47% of the cases, the patient had an Egyptian-type forefoot, 37% had a Greek-type forefoot and 16% had a square-type forefoot. In all, 41% of the patients presented gait disturbances involving the foot: 17% presented pies cavus and 24% flatfoot. Frequent wear of high heels was reported by 61% of the women. A history of injury to the great toe was found in two cases.

Clinically, we treated five cases of grade I hallux rigidus, 29 grade II and four grade III. Based on the radiographs, there were six cases of grade I hallux rigidus, 19 grade II and ten grade III. The metatarsal-sesamoidal joint was modified in 22 cases (0 grade I, 12 grade II and ten grade III).

The preoperative AOFAS score was 47 out of 100; the mean range of movement was 34°. There was a correlation with the grade as determined from the radiographs (Table 1).

One or several complementary acts were performed in 24% of the cases (eight tendon transpositions, two tenotomies and two osteotomies of the lateral metatarsals).

The joint space was a mean 1.4 mm (range: 0–4 mm). One or several osteophytes were present on the first metatarsal in 89% of the cases, all located dorsally. The osteophytes was circumferential in 34% of the cases.

Operative technique

The surgery required only a short hospital stay (48 h). The patients presenting bilateral involvement preferred that both sides be treated in the same surgical time. The procedure was performed with rachianesthesia, with the patient in the dorsal decubitus position, with a pneumatic tourniquet inflated at mid-calf. A medial incision was made at the point where the plantar and dorsal skin meet (Fig. 1 A). Capsulotomy and arthrolysis exposed the dorsal and medial parts of the joint. After ablation of the osteophytes, the arthroplastic resection began with the osteotomy of the metatarsal head. The osteotomy line, cut with the oscillating saw, extended from the dorsal cortex at the neck to the joint at the junction of the upper two-thirds and the...
Table 1  Preoperative and final scores for each radiological grade.

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<tr>
<th>Preoperative radiological stages</th>
<th>I 5 cases</th>
<th>II 17 cases</th>
<th>III 10 cases</th>
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<tr>
<td>Overall AOFAS score (/100)</td>
<td>Preoperative 71 (57–77)</td>
<td>44.8 (30–65)</td>
<td>34 (20–42)</td>
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<td>Final 83.4 (75–100)</td>
<td>81.5 (53–100)</td>
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<td>AOFAS pain score (/40)</td>
<td>Preoperative 24 (20–30)</td>
<td>7.1 (0–20)</td>
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<td>AOFAS function score (/45)</td>
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<td>24.6 (15–37)</td>
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<td>Final 37.8 (32–40)</td>
<td>36.4 (24–45)</td>
<td>36.3 (22–45)</td>
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<td>MTP 1 joint range of movement</td>
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<td>38.8° (15–50)</td>
<td>7.4° (0–20)</td>
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<td>Final 57° (45–90)</td>
<td>51.8° (50–80)</td>
<td>25.6° (0–55) (p = 0.004)</td>
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lower third, forming a 30° angle with the diaphyseal axis. At
the first phalanx, the osteotomy cut extended in the same
manner from the dorsal cortex up to the joint, forming a
45° angle with the diaphyseal axis (Fig. 1 B). Intraopera-
tive mobilization allowed us to obtain dorsal flexion close
to 90°. The capsular suture at the end of the procedure
retightened the dorsal capsule above the resected zone.
Joint stability was ensured by maintaining the plantar joint
and by capsuloplasty. The wound was closed using simple
skin stitches with no drainage. The postoperative x-ray pro-
vided evaluation of the angle and height of the resected part.
Weightbearing was allowed immediately postoperative
with no immobilization. Oral pain relief was necessary for
approximately 2 weeks. The bandage was changed regularly
until the stitches were removed toward the 15th day. During
the first 2 weeks, patients wore a postoperative shoe with
rigid soles. Normal shoe wear was possible beginning after
6 months.

Methodology

Data were collected on a data collection sheet, with the
statistical analysis carried out by an independent opera-
tor. The osteoarthritis grade was evaluated radiologically
before surgery. Different radiological classifications are in
use today. The three-stage classification is widely used and
has the advantage of being simple [4]. Grade 1 corre-
sponds to beginning involvement with minimal or absent
joint space reduction associated with beginning dorsal and
lateral osteophytosis (Fig. 2). Grade 2 is characterized by
progressive joint space reduction, substantial osteophytosis,
as well as the appearance of geodes in condensed subchon-
dral bone. Grade 3 corresponds to nearly complete joint
space loss associated with deformation of the metatarsal
head, circumferential osteophytosis and involvement of the
metatarsal-sesamoidal joint (Fig. 3).

The radiological workup included:

- preoperative: anteroposterior and lateral views of the
  forefoot with load, a Meary view and a Guntz view;
- final: anteroposterior and lateral views of the forefoot
  with load.

The radiological criteria studied were:

- joint space, in millimeters, on the anteroposterior view
  at the central part of the joint preoperatively and on the
  final lateral view at the remaining plantar joint;
- the number and location of the osteophytes;
- subluxation of the remaining plantar joint corresponding
to the displacement of the base of the first phalanx under
the head of the first metatarsal. This was checked on the
final lateral radiograph with load.

The AOFAS score [5] was the preoperative and final evalu-
ation criterion. This is a 100-point clinical score comprising
three parts: a function scored out of 45 points, a pain out
of 40 and alignment of the first ray out of 15. The result
was judged excellent for a score higher than or equal to
95 out of 100, good between 80 and 94, fair between 50
and 79 and poor for a score less than 50. The evaluation
was completed by measuring walking distance, gait qual-
ity and patient satisfaction. The evaluation of walking was
based on the clinical analysis of the gait and sought to see
whether the patient could achieve painless digitigrade walk-
ing. The degree of patient satisfaction was collected without
any particular questionnaire.

The statistical analysis was carried out with the following
tests: the Chi square and Fisher tests (to compare qualitative
data), the Anova test (a parametric test comparing means),
The Valenti technique in the treatment of hallux rigidus

the Kruskal-Wallis and Wilcoxon tests (nonparametric tests of identity comparing means), and the Bartlett test (testing homogeneity of variances). Significance was set at a 5% margin of error ($p = 0.05$).

**Results**

The mean follow-up was 65 months (range: 33–90). Eight patients were lost to follow-up and complete analysis was therefore done on 32 cases (24 patients).

Only two algodystrophy complications occurred. There was no septic nor thromboembolic complication. Postoperative weightbearing was immediate in 26 cases. For the six remaining patients, postoperative antalgics were not used beyond 2 weeks. The mean duration of time off work was 3.5 months (3 weeks to 8.5 months).

Pain was totally absent in 12 cases (38%), it was occasionally present primarily when the weather changed in 18 cases (56%) and was daily in two cases (6%). Discomfort when wearing shoes was totally absent in 16 cases (50%), moderate (with comfortable, wider, soft-soled shoes) in 13 cases (41%) and severe in three cases (9%). None of the patients wore orthopaedic shoes. Walking was normal for 20 patients (87%). Three patients (13%) presented slight painful supination in the forefoot when walking. One patient presented transfer metatarsalgia on the second metatarsal. Walking distance was unlimited in 79% of the cases. Tiptoeing was possible in 79% of the cases.

Metatarsophalangeal joint mobility was normal in eight patients (25%), in 15 it was reduced, between $30^\circ$ and $75^\circ$ (47%), and in nine patients it was sharply reduced to less than $30^\circ$ (28%). The mean joint range of movement was $40^\circ$ (range: $0^\circ$–$90^\circ$) with $39^\circ$ dorsal flexion and $1^\circ$ plantar flexion; 20% of the patients had plantar flexion at $-10^\circ$ with loss of the toe’s pulp bearing. The interphalangeal range of movement was reduced or painful for three toes (9%).

The alignment of the first ray was perfect in 24 cases (75%). The eight remaining toes presented a moderate valgus deviation. All the toes were clinically stable. None had a callous in the pulp. The pressure force of the hallux on the ground was not recorded.

The mean Kitaoka score of the series was 81.6 out of 100 (range: 45–100), the pain score was 33 out of 40, the function score was 35.3 out of 45 and the alignment score was 13.3 out of 15. The objective results (determined from the AOFAS score) were distributed into four excellent, 20 good, seven fair and one poor. The subjective results (based on patient satisfaction) were distributed into 15 excellent, nine good, five fair and three poor. The results obtained were comparable for the patients who had bilateral treatment.

**Final radiographic analysis**

The mean residual joint space (measured on the lateral view with load measuring the joint space at the plantar joint) was

Figure 2  Grade I hallux rigidus: pre- and postoperative radiographs. A. Anteroposterior preoperative radiograph. B. Lateral preoperative radiograph. C. Anteroposterior postoperative radiograph. D. Lateral postoperative radiograph.

Figure 3  Grade III hallux rigidus: preoperative, postoperative and final radiographs. A. Anteroposterior preoperative radiograph. B. Lateral preoperative radiograph. C. Anteroposterior postoperative radiograph. D. Lateral postoperative radiograph. E. Final anteroposterior radiograph. F. Final lateral radiograph.
1.2 mm, a mean, nonsignificant reduction of 0.2 mm. This reduction had no clinical repercussions.

A plantar subluxation of the base of the first phalanx under the head of the first metatarsal was found in 30% of the cases. This was identical for all degrees of osteophyisis. It has no clinical consequences, notably on joint mobility. The joint range of movement was 49°. The AOFAS score was 86 out of 100. The objective, subjective, functional and toe alignment results were not altered.

**Results of radiographic grades (Table 1)**

The functional result after the Valenti procedure (measured by the AOFAS score) was relatively constant for all hallux rigidus radiological grades. Only metatarsophalangeal joint range of movement was significantly less in stage III cases ($p < 0.004$). When metatarsal-sesamoidal involvement was associated, the AOFAS score was not modified (81 out of 100) and only the range of movement was significantly reduced to 28 ($p = 0.04$). The results were unchanged in cases of circumferential osteophytosis.

**Results of associated surgical acts**

Associating a complementary act to the arthroplasty did not significantly modify the result obtained for any of these acts. Only the complementary transposition of the abductor onto the extensor muscles significantly improved the metatarsophalangeal mobility at follow-up ($p = 0.02$). The mobility of the metatarsophalangeal joint did not improve the quality of shoe wear.

**Discussion**

The Valenti procedure presents several advantages. It restores joint range of movement in the most useful sector of the gait. It preserves the length of the first ray because it maintains the plantar joint. It also respects the sesamoid ligament complex and the intrinsic plantar musculature that provide stable weightbearing of the metatarsal head.

The results of this series are comparable to those of other series investigating the Valenti procedure (Table 2). There were few complications beyond transfer metatarsalgia on the external rays. Curvale et al. [6] found 6% in their series. We report 9% of patients experiencing pain or stiffness of the great toe’s interphalangeal joint. Saxena [7] and Grady and Axe [8] found 25% and 86% sesamoiditis at follow-up, respectively. This is transitory (resolving in less than 6 months). This sesamoid and interphalangeal pain is responsible for a delay in resuming normal walking and shoe wear. The sector of joint mobility is nearly totally dorsal, with a loss of the toe’s pulp bearing in 20% of the cases. The functional repercussions are limited since the mobility sector essentially corresponds to the zone necessary to swing. Saxena [7] and Kurtz et al. [9] obtained comparable results with 6.8° and 13° mean plantar flexion, respectively, and 40.4° and 44.8° mean dorsal flexion.

A number of biases make it difficult to interpret the results of the different surgical treatments of hallux rigidus.

Although cheilectomy and Valenti resection are reserved for hallux rigidus treatment, this is not necessarily true for arthrodesis. The series studying arthrodesis for the most part are not highly homogeneous, grouping different indications (hallux rigidus, hallux valgus, rheumatoid arthritis and surgical revision) [10–13]. The classification of hallux rigidus lesions differs from one series to another. Some authors use a three-grade classification [14–17]; others use a four-grade classification [7,9,13,18]. This makes it difficult to compare the different indications proposed for the different surgical techniques.

The criteria retained to assess the final result vary from one study to another. In the series studied by Kurtz et al. [9], the result was judged based on the AOFAS score. In other series, it is established using different objective criteria — pain, gait and shoe wear quality, and joint range of movement [10,11] — or subjectively based on patient satisfaction [12,18,19]. Some studies do not specify these criteria [7].

The results of the Valenti procedure are also similar to the results of arthrodesis and cheilectomy (Table 2). The Keller technique gives less satisfactory results. Méary and Ficat [20] found 61% good and excellent results, Curvale et al. [6] only 48%. They noted that walking distance was limited in 81% of the cases. Associating interposition of the dorsal capsule with the extensor hallucis brevis tendon at the joint resection improves the result [17,21].

The complications of arthrodesis are more numerous and more frequent. Metatarsalgia is present in 21% of cases [14]. Depending on the case, this can be first-ray metatarsalgia or transfer metatarsalgia if there has been a technical error during the arthrodesis procedure (first metatarsal oversHORTened, excessive dorsal flexion, greater than 30°) or with malunion [11]. The interphalangeal joint is the most often painful or arthritic. It is involved in 20% of Curvale et al. ’s series [6]. According to Groulier et al. [22], it results from insufficient valgus when adjusting the arthrodesis. Méary and Ficat [20] and Ettl et al. [23] found only 4% and 0%, respectively. There are many poor adjustments and this can have repercussions on function. The extension defect is better tolerated than the valgus defect [10]. Malunion is not rare but its frequency varies greatly from one series to another. Méary and Ficat [20] found 17%. On the other hand, Ettl et al. [23] report none in their series.

The series investigating chellectomy do not report specific complications. Lau and Daniels [17] found 4% metatarsalgia. The results obtained with prosthetic replacements are heterogeneous and controversial. The main types of prostheses used are implants in silastic that were initially developed by Swanson [24–26], unipolar interposition implants whose concept is close to capsular interposition arthroplasty [27,28] and the total nonconstrained endoprostheses [29–31]. The diversity of the results is related to the type of prosthesis but also to the varying length of follow-up periods. The silastic implants have encouraging short-term results, but they deteriorate with time. Wenger and Whalley [24] obtained 88% good results at 2 years. Shankar and Orth [25] had only 64% at 9 years. Mahieu et al. [26] found 88% good results at 8 years but recommend limiting the use of these implants because of the frequent associated complications (44% metatarsalgia, 33% delay in healing and...
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<th>AOFAS score</th>
<th>Pain-free (%)</th>
<th>Joint range of movement (%)</th>
<th>Limitation of walking distance (%)</th>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Kurtz et al. [9]</td>
<td>36</td>
<td>4.2</td>
<td>91</td>
<td>84</td>
<td>79°</td>
<td></td>
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<tr>
<td>Our series</td>
<td>41</td>
<td>5.4</td>
<td>75</td>
<td>81</td>
<td>94°</td>
<td></td>
<td>40°</td>
<td>21</td>
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14% infection). As a rule, these implants are poorly tolerated (foreign-body reaction) and they are not highly resistant. Curvale et al. [6] recommend abandoning these implants, whose biomechanical characteristics are not well adapted to this joint. The unipolar interposition prostheses give results that are comparable to the conservative techniques at the midterm. They improve the Keller technique in that they preserve the first phalanx [27]. The results of total endoprostheses are less conclusive. Ess et al. [29] only obtained 60% good and excellent results at 2 years and do not recommend these implants for young or active patients. Fuhrmann et al. [30] reported medial instability in 16% of their cases causing poor toe alignment. Olms and Dietze [31] obtained better results but the follow-up period remains short (2 years).

The Valenti procedure gives reproducible results in terms of function and pain-free activity for all grades of hallux rigidus. Complications are rare. Inversely, arthrodesis, arthroplasty and the Keller technique have a high rate of complications, in particular transfer metatarsalgia.

The indications proposed in the literature for each technique are concordant (Table 3). None of the techniques seems ideal, whatever the grade of pathology presented by the patient.

Cheilectomy is proposed for beginning and moderate pathology. Arthrodesis and arthroplasty are proposed in cases of advanced disease or for surgical revision. The Valenti procedure is classically proposed up to advanced grade II, as described in the Hattrup and Johnson [16] classification.

### Conclusion

The partial arthrectomy described by Valenti for the treatment of hallux rigidus is a procedure that can be easily reproduced with little risk of technical error. The results of this series are stable over time and comparable to the results reported in the literature for all grades of hallux rigidus, with a low complication rate.

### Conflicts of interests

None.

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**Table 3** Indications for the different operating procedures in the literature.

<table>
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**References**


The Valenti technique in the treatment of hallux rigidus


