J Orthopaed Traumatol (2006) 7:93–96
DOI 10.1007/s10195-006-0128-7

ORIGINAL

M. Bardelli
G. Scoccianti

Uncemented total ankle arthroplasty in post-traumatic osteoarthritis: 3- to 7-year follow-up

Received: 17 April 2005
Accepted: 16 December 2005
Published online: 20 June 2006

M. Bardelli • G. Scoccianti (✉)
Orthopaedic Unit
S. Maria Annunziata Hospital
ASL 10 Florence
Via dell'Antella 58
I-50011 Bagno a Ripoli (FI), Italy
E-mail: marcobardelli@hotmail.com

Abstract Ankle replacement in post-traumatic arthritis is a challenging procedure, and adequate data are lacking about its results, as most studies are mainly focused on the results of ankle arthroplasty in primary osteoarthritis and rheumatoid arthritis. We present the results of 7 ankle replacements in post-traumatic arthritis with an uncemented total ankle arthroplasty at an average follow-up of 5.1 years (range, 3–7). One ankle had been revised and one ankle showed an unsatisfactory result (with radiographic signs of loosening of the talar component). The average functional score of the 6 surviving prostheses was 68.3 according to Kofoed and 70.8 according to AOFAS. Range of motion averaged 24.1° at follow-up. No infections nor collapse of the talus occurred. No ankles showed areas of periprosthetic osteolysis. Periarticular calcifications were a common finding (3 patients) but not evidently connected to the clinical result. Radiographic signs of progressive degeneration of the neighboring joints were present in three patients at the talonavicular joint and in one patient at the talocalcaneal joint. Ankle arthroplasty with new generation prostheses is a promising procedure but results are still worse than those of replacement of the other major joints of the lower limb. Replacement of the post-traumatic ankle presents particular difficulties and studies should evaluate the results separately from ankles affected by primary osteoarthritis and rheumatoid arthritis.

Key words Ankle replacement • Ankle arthroplasty • Post-traumatic arthritis

Introduction

Total ankle arthroplasty is still performed in some orthopaedic units and adequate data and experience are still lacking. This is mainly due to the negative results obtained with first-generation ankle prostheses [1–5] combined with the fact that, unlike at the hip and knee, arthrodesis of the ankle maintains good function of the lower limb. New generation prostheses are showing better results, even if there are few studies with a relevant number of cases. This led to a new and increasing interest in this procedure in the latest years but adequate data about long-term results are not available yet.

In the 1990s, promising short- and mid-term results with new designs of ankle prosthesis were reported [6–8]. On the basis of these results, in 1997 we began to perform ankle replacement with S.T.A.R. uncemented prosthesis in selected cases. The aim of this study was to evaluate the results of ankle arthroplasty in post-traumatic arthritis, which presents specific intraoperative technical difficulties, often more relevant than in ankles affected by pri-

mary osteoarthritis or rheumatoid arthritis. An evaluation of the results of ankle replacement in post-trauma ankle degenerative disease is of particular interest also because most of the studies do not specifically address this pathology and are mainly based on the evaluation of patients affected by rheumatoid arthritis or primary osteoarthritis.

Materials and methods

Between March 1997 and July 2004, we performed 24 total ankle replacements in 24 patients, of whom 15 were affected by post-traumatic arthritis following ankle or pilon fracture.

In this study we considered only patients treated for post-traumatic arthritis who had a minimun follow-up of 3 years and who were available for clinical and radiographic re-evaluation. Of the 10 patients who met first two inclusion criteria, 2 had died because of causes unrelated to ankle replacement and 1 patient was lost to follow-up. Therefore, 7 patients (7 ankles) were available for evaluation. These patients (4 women) received a monolateral S.T.A.R. uncemented total ankle replacement (Waldemar Link, Hamburg, Germany). The average age at the time of surgery was 59.1 years (range, 30–76). The ankle operated on was the left one in four patients and the right one in three patients.

All patients had received perioperative antibiotic prophylaxis with first-generation cephalosporin and antithrombotic prophylaxis with heparin. After the procedure, a below-knee cast was applied and mantained for 30 days. Weight-bearing with cast was allowed immediately after surgery. After cast removal, physiotherapy with progressive mobilization was performed. None of these 7 cases had delayed wound healing or clinical signs of a thromboembolic complication.

In one case an intraoperative lateral malleolus fracture occurred. The fracture was undisplaced and internal fixation was not undertaken. It was treated by delaying cast removal for two more weeks (6 weeks of cast wearing) and allowing weight-bearing only one month after surgery. The fracture healed with no adverse effect on the immediate clinical result.

At follow-up, we learned that one female patient (aged 75 years at time of surgery) had undergone revision surgery elsewhere about 20 months after the primary procedure; we classified this case as a failure and excluded the patient from the subsequent analysis. The remaining 6 patients were subjected to a clinical and radiological evaluation. The average follow-up was therefore 60.8 months (5.1 years), ranging from 36 months (3 years) to 81 months (6.75 years).

Clinical evaluation considered walking ability, pain, and limitation in daily activities. The patients underwent a radiographic examination consisting of anteroposterior and lateral views. They were also evaluated with functionally the Kofoed ankle scale [7] and with the AOFAS (American Orthopaedic Foot and Ankle Society) evaluation system [9]. Range of motion was measured clinically with the use of a goniometer.

All patients enrolled in the study gave informed consent. The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki.

Results

The average functional score of the six patients available for evaluation was 68.3 according to the Kofoed system (range, 15–92; only one patient had less than 60 points) and 70.8 according to the AOFAS system (range, 22–96; only one patient had less that 60 points). The mean range of motion of the ankle at the time of follow-up was 24.1° (range, 1°–35°), with a plantar flexion of 21.6° (range, 10°–35°) and dorsiflexion of 2.5° (range, 0°–10°). These results show a high variability in restoration of range of motion after surgery, from very limited results to a range similar to the unaffected controlateral side (Fig. 1).

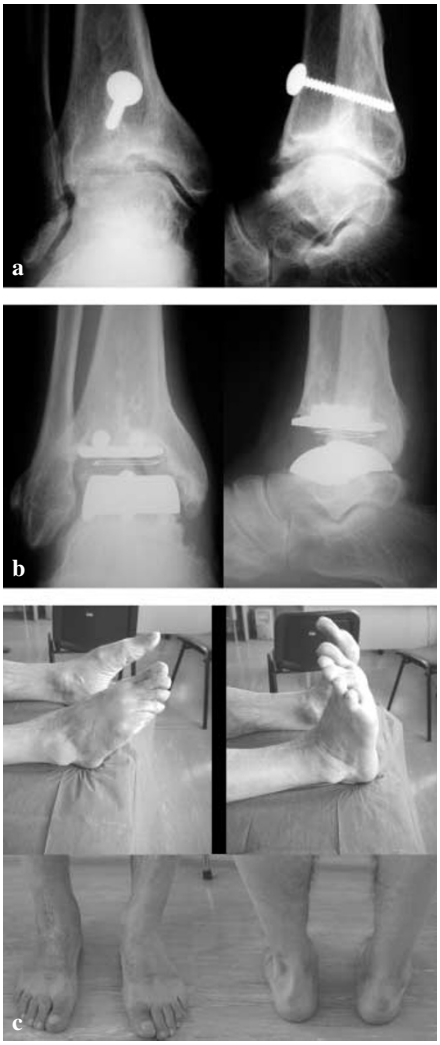

Fig. 1a-c *A 59-year-old man who suffered a pilon fracture of the right ankle.* **a** Anteroposterior (*left*) and lateral (*right*) radiographs before ankle replacement, 5 years after fracture, show advanced post-traumatic arthritis. **b** Anteroposterior (*left*) and lateral (*right*) radiographs 4 years after ankle replacement with STAR prosthesis show stability of the implant with no signs of loosening. **c** Range of motion (plantar flexion and dorsiflexion) of the right ankle was similar to that of the left healthy ankle at follow-up

Three patients had no limping, two patients showed moderate limping, and one showed serious limping at the follow-up visit. Walking distance was unlimited in four patients, and limited to 4–6 blocks in one patient and less than 3 blocks in another patient. Only one patient walked with crutches; 5 patients did not use any walking aid. One-leg standing on the operated limb was possible in four patients. Climbing and descending stairs was difficult also postoperatively and only 3 of the patients could do these activities with a normal gait.

Pain was completely absent in 2 patients. In 2 cases, pain was occasional on weight-bearing or after prolonged walking. In another patient, pain presented at the commencement of walking ("start-up pain"). In the last patient, pain was continuous and severe.

Regarding life activities, limitation was not reported at all by one patient; 4 patients reported a limitation just for some recreational activities; and one patient reported a major limitation in the activities of daily life. Subjectively, one patient declared to be very satisfied by the procedure, 3 patients were satisfied, one patient was only partially satisfied (but she reported an improvement after surgery), and one patient was not satisfied at all.

At radiographic evaluation, we observed no cases of talar collapse nor evident periprosthetic osteolytic areas. No patients had evident radiolucent lines (>2 mm and progressive) around the implants. However, it is important to note that, because of the geometric characteristics of the prosthesis, it is difficult to obtain a radiograph adequate for accurately and completely discerning the presence or absence of radiolucencies at the bone-prosthesis interface. For this reason, we cannot completely rule out the presence of radiolucent lines around the implants in this series.

No tibial components showed signs of loosening. As for the talar component, four ankles showed no signs of subsiding in comparison with the initial position. In one ankle we saw in the immediate postoperative period a subsiding of the talar component (possibly due to inadequate primary stability), which was already evident on the first radiographs after the beginning of weight-bearing. Afterwards, no change in the component position occurred untill the last follow-up. In our opinion, the prosthesis is stable (with good clinical and subjective results at follow-up). One ankle showed signs of loosening of the talar component with an anterior shift (clinical and subjective results were unsatisfactory).

Diffuse periarticular calcifications were present in three cases at follow-up. Progressive degeneration of the neighboring joints was radiographically noted in three patients at the talonavicular joint (slight in one case, moderate in two cases) and in one patient at the talocalcaneal joint (slight).

Discussion

Ankle arthroplasty is increasingly performed and is often replacing the more traditional procedure of ankle arthrodesis in treating ankle degenerative diseases. Nonetheless, the results of this procedure must be verified, particularly in the long-term. Therefore, even small studies with a long follow-up can offer useful data. This is particularly true for post-traumatic osteoarthritis, because most of the published studies dealt with primary osteoarthritis and rheumatoid arthritis.

At an average follow-up of 5.1 years in 7 patients, we observed a high rate of failure due to one revision and one unsatisfactory outcome. This finding confirms that the results of ankle arthroplasty are today worse than those of hip and knee replacement.

Similar data were recently reported by other Authors. Anderson et al. [10] reported a 23.5% revision rate at an average follow-up of 4.5 years in a series of 51 S.T.A.R. prostheses. Moreover, an additional 11.8% of patients were not satisfied. The average functional scores (68 according to Kofoed and 73 according to AOFAS) were similar to those obtained in the present series.

Natens et al. [11] implanted the S.T.A.R. prosthesis in 26 ankles, including 7 post-trauma cases. At a short follow-up (15.8 months), they reported an average Kofoed score of 74.8, slightly superior to that of the present series. The Authors also reported no cases of revision surgery but unsatisfactory results were obtained in 26% of patients.

Spirt et al. [12] reported the results of 306 Agility prostheses at a follow-up of less than 3 years. In 64% of cases, ankle replacement was indicated for post-traumatic complications. In this series, there was a 10.8% revision rate and an additional 18% rate of different secondary surgical procedures. Valdebarrano et al. [13] reported a 13% revision rate and a 21% rate of secondary or additional operations at an average 3.7-year follow-up of S.T.A.R. implants.

Better results were reported by some Authors with the same S.T.A.R., Agility and Buechel-Pappas prostheses [8, 14–20]. This difference may be due to the prevalence in these studies of ankles affected by primary osteoarthritis and rheumatoid arthritis instead of post-trauma degenerative disease and also to a longer and larger experience of the surgeons in a procedure with a relevant learning curve [10, 18, 21]. In fact, most of the these studies focused on the results of procedures performed by the inventor of the ankle prosthesis himself, who obviously has intimate familiarity with the implant.

In our experience, persistent symptoms at follow-up are not always easy to be linked to an obvious etiology (e.g. component malposition or loosening, infection, osteolysis). Heterotopic calcifications were a common finding in

series (50%) but they did not seem to correlate with the clinical result, as already reported [18]. More worrisome is the incidence of progressive degeneration of the neighboring joints (talocalcaneal and talonavicular) that can be indicative of an inadequate restoration of ankle biomechanics with a consequent overuse of the neighboring joints and perhaps the prosthesis itself. Incomplete restoration of ankle biomechanics may also be explained in the series by the presence in all our ankles of the long-term effects of a major trauma of the hindfoot with consequent complex deformities. Dorsiflexion of the ankle is often not or very partially regained, as already reported in other series [10, 18]. This can determine functional limitations in specific activities, mostly recreational or work-related, but also in daily life activities (e.g. climbing stairs).

In conclusion, we believe that our results are promising even if they show that many efforts are still needed to make ankle replacement as efficient and reliable as hip and knee replacement. Ankle replacement in post-traumatic osteoarthritis presents particular technical difficulties, often more than in ankles affected by primary osteoarthritis or rheumatoid arthritis. For this reason, we believe that the results of ankle replacement in post-traumatic ankles should be examined separately from ankles affected by degenerative disease, as we did in our study. The high incidence of these fractures and their frequent occurrence in young and active persons make particularly attractive in this category of patients the possibility of a procedure which maintains function and motility of the ankle. An important issue supporting the choice of ankle replacement in these patients is that new-generation ankle prostheses necessitate limited bone resection, leaving adequate bone stock for a secondary arthrodesis procedure at an older age [22, 23].

References

1. Helm R, Stevens J (1986) Long-term results of total ankle replacement. J Arthroplasty 1:271–277
2. Kitaoka HB, Patzer GL (1996) Clinical results of the Mayo total ankle arthroplasty. J Bone Joint Surg Am 78:1658–1664
3. Bolton-Maggs BG, Sudlow RA, Freeman MA (1985) Total ankle arthroplasty. A long-term review of the London Hospital experience. J Bone Joint Surg Br 67:785–790
4. Newton SE 3rd (1982) Total ankle arthroplasty – Clinical study of fifty cases. J Bone Joint Surg Am 64:104–111
5. Wynn AH, Wilde AH (1992) Long term follow-up of the Conaxial (Beck-Steffee) total ankle arthroplasty. Foot Ankle 13:303–306
6. Buechel FF, Pappas MJ (1992) Survivorship and clinical evaluation of cementless, meniscal-bearing total ankle replacements. Semin Arthroplasty 3:43–50
7. Kofoed H, Stürup J (1994) Comparison of ankle arthroplasty and arthrodesis – A prospective series with long-term follow-up. Foot 4:6–9
8. Kofoed H, Danborg L (1995) Biological fixation of ankle arthroplasty. Foot 5:27–31
9. Kitaoka HB, Alexander IJ, Adelaar RS et al (1994) Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. Foot Ankle Int 15:349–353
10. Anderson T, Montgomery F, Carlsson Å (2003) Uncemented STAR total ankle prosthesis. J Bone Joint Surg Am 85:1321–1329
11. Natens P, Dereymaker G, Abbara M, Matricali G (2003) Early results after four year experience with the S.T.A.R. uncemented total ankle prosthesis. Acta Orthop Belg 69:49–58
12. Spirt AA, Assal M, Hansen ST (2004) Complications and failure after total ankle arthroplasty. J Bone Joint Surg Am 86:1172–1178
13. Valdebarrano V, Hintermann B, Dick W (2004) Scandinavian total ankle replacement: a 3.7-year average follow-up of 65 patients. Clin Orthop 424:47–56
14. Kofoed H, Sorensen TS (1998) Ankle arthroplasty for rheumatoid arthritis and osteoarthritis: prospective long-term study of cemented replacements. J Bone Joint Surg Br 80:328–332
15. Pyevich MT, Saltzman CL, Callaghan JJ, Alvine FG (1998) Total ankle arthroplasty: a unique design. Two to twelve-year follow-up. J Bone Joint Surg Am 80:1410–1420
16. Schill S, Biehl C, Thabe H (1998) Prothetische Versorgung des Sprunggelenks. Orthopäde 27:183–187
17. Buechel FF Sr, Buechel FF Jr, Pappas MJ (2002) Eighteen-year evaluation of cementless meniscal bearing total ankle replacements. AAOS Instr Course Lect 51:143–151
18. Wood PLR, Deakin S (2003) Total ankle replacement: the results in 200 ankles. J Bone Joint Surg Br 85:334–341
19. Knecht SI, Estin M, Callaghan JJ et al (2004) The Agility total ankle arthroplasty – Seven to sixteen-year follow-up. J Bone Joint Surg Am 86:1161–1171
20. Kofoed H (2004) Scandinavian total ankle replacement (STAR). Clin Orthop 424:73–79
21. Haskell A, Mann RA (2004) Perioperative complication rate of total ankle replacement is reduced by surgeon experience. Foot Ankle Int 25:283–289
22. Makwana NK, Morrison P, Jones CB, Kirkup J (1995) Salvage operations after failed total ankle replacement. Foot 5:180–184
23. Carlsson Å, Montgomery F, Besjakov J (1998) Arthrodesis of the ankle secondary to replacement. Foot Ankle Int 19:240–245