

First metatarsophalangeal joint replacement with total arthroplasty in the surgical treatment of the hallux rigidus

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Abstract. The hallux rigidus, especially in advanced stage, has always been a challenge as regards the surgical treatment. Over the years there have been various surgical techniques proposed with the aim of relieving pain, correcting deformity and maintain a certain degree of movement. For some years we have addressed the problem with the replacement metatarsophalangeal joint arthroplasty with Reflexion system. As far as our experience we have operated and monitored 25 patients (18 females and 7 males) of mean age 58.1 years, operated with this technique from June 2008 to June 2011. It reached an average ROM of 72° (extension and flexion 45° and 27°) with a good functional recovery in 8 patients, and this articulation was good (50° - 40°) in 12 patients and moderate in 5 with a articular range from 40° - 30°. The clinical results, according to our experience, appear to be favorable, as even patient satisfaction is complete. (www.actabiomedica.it)

Key words: hallux rigidus, metatarsophalangeal, arthroprosthesis

Introduction

Degenerative disease of the first metatarsophalangeal articulation, the so-called "Hallux rigidus", especially in advanced phase, has always been a sort of challenge as a surgical treatment. Various surgical techniques, over the years, have been proposed with the aim of relieving pain, correcting deformity and maintain a certain degree of movement. The stiff big toe, described for the first time by Davies-Colley in 1887 (1) is also called Hallux limitus or flexus, because of tendency to ankylosis of metatarsophalangeal joint, as first in slight flexion with extended interphalangeal joint.

As is well known, to hallux rigidus etiopathogenesis may contribute: congenital factors (flat metatarsal head), biomechanical factors (high first metatarsal), trauma (fractures/ microfractures/osteochondral lesions) and microtraumatic, these ones due to calcium (2-4).

The pathology of stiff big toe has ranked about Regnault classification (5) in three stages, so that the I stage is characterized by wear of the joint with minimal osteophytes reaction, the II stage is reached when the joint line is further reduced, the articular surfaces becomes sclerotic with osteophytes, dorsolateral, exuberant, and the III stage where the joint is virtually disappeared to seem like an ankylosis.

There are further classifications, such as the one of Hattrup & Johnson, and the one Coughlin that splits pathology in four stages.

When arthrosis at MF1 joint is at a so advanced level to include even pain and functional limitations, a surgical treatment is required (6-8). Various procedures have been purposed, as already said, like cheilectomy, decompressive osteotomy in recession, arthroplastic resections and arthrodesis, all of them burdened by limitations and failures (9-11). There is even the possibility of a prosthetic implant with a total or partial prosthesis.

In literature still remains the uncertainty if in more advanced cases it is more appropriate arthrodesis or if it is necessary to replace the diseased joint with an arthroplasty to maintain a physiological movement, which should preserve the possible occurrence of metatarsalgia by transfer and by a wrong gait, being reduced the phase of hallux detachment reduced in power by the presence of arthrodesis (12, 13).

Currently arthrodesis is the standard of care for the treatment of a severe hallux rigidus (ie, 3rd and 4th Grade), although nonunion and metatarsalgia are commonly reported as complications. Satisfaction rates in patients with arthrodesis are often high and in a range from 81% to 100%, the Aofa Score is between 82 - 89, depending by the used technique, and a nonunion can occur from zero to 8.9% of cases. Typically arthrodesis is performed with a dorsal plate and screws or with two screws positioned in a cross (14).

Arthrodesis, however, lead to increase pressure under the head of the first metatarsal. In 2005, Brodsky and coll. (15) evaluated sports and functional results in 53 patients (60 feet) with a mean follow-up of 3.7 years. Sport activities carried out in the preoperative have been taken up in 92% of patients who practiced the non-competitive race, in 80% of those who played golf, in 75% of those who practiced jogging, and in 75% of tennis players.

There was a significant pain reduction with greater functional and mechanical stability that have led to a moderate recovery activities.

Trying to keep the biomechanics and functionality of the metatarsophalangeal joint several authors propose surgical solutions that maintain, and indeed promise to increase, passive and active motility of the first MF joint, respecting, in the meanwhile, the stability (16, 17).

These solutions can be classified in the category of the spacers and in the one of the prosthesis that may further be divided into implants that replace one articular surface and implants that replace both the articular surfaces. Even in our Institute, to treat surgically more advanced grades of hallux rigidus we used different techniques in hopes of finding the best technical solution to get the more physiological results as possible. At first we used the osteotomy technique "hinge" proposed by Valenti, getting discrete results against

pain but some instability and loss of force during the take-off phase of movement, caused by the shortening of the first metatarsal. After this experience, we turned to the technique of arthroplasty with resection of the head of the first metatarsal and replacement with a bioresorbable metatarsal spacer devised by Giannini. By this technique we have treated more than 40 patients getting always positive feedbacks about patients satisfaction with improvement of active and passive motility, but with the sporadic onset, sometimes, of an important inflammatory reaction. A few years ago we started to replace the first metatarsophalangeal joint with total prosthesis and now we propose here our experience.

Material and Methods

Arthroplasty that we chose to treat severe rigid toes, is a metal-polyethylene prosthesis called Reflexion. This is produced by OsteoMed which in 1994 presented a model of the prosthesis with two components and a design like "ball and socket" that consists in total, however, from three components. A metatarsal stem and a phalangeal one with high-density polyethylene cup supported by a titanium rod and a minimal resection metatarsal rod with head of variable length, for a proper tension of the soft parts. Such design should ensure an optimal distribution of loads and the system should be stable in the time. This system is an accurate one and relatively easy to implant in the correct directions and with particular solutions of implant.

About this implant High and colleagues reported five years later 93 % of success on 65 patients random selected among those ones operated between 1995-99.

As far as our experience we operated and monitored 25 patients (18 females and 7 males) average age of 58.1 years, operated with this technique from June 2008 to June 2011. The surgery was performed under general truncular anesthesia at the ankle and was allowed immediate loading. Follow-up of patients was clinic and with radiographs (mean follow-up of 18 months). The function was evaluated with the Kitaoka and others score, and according to the AOFAS score.

Results

Return to normal activities occurred after about 28 days (min 21, max 65). The media according to the Kitaoka score increased to 75 points at three months after surgery and 87.1 points after 6 months, starting from a preoperative score of 36.6.

About the AOFAS score: 41 points is a result of (medium) increase, from 45 to 90 at follow-up.

The painful symptoms were completely solved in 18 patients, in 6 patients exited with the presence of occasional mild pain and persistent pain in only one patient.

It has been reached an average ROM of 72° (extension of 45° and flexion of 27°) with an excellent functional recovery in 8 patients; this joint movement was good (50°-40°) in 12 patients and modest in 5 patients with a articular range from 40°-30° (Fig. 1 and 2) (Fig. 5 and 6).

There was one case of aseptic loosening of the implant with removal prosthesis and a case of subluxation of the components with the appearance of valgus of first MP joint accompanied by occasional pain (Fig. 3 and 4).



Figure 1. Before surgery radiography: very bad arthrosis in MF1 joint



Figure 2. Postoperative radiographs: well-positioned prosthesis



Figure 3. After 2 months follow-up: mobile articulation, without pain



Figure 4. Subluxation of the prosthesis after 12 months follow-up



Figure 5. Preoperative severe hallux rigidus



Figure 6. Follow-up at 18 months: well-positioned prosthesis without radiolucent lines

At radiographic controls were not highlighted radiolucent lines, except in the case of mobilization, but in this case it was produced, during the insertion of the phalangeal component, a fracture of the base of the same phalanx, in a case however complicated by the presence of a serious iatrogenic hallux varus. Patient satisfaction was found to be

almost complete with persistence of these results also at a medium term follow-up. Moreover two patients wanted to be operated contralateral limb about 18 months after the first implant.

Discussion

Over the years various techniques have been proposed to relieve pain, restore and maintain the motility of the first MF in patients with hallux rigidus.

Our results seem to be in line with those obtained by other authors that use prosthetic replacement. In our opinion the prosthetic replacement seems to be a good alternative to arthrodesis which is in each case a sacrifice of the joint (moreover of a very important articulation for the efficiency of our walking). The re-

search should go towards improving the bone integration of prosthetic stems, trying to find a better “fill” and “fit”, as has been done in prosthesis to be implanted in other joints. Prosthetic replacement of the first MP joint can be considered one of the best surgical solutions if we could get a good stability of the implant.

According to our experience is very important, to reach a good result, don't to implant metatarsal phalangeal joint components reduced in size. The measurements must be sufficiently large so that the collar of the head of the component and the base of the metatarsal phalangeal component are supported on cortical bone tissue thus avoiding a premature sinking and a further mobilization.

Another caution is don't to remove too much bone from the M1 head and from the F1 base so don't to cause instability in the joint, submitting the prosthetic components to maximal loads in addition to produce a valgus deformity of the first metatarsophalangeal joint, causing a bunion or, less frequently, a hallux varus. The plantar of the head of M1 should also been kept intact, so that is not altered the relationship between the head and the sesamoid bone and then changing the normal kinetic joint, being the sesamoid as an important stabilizers.

Conclusions

Clinical results, according to our experience, appear to be favorable, as also the satisfaction of patients is complete. We must, as already mentioned, to improve the prosthetic design to achieve positive results comparable to those obtained in arthroplasty of the knee and of the hip. We believe, however, that with this technique is maintained a certain range of movement of the joint ensuring good physiological and biomechanical forefoot movement

and this is the characteristic that makes it superior, in our opinion, compared to arthrodesis. We believe that this method should still be reserved to centers where you can get a decent series. Hopefully it would be necessary to obtain a network of clinical sites in order to create even a register for this type of implant. Therefore, considered our results, we can say that the replacement of first metatarsophalangeal joint

with a total arthroplasty, among surgical treatment in the hallux rigidus, is a concrete therapeutic possibility, which tends to maintain the functionality and the physiological joint biomechanics.

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