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Original article

High tibial osteotomy: our experience with hemicallotasis method

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Abstract. Despite the many progresses and ever better outcomes in knee arthroplasty, surgical osteotomy in this area of the body is still commonly used. Valgus high tibial osteotomy (HTO) through external fixator progressive distraction (hemicallotasis) has given good results in the treatment of varus knee deformities. Such surgical techinque, once all contraindications and favorable factors have been identified, allows to progressively correct the deformity with extreme precision without using internal fixation devices or bone grafts. The positive outcomes in all 24 subjects included in our study affected with varus knees and initial medial osteoarthritis confirm the validity of this osteotomy technique. (www.actabiomedica.it)

Key words: knee, osteotomy, hemicallotasis, axial external fixator, osteoarthritis, varus deformity

Introduction

It is without any doubt that in the last few years the extension of unicompartmental and total knee joint replacement (KA) and the long-term positive outcomes have narrowed the indications for hemicallotasis (1-6). Nonetheless, these bone realignment "prevention" surgeries, especially in high demanding young patients, remain the treatment of choice because they slow down or even prevent degenerative processes or at least delay KA. Several studies (7-17) confirm the validity of this treatment choice and many authors have reported satisfactory and long-term results after hemicallotasis in genu varum (18-21). Of all the proposed surgical technique (22-24), the hemicallotasis method utilizing axial external fixator (AEF) (25-27) has become popular in the orthopaedic field for its surgical simplicity and precision in obtaining correction. The aim of the present study is to retrospectively analyze the results of 26 idiopathic genu varum treated with HTO through hemicallotasis.

Material and Methods

Twenty-four patients (26 knees) affected by idiopathic genu varum were treated, between February 2002 and September 2010 in the Parma University Hospital and in the Borgotaro Santa Maria Hospital Orthopaedic Units, with HTO through hemicallotasis. Patients below 60 years of age were included in the study with low grade arthritis of the medial compartment (Stages 1 and 2 according to the Ahlback classification) (28), with full knee range of motion (ROM) (at least 100° of flexion) and without associated knee instability. Patients with any of the following criteria were excluded from the study: knee varus deformity beyond 18°, arthritis greater than Ahlback's Stage 2 (28), presence of autoimmune pathology such as rheumatoid arthritis or chondrocalcinosis, severe osteoporosis or obesity (BMI >35). All patients were examined with standard radiographs prior to surgery to determine the Ahlback Stage of arthritis (28) and with weight bearing lower limb radiographs in order

to properly plan the amount of corrective osteotomy in relation to the severity of the deformity. A Mikai AEF was used for all patients. After positioning under fluoroscopy of 2 pins proximally and parallel to one another and to the knee joint surface and 2 placed in a similar manner distally and perpendicular to the tibial diaphysis, a Kirschner wire was inserted from distal to proximal and medial to lateral as a guide for the osteotomy which was then realized with an oscillating saw. The AEF body was then positioned on the pins and fixed in compression.

Partial and protected weight bearing was allowed 2 days after surgery in conjunction with the beginning of the controlled hemicallotasis which was transmitted by the distraction mechanism of the AEF, and later continued at home until the desired correction was obtained. Wound care was done weekly in the out-patient clinic and radiographic controls were done bi-weekly until the foreseen correction and bone consolidation was obtained and to evaluate bone consolidation. At follow-up weight bearing lower limbs radiographs were done in order to measure the amount of correction obtained. All patients were assessed clinically according to the Hospital for Special Surgery (HSS) Knee Service Rating System (14). Radiographic measurements were done in collaboration with the Radiology of the University Hospital of Parma using the EBIT Esaote Software.

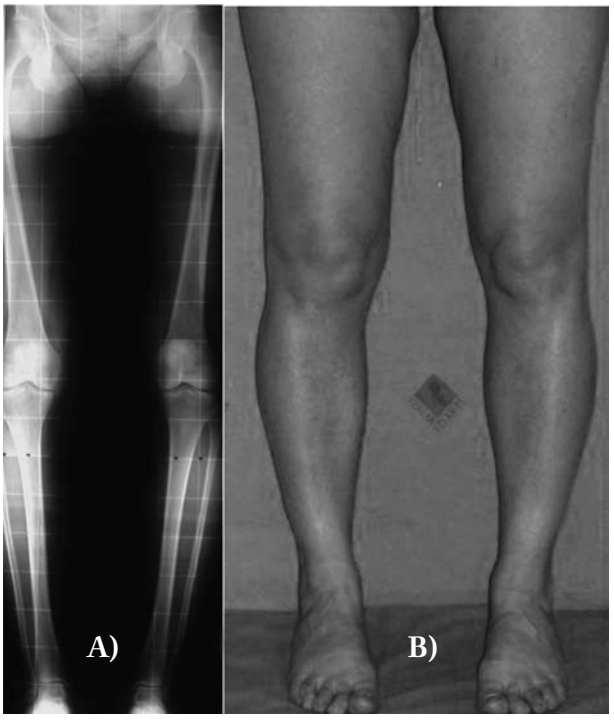

Figure 1. Bilateral genu varum in a patient of 40 years of age; preoperative long weight bearing lower limbs radiographs (A) and clinical image (B)

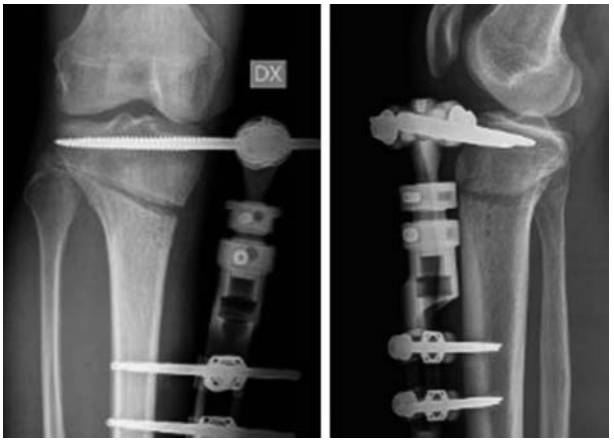

Figure 2. X-ray performed 30 days after osteotomy with good correction and initial signs of bone callus formation

Results

The mean age of the patients in this study was 44 years (range: 26-53) and the mean follow-up was 5 years and 1 month (range: 1-10). The average pre-operative score according to the HSS Knee Service Rating System was 85 (Range: 55-97), with an improvement of each subjective and objective single chart parameter and of the knee ROM if compared to the pre-operative measurements. Results were excellent in 20 cases (77%) and good in 6 (23%) (Figure 1-6). None of the patients of this study underwent subsequent TKA. According to the radiographic evaluation, the tibiofemoral valgus angles improved from a pre-operative mean of 183° (range: 177°-195°) to a post-operative of 172° (range: 168°-174°) and there were no cases of recurrence of the deformity nor significant loss of the correction.

The following complications were observed:

- 2 cases of late infection at the pin sites which were successfully treated with specific oral an-

Figure 3. X-ray performed 90 days following osteotomy and after consolidation and AEF removal

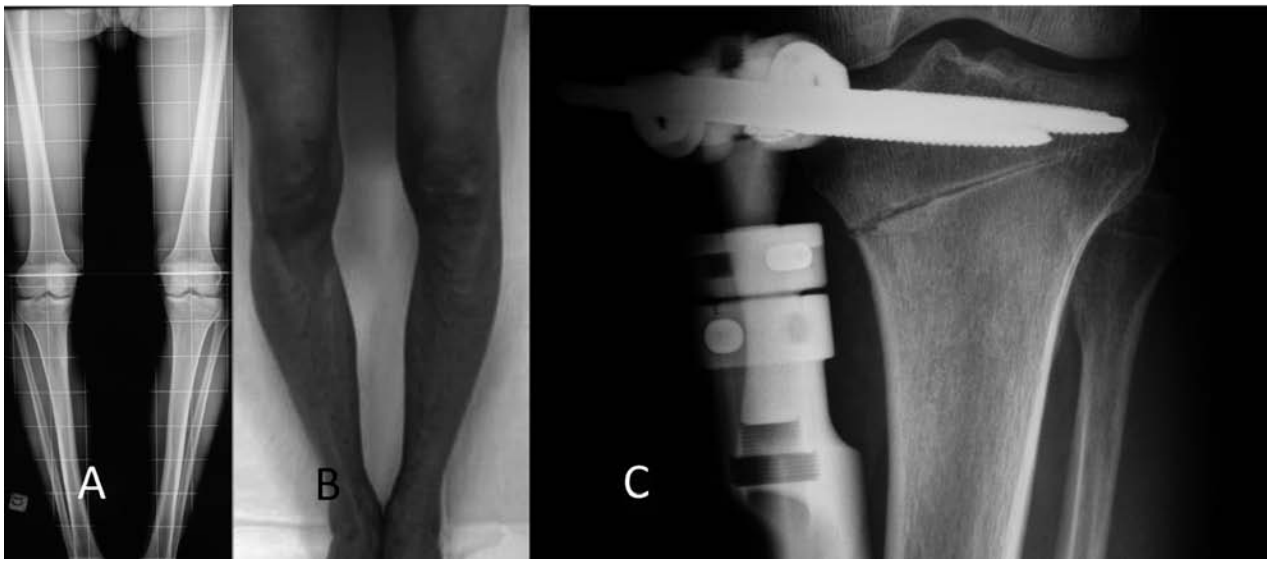

Figure 4. Bilateral genu varum in a patient of 37 years of age; preoperative long weight bearing lower limbs radiographs (A), clinical image (B) and postoperative x-ray.

tibiotics and removal of the AEF with maintenance of the correction

- 1 delayed-union that was successfully treated with physical modalities (Electromagnetically Pulsed Fields)

In all cases the osteotomy consolidated without the need of further surgery.

The AEF was removed on average at 90 days from surgery (range: 80-110).

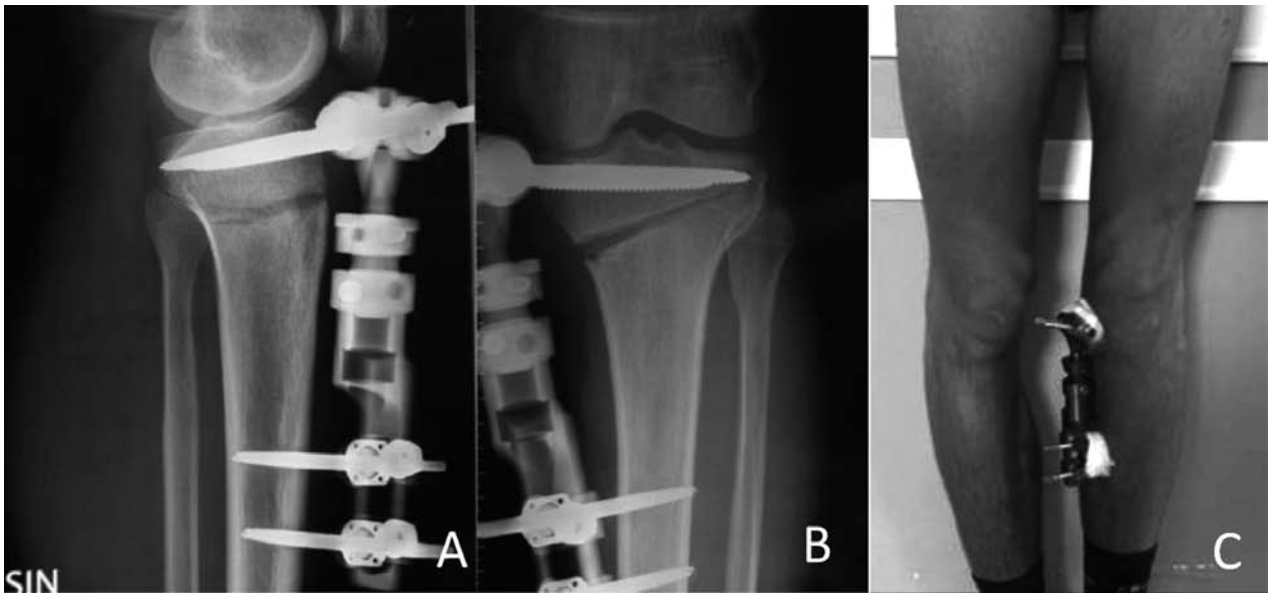

Figure 5. Radiographic (A-B) and clinical views (C) 30 days after osteotomy; satisfactory correction and initial bone callus formation

Figure 6. X-ray performer 85 days after osteotomy, that is consolidated, and removal of AEF

Discussion

Valgus lengthening HTO in genu varum allows to correct the tibiofemoral axis and improves weight distribution over the joint surface, thus slowing the progression and/or development of medial knee osteoarthritis. Various techniques of corrective osteotomy described in the literature have shown to be effective offering satisfying and sustainable long-term results (7-27). The hemicallotasis method utilizing an axial external fixator is a valid treatment option which also gives excellent long-term results in more than 90% of cases (18-21). Our results are comparable to those found in the literature (18-21) and still remain positive at 5 year follow-up. The authors believe this is due to the validity of the technique but also to a strict patient selection and to the fact that this type of surgery should be done in young adults below 60 years of age, not obese, without joint instability and with low-grade medial compartment osteoarthritis of the knee (23, 29-33). Also, a careful pre-operative planning using long weight bearing radiographs of the lower limbs, possibly with computerized measurements, is essential for a precise axis correction. The authors also believe, as shown in the literature (18-21, 27) and according to this study's results, that a slight overcorrection in valgus favours, throughout the years, axis preservation which may prevent potential recurrence of the deformity.

There are several advantages of this technique. The minimal invasiveness, with the positioning of the pins away from the site of the osteotomy and the avoidance of internal fixation and bone grafts, guarantees a more physiological callus formation. In addition, medial lengthening osteotomy, unlike lateral shortening osteotomy, preserves the fibular neurovascular bundle and does not require to shorten the fibula and release the proximal tibio-fibular joint (34-35). Finally, the

dynamic correction after surgery allows to a more precise realignment of the tibiofemoral axis (18-21, 27). On the other hand, the long period of fixation and the difficult management of the external fixator by the patient increase the risk of infection at the pin sites, seen in as much as 30% of the cases (18-21, 27, 35). For this reason patient selection is fundamental and they need to be motivated, compliant, carefully educated and meticulously monitored on a weekly or bi-weekly basis in a dedicated out-patient clinic. Two (2) out of 26 cases in the present study developed at the end of the treatment this complication which were however successfully treated with specific oral antibiotics and removal of the AEF. In no case the osteotomy failed or required the conversion to TKA, and if this latter treatment should be needed in the future, no additional difficulties are to be expected because of the absence of internal hardware (18-21, 27, 36).

In this study, patients with severe joint instability were excluded. In such patients, the success of HTO through hemicallotasis technique strongly relies on preliminary or simultaneous soft-tissue surgery to provide stability to the osteotomized knee (37-40). A wide discussion on the advantages of exploratory knee arthroscopy preceding the osteotomy can be found in the literature (41-43). In our experience, pre-osteotomy arthroscopy was never done, and the authors feel that the high rate of success of the AEF technique relies more on the correct re-alignment of the axis rather than on arthroscopic debridement in knees presenting initial degeneration. Surely, pre-operative magnetic resonance imaging studies and diagnostic arthroscopy done simultaneously during the osteotomy surgery would allow a more precise classification of cartilage damage, which is a predictive factor of success for this technique.

Conclusions

Valgus lengthening HTO through hemicallotasis is a valid treatment option in genu varum. Its long-term success, aside from the accuracy of the procedure, greatly relies on proper patient selection. In addition, the dynamic aspect of the external fixator allows for more precise minimal invasiveness corrections of the tibiofemoral axis in post-operative period. The positive results in all case of the present study confirm the validity of this osteotomy technique.

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