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Original article

Computer-assisted osteotomy for valgus knees: Medium-term results of 29 cases

D. Saragaglia*, B. Chedal-Bornu

Clinique universitaire de chirurgie orthopédique et de traumatologie du sport, hôpital Sud, CHU de Grenoble, avenue de Kimberley, 38130 Échirolles, France

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ABSTRACT

Introduction: Computer-assisted surgery has been shown to be beneficial for correcting misaligned lower limbs. The purpose of this study was to analyze the medium-term results of computer-assisted osteotomy for 29 valgus knees. The hypothesis was that computer navigation would allow a valgus deformity to be corrected with similar precision as varus deformity.
Material and methods: The series consisted of 27 patients (29 knees); there were 7 men and 20 women with ages ranging from 15 to 63 years (mean: 42.4 ± 14.3 years). Twenty-four varus osteotomies of the femur (14 medial closing and 10 lateral opening) and five double osteotomies (proximal tibia and distal femur) were performed. The pre-operative functional status was evaluated with the Lysholm-Tegner score. The mean score was 64 ± 20.5 points (range: 18–100). According to Ahlbäck's modified classification for knee osteoarthritis, 12 patients were at stage 1, nine were at stage 2, five at stage 3 and one at stage 4. Two of the knees had no radiological signs of osteoarthritis but had a particularly unsightly deformity; one of these was secondary to high tibial valgus osteotomy. The mean pre-operative hip-knee-angle (HKA) angle was 189.3 ± 3.9°; the mean mechanical medial distal femoral angle (mMDFA) was 97.2 ± 2.6° and mechanical medial proximal tibial angle (mMPTA) was 90.1 ± 2.8°. The goal was to achieve an HKA angle of 179 ± 2° and mMPTA of 90 ± 2° to avoid an oblique joint line. Functional outcomes were evaluated with the Lysholm-Tegner, KOOS and IKS scores.
Results: No complications other than a transient paralysis of the common fibular nerve were observed. Twenty-three patients (25 knees) were reviewed at a mean follow-up of 50.9 ± 38.8 months (range: 6–144). The mean Lysholm-Tegner score was 92.9 ± 4 points (86–100), the mean KOOS was 89.7 ± 9.3 (range: 68–100), the mean IKS "knee" score was 88.7 ± 11.4 points (range: 60–100) and the "function" score was 90.6 ± 13.3 points (range: 55–100). Twenty-two patients were satisfied or very satisfied. The mean HKA angle was 180.1 ± 1.9°, the mean mMDFA 90.7 ± 2.5° and the mean mMPTA 89.1 ± 1.9°. The pre-operative goal was achieved in 86.2% of cases (25/29) for the HKA angle and 100% of cases of the mMPTA angle. At the follow-up, none of the knees had been revised with a prosthesis.
Conclusion: Computer-assisted osteotomy for cases of osteoarthritis secondary to valgus knee leads to excellent medium-term results. Navigation provides reliable and accurate deformity correction.
Level of evidence: IV. Retrospective study.

1. Introduction

Osteotomy at the knee was described more than 50 years ago as a treatment for frontal plane misalignment [1–3] and certain inflammatory conditions with or without lower limb deformity [4]. Osteotomy for valgus deformity is much less common than for varus deformity, as evidenced from the lesser number of published studies and cases [5–10]. In varus knee, it is commonly accepted that 3–6 degrees of hyper-correction extends the duration of the beneficial effects of the osteotomy [11–15]. In previous studies, our group has shown that computer-assisted surgical navigation will lead to a more accurate correction [16–19]. It is logical to think that the same can be achieved in valgus knees. However, the pre-operative goal or methods to achieve this goal have not been well defined in published studies. We have been using computer-assisted navigation during knee osteotomy procedures for varus deformity in March 2001 and for valgus deformity in September 2001. The primary objective of this study was to evaluate the reliability of computer-assisted navigation in achieving the correction set out before the surgery. The secondary objective of this study was

* Corresponding author. Tel.: +33 47 67 65 833; fax: +33 47 67 65 818.
E-mail address: DSaragaglia@chu-grenoble.fr (D. Saragaglia).

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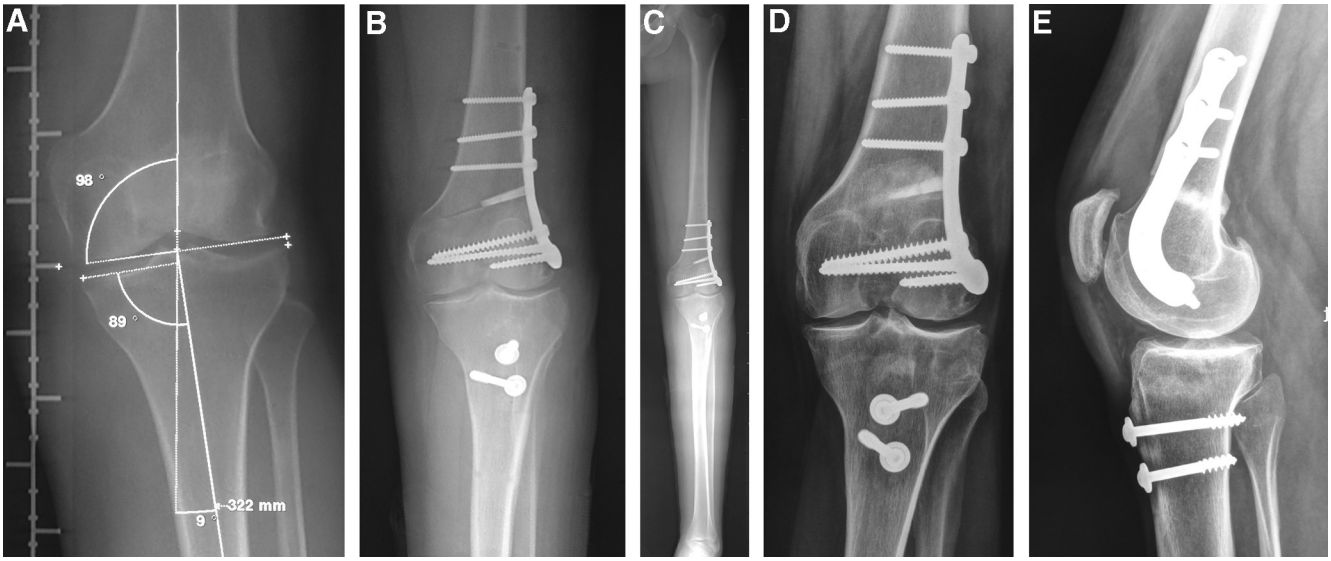

Fig. 1. A. Stage 1 lateral compartment osteoarthritis of the knee associated with patellofemoral osteoarthritis. HKA angle of 189°, mechanical medial distal femoral angle of 98° and mechanical medial proximal tibial angle of 89°. B. Computer-assisted lateral opening femoral varus osteotomy with a tricalcium phosphate wedge and OTIS-F® plate, along with tibial tubercle medialization and iliotibial band piecrust lengthening. C. Post-operative long-leg standing radiograph showing valgus correction. D and E. X-rays one year post-operative; Lysholm-Tegner score of 90.

to evaluate clinical outcomes with an average follow-up of at least four years. Our hypothesis was that computer navigation would allow a valgus deformity to be corrected with similar precision as a varus deformity.

2. Material and methods

2.1. Patient series

Between September 2001 and March 2013, 29 computer-assisted osteotomy procedures for valgus knee were performed in 27 patients (2 bilateral cases). There were 20 women and 7 men with a mean age of 42.4 ± 14.3 (range: 15–63). The right knee was operated in 18 cases and the left in 11 cases. The mean body mass index (BMI) was 26.7 ± 5 kg/m^2 with a mean height of 170 cm and mean weight of 77.3 kg. Twenty-seven of the knees had lateral compartment knee osteoarthritis, with three of these also having patellar instability. Based on the modified Ahlbäck's classification [17], 12 patients were at stage 1, nine were at stage 2, five at stage 3 and one at stage 4. One patient had no signs of osteoarthritis but instead had a particularly unsightly deformity. Another patient had iatrogenic painful valgus knee after high tibial osteotomy.

The mean pre-operative HKA angle was 189.3 ± 3.9° (range: 181–198°); the mean mechanical medial distal femoral angle (mMDFA) was 97.2 ± 2.6° (range: 93–105°) and the mean mechanical medial proximal tibial angle (mMPTA) was 90.1 ± 2.8° (range: 86–95°).

The pre-operative Lysholm-Tegner score [20] was 64 ± 20.5 points (range: 18–100), the mean IKS [21] "knee" score was 55.5 ± 19.2 points (range: 30–100) and the "function" score was 61.8 ± 29 points (range: 0–100).

2.2. Surgical technique

The main goal was to achieve a 179 ± 2° HKA angle and reduce the mMDFA. The secondary goal was to avoid a valgus mMPTA, which led us to perform five double osteotomies.

All of the procedures were carried out using the Orthopilot™ (B. Braun-Aesculap, Tuttlingen, Germany) navigation system; the technique used was very similar to the one used in varus knees [16–19]. After intra-operative acquisition of the mechanical axis of the lower limb, the appropriate femoral varus osteotomy was carried out: medial closing in 14 cases and lateral opening in 10 cases. In some cases of excessively tight fascia lata where the required lateral opening osteotomy exceeded 6 to 8°, piecrust lengthening was performed on the iliotibial band (ITB); this contributes to easier recovery of knee flexion (Fig. 1). Medial closing osteotomies were performed in our earliest cases and were secured with an AO T-shaped plate (Synthes, Étupes, France). Lateral opening osteotomy was performed in our later cases; the opening was filled with Biosorb® wedges (SBM, Lourdes, France) and secured with an AO T-shaped plate or an OTIS-F® locking plate (SBM, Lourdes, France). A double varus osteotomy of the femur and tibia due to valgus mMDFA and mMPTA was performed in five cases to avoid an oblique joint line (Fig. 2). In these five cases, a medial closing-wedge osteotomy of the tibia was performed first with an OTIS locking plate and then a lateral opening-wedge varus osteotomy of the femur was carried out. Medialization of the tibial tubercle was performed in three cases with associated patellar instability.

3. Assessment methods

All of the patients underwent a standing A-P long-leg radiograph at the third post-operative month according to Ramadier et al. protocol [22]. The mMDFA was defined as the angle between a line from the center of the femoral head to the middle of the intercondylar notch and a line tangent to the most distal part of the femoral condyles without taking the cartilage into account. The mMPTA was defined as the angle between a line from the middle of the intercondylar eminence to the middle of the talar dome and a line tangent to the bone landmarks on both tibial plateaus without taking the cartilage into account. Medial angles were measured at the femur and tibia.

Functional outcomes were evaluated through the Lysholm-Tegner, KOOS [23] and IKS scores at the last follow-up. Patients were either reviewed by an independent observer (12 cases) or through a telephone questionnaire (11 cases).