

## PROGNOSTIC FACTORS IN THE OUTCOME OF SUPRACONDYLAR FEMORAL OSTEOTOMY FOR LATERAL COMPARTMENT OSTEOARTHRITIS OF THE KNEE

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**OBJECTIVE:** To identify the demographic and operative factors that determine outcome in supracondylar femoral osteotomy for lateral compartment osteoarthritis of the knee.

**DESIGN:** Clinical and radiologic review of a nonrandomized, consecutive one-surgeon series.

**SETTING:** A university-affiliated, elective surgical referral centre.

**PATIENTS:** Forty-nine consecutive patients with unicompartmental osteoarthritis of the knee, involving the lateral compartment, and of sufficient severity that the alternative surgical procedure would be total knee replacement.

**INTERVENTION:** Supracondylar varus osteotomy stabilized with a blade plate.

**MAIN OUTCOME MEASURES:** Knee function measured by the Knee Society Score and time to conversion to total knee replacement.

**RESULTS:** A Knee Society Score greater than 80 was obtained in 81% of patients, but in the function portion of the measurement only 30% had a similar score. After discarding the patients who died, life-table analysis demonstrated the predicted survival before conversion to total knee replacement to be 87% at 7 years. There was no correlation with patient age or sex, femorotibial angulation, amount of correction or time after the intervention. Removal of the fixation device improved the clinical result.

**CONCLUSION:** The role of supracondylar femoral osteotomy remains poorly defined, but the procedure can delay total knee replacement for considerable time in appropriate patients.

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**OBJECTIF :** Définir les aspects démographiques et ceux de l'intervention qui jouent sur le résultat d'une ostéotomie fémorale sus-condylienne dans un cas d'ostéoartrite du compartiment latéral du genou.

**CONCEPTION :** Étude clinique et radiologique d'une série consécutive non randomisée d'interventions réalisées par un même chirurgien.

**CONTEXTE :** Centre de référence pour chirurgie élective affilié à une université.

**PATIENTS :** Quarante-neuf patients consécutifs atteints d'ostéoartrite unilatérale du genou affectant le compartiment latéral et de gravité suffisante pour que l'autre intervention chirurgicale possible soit une arthroplastie totale du genou.

**INTERVENTION :** Ostéotomie de varisation sus-condylienne stabilisée par une lame.

**PRINCIPALES MESURES DES RÉSULTATS :** Fonction du genou mesurée selon le score de la Knee Society et temps écoulé jusqu'à l'arthroplastie totale du genou.

**RÉSULTATS :** On a obtenu un score de la Knee Society de plus de 80 chez 81 % des patients, mais dans la

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partie fonctionnelle de la mesure, 30 % seulement ont obtenu un score semblable. Après élimination des patients décédés, l'analyse d'après la table de vie a démontré que la survie prévue avant la conversion à l'arthroplastie totale du genou s'établissait à 87 % à 7 ans. On n'a établi aucun lien avec l'âge, le sexe, l'angulation fémoro-tibiale, l'importance de la correction ou la période écoulée après l'intervention. L'enlèvement de l'appareil de fixation a amélioré le résultat clinique.

CONCLUSION : Le rôle de l'ostéotomie fémorale sus-condylienne demeure mal défini, mais l'intervention peut reporter considérablement l'arthroplastie totale du genou chez les bons patients.

Supracondylar femoral varus osteotomy for osteoarthritis was first described in the English-speaking literature by Jackson.<sup>1</sup> Most of the literature consists of small series performed over a long period.<sup>2-11</sup> A number of these series had a heterogeneous population of post-traumatic, rheumatoid and osteoarthritic patients;<sup>7,8,12</sup> in some series, staples were used to fix the osteotomy site, a technique that has generally been replaced by fixation with a blade plate.<sup>6,8,11</sup> In the two largest papers, the factors determining outcome were not examined statistically.<sup>7,10</sup> In this paper, we reviewed and analysed data collected on a large consecutive series performed by the senior author (H.U.C.) to determine the factors that determine outcome in supracondylar femoral osteotomy for lateral compartment osteoarthritis of the knee.

## PATIENTS AND METHODS

The study population comprised all patients who had a supracondylar osteotomy performed between 1984 and 1992 for osteoarthritis of the knee clinically and radiologically involving the lateral compartment only, with a preoperative knee flexion of greater than 100°. Arthroscopy was not done routinely. The procedures were performed as described by McDermott and colleagues,<sup>10</sup> using a medially-based wedge of bone and stabilizing the osteotomy with a 90° 15-mm offset AO hip osteotomy blade plate (Fig. 1). The objective was to correct the alignment into neutral or slight varus. All patients were allowed full

mobilization but were kept non-weight bearing. The patients were followed up postoperatively by determination of the Knee Society Score, which consists of functional and knee components.<sup>13</sup> Three-foot standing anteroposterior x-rays of the knees were obtained preoperatively and at each follow-up visit. If the patient required conversion to a total knee replacement or died, the last available follow-up score and x-rays before death or conversion were used in the analysis. Dichotomous independent variables were analysed by the Mann-Whitney U test, and ordinal data with the Spearman rank correlation coefficient. Life-table analysis was also done for the survival of the os-

teotomy. The level of statistical significance used was  $p < 0.05$ . Statistical analysis was performed using the SPSS for Windows package, version 6.1.

## RESULTS

Between 1984 and 1992, 49 osteotomies (15 in men, 34 in women) were performed in 46 patients, ranging in age from 23 to 84 years (mean 60 years). The mean (and standard deviation) preoperative femorotibial angle was 13° (3.5°) (range from 7° to 23°). Although the preoperative Knee Society Score was not recorded in these patients, the study included 1 patient with spina bifida and 1 patient with multiple sclerosis, both of whom



FIG. 1. Preoperative (left) and postoperative (right) standing anteroposterior radiographs.

had neurologic deficits affecting their functional status, but they were thought not to have Charcot joints. Another patient had had a patellectomy.

Including all patients entering the study, the mean follow-up was 3.5 years (range from 1 to 7 years). Five of the patients required conversion to total knee arthroplasty at a mean of 3 years after the osteotomy (range from 1 to 5 years). Four of the patients died, a mean of 2.5 years after the os-

teotomy (range from 1 to 5 years), but none of the deaths was due to operative complications. No patients were lost to follow-up.

In 1 case, stability was not achieved with the blade plate alone intraoperatively, and additional fixation was provided with a compression plate applied laterally during the same operation. Six patients had delayed union; all were treated with lateral compression plating and occasionally with autogenous bone grafting from the iliac

crest.<sup>4</sup> All delayed unions were radiologically and clinically healed at 2 to 4 months after the second procedure. One patient lost fixation of the blade plate in the early postoperative period; fixation was achieved by the same technique as that used for delayed union. This result is included in the group of delayed unions. In 1 patient it was noted postoperatively that fixation was in 15° of external rotation. This was later corrected with a derotation osteotomy at the same level. One patient had a fall and sustained a femoral fracture 4 cm proximal to the proximal end of the osteotomy plate. The fracture was fixed with open compression plating through a lateral approach.

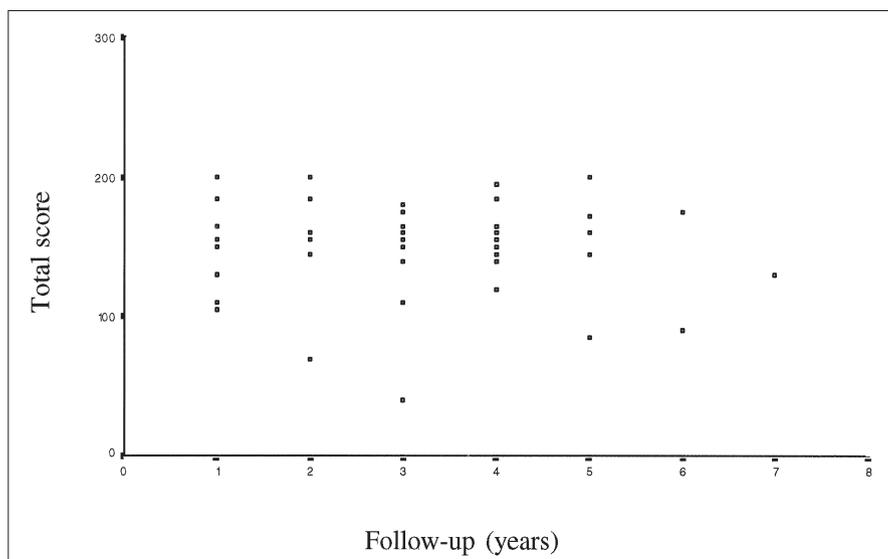
Before surgery, all patients were informed that the plate would be removed after 1 year. Twenty-seven patients accepted this. The others preferred not to have further surgery. There were no refractures after removal of the plate. In 14 cases, the patients underwent arthroscopic débridement of the knee between 1 and 5 years after osteotomy for ongoing symptoms. In all cases, the Knee Society Score used in the analysis was determined after the débridement.

The overall results are shown in Table I. Patients with scores of 90 and over were classified as excellent, between 80 and 89 were good, between 70 and 79 fair and less than 70 were poor. Using Spearman rank correlation coefficients and Mann-Whitney U tests, we examined the following preoperative information in terms of its effect on the components of the knee score and the total score: age, sex and preoperative femorotibial angle. None of these had a significant effect on the knee scores. It is also notable that there was no correlation between the number of years after the procedure that the final follow-up assessment took place and the knee scores (Fig. 2).

**Table I**

**Postoperative Results for the Series of 49 Patients**

Result	No. (%) of patients
Knee score, mean ( $\pm$ SD)	84.8 (18.5)
Excellent ( $\geq 90$ )	32 (65)
Good ( $\geq 80$ and $< 90$ )	8 (16)
Fair ( $\geq 70$ and $< 80$ )	1 (2)
Poor ( $< 70$ )	8 (16)
Function score, mean ( $\pm$ SD)	64.5 (21.5)
Excellent ( $\geq 90$ )	9 (18)
Good ( $\geq 80$ and $< 90$ )	5 (10)
Fair ( $\geq 70$ and $< 80$ )	6 (12)
Poor ( $< 70$ )	29 (59)
Conversion to total knee arthroplasty	5 (10)



**FIG. 2.** Scatterplot of the total knee score versus years of follow-up.

The effects of the final femorotibial angle, the number of degrees of correction and of having the plate removed were examined. Neither the final femorotibial angle nor the number of degrees of correction achieved had an effect on either of the components of the knee score or the total score (Figs. 3 and 4). The patients who had the blade plate removed had a significantly higher knee score ( $p = 0.04$ ); however, this did not translate into a

significantly higher total score. On examination of the components of the knee score, the pain component was the significant contributor to improvement. Those who had delayed union did not differ significantly from those who did not have a delayed union. As might be expected from the indications for doing these procedures, the patients who had arthroscopic débridement and those who required revision to total knee re-

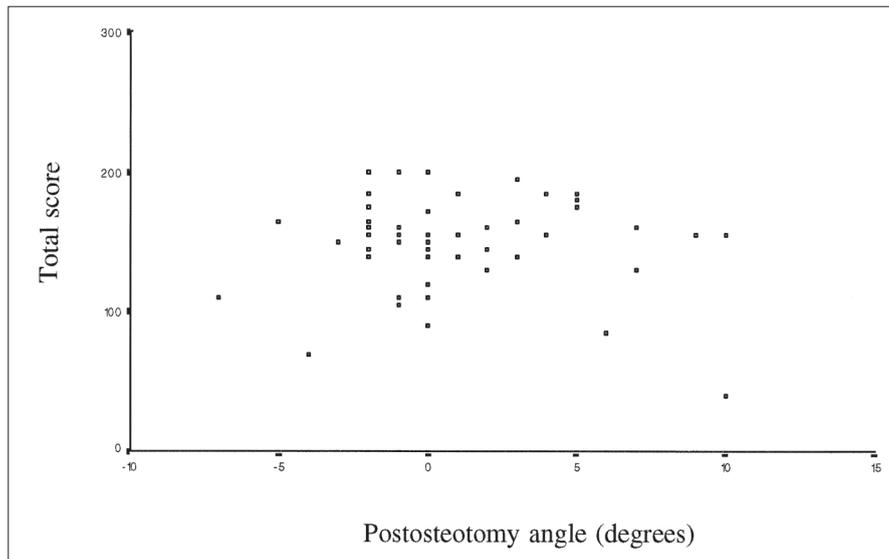
placement were significantly worse in terms of all three scores at the time of assessment before their arthroscopy or revision.

Finally, we performed life-table analysis on the duration of survival of the osteotomy before conversion to total knee arthroplasty (Fig. 5). Predicted survival without revision to total knee replacement was 70% at (95% confidence interval [CI] 42% to 99%). Eliminating from the analysis the patients who died, the predicted 7-year survival was 87% (95% CI 72% to 100%).

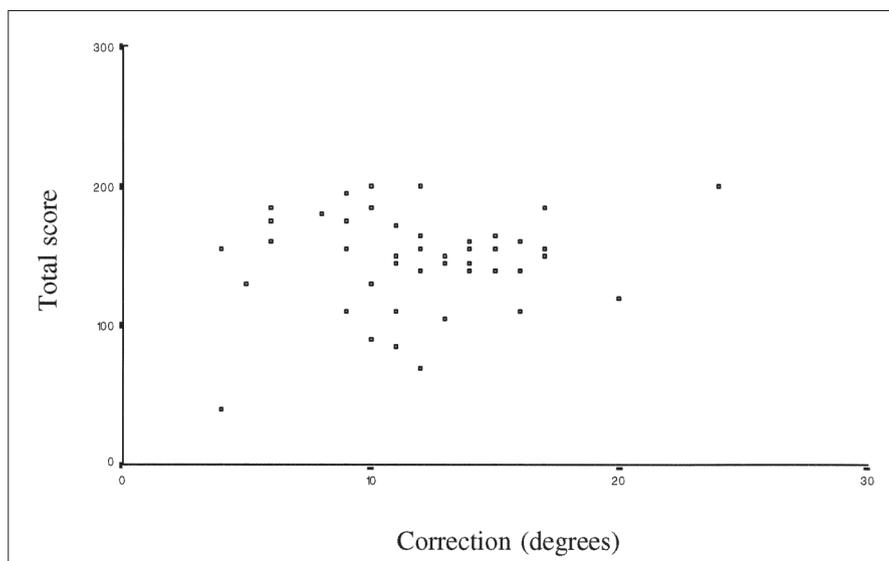
**DISCUSSION**

The current role of femoral osteotomy is therefore not clear. In undertaking this review, we wished to determine what factors predicted a good or poor outcome in this procedure and identify either a population or a group of patients with intraoperative factors (such as amount of correction) that would predict a good clinical outcome.

The 2 largest series of varus femoral osteotomy reported in the English language literature to date have been those of Healy and associates<sup>7</sup> and McDermott and colleagues.<sup>10</sup> The first paper reported the results of 23 femoral osteotomies for various indications; of these, 15 were performed for osteoarthritis. Only 1 of the osteoarthritic group had less than a good result as assessed by the Hospital for Special Surgery Score. The article from McDermott and colleagues reported on the results of a group of 24 femoral osteotomies using a technique similar to that described in this review. They reported better pain relief than functional improvement from the procedure. They also stated that the pain relief was maintained. They did not find a correlation between the final angle



**FIG. 3.** Scatterplot of the total knee score versus postosteotomy angle.



**FIG. 4.** Scatterplot of the total knee score versus degree of correction.

achieved and the outcome. Of the 23 patients, 1 required conversion to a total knee arthroplasty.

Our present review has failed to identify any preoperative prognostic factor in the outcome of this procedure. Specifically, better results do not appear to be achieved in younger patients than in older ones. We have found that patients in whom the plate is removed have a higher knee score than those in whom the plate is left in. This is surprising since all patients were offered plate removal.

The complication rate in our series was high, with 6 cases of delayed union, 1 case of loss of fixation and 1 of rotatory deformity. The rotational deformity could have been avoided, but we could see no obvious factors that led to the delayed union. Fortunately, after lateral plating and bone grafting, the end result in these patients was not significantly different from that in patients who achieved early union.

Our review agrees with that of McDermott's group in that we did not find that those with longer follow-up had worse results than those with a shorter follow-up. Although we did not specifically analyse deterioration in score for each patient, this finding does suggest that those who achieve a

good result tend to maintain it. If this is true, the results presented in the survival analysis may be worse than the true clinical situation. It may be that the patients not requiring early revision will not require revision for a much longer period, thus flattening out the survival curve.

## CONCLUSIONS

We had good or excellent results in 81% of patients according to the knee portion of the Knee Society Score, but a comparable function score was recorded in only 30% of patients. It is difficult to know how to interpret the overall results of any of the papers describing the results of varus supracondylar osteotomy. Clearly, pain relief in this procedure is inferior to that in total knee arthroplasty; however, we believe that this procedure should not be compared directly to arthroplasty but rather should be seen as one that may delay the need for a total knee arthroplasty by a number of years, possibly obviating the need for revision earlier in the patient's life. Overall, we remain uncertain about the place of supracondylar femoral osteotomy in the treatment of valgus arthritis of the knee.

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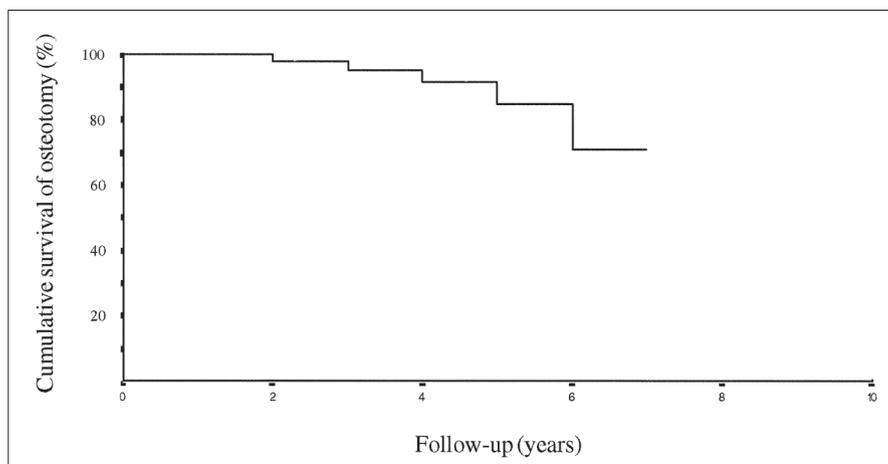


FIG. 5. Survival curve for conversion to total knee arthroplasty.