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Combined Intra-Articular and Varus Opening Wedge Osteotomy for Lateral Depression and Valgus Malunion of the Proximal Part of the Tibia

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Background: Reconstructive surgical measures for treatment of posttraumatic deformities of the lateral tibial plateau are seldom reported on in the literature. We report the long-term follow-up results of a consecutive series of reconstructive osteotomies performed to treat depression and valgus malunions of the proximal part of the tibia.

Methods: From 1977 through 1998, a combination of an intra-articular elevation and a lateral opening wedge varus osteotomy of the proximal part of the tibia was performed in twenty-three consecutive patients. The patients were assessed clinically and radiographically at a minimum of five years postoperatively.

Results: A correction of the intra-articular depression and the valgus malalignment was achieved and the anatomic lower-extremity axis was restored in all patients. The clinical results were evaluated at a mean of thirteen years (range, two to twenty-six years) after the reconstructive osteotomy. Two patients had an early failure and were considered to have had a poor result. Two other patients had severe progression of osteoarthritis after the osteotomy, four had slight progression, and fifteen had no progression. There were no nonunions. There were two superficial wound infections, which were treated successfully without surgical intervention. According to the scale of Lysholm and Gillquist, the subjective result was excellent for seventeen patients (74%), good for three, fair for one, and poor for two.

Conclusions: A knee-joint-preserving osteotomy can provide satisfactory results in active patients with painful posttraumatic lateral depression and valgus malunion of the proximal part of the tibia.

Level of Evidence: Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.

Primary cartilage damage and posttraumatic joint incongruency contribute to the development of posttraumatic osteoarthritis. The prevalence of posttraumatic osteoarthritis of the knee joint at the time of long-term follow-up after tibial plateau fractures has been estimated to be 30%. Correction of posttraumatic deformities is a treatment option to prevent the progression of symptoms from those deformities. Posttraumatic valgus deformity of the proximal part of theibia without an intra-articular zone of depression can be treated with a proximal varus osteotomy to correct the valgus and restore natural alignment. Treatment of a posttraumatic valgus deformity of the proximal part of the tibia in combination with intra-articular depression is technically more demanding. Reconstructive surgical strategies involving preservation of the native knee joint are rarely mentioned in the literature. We perform a corrective osteotomy (rather than a primary osteotomy) as the first step in the treatment of posttraumatic deformity of the lower limb. The aim of this strategy is to restore joint congruency and enhance stability through osseous alignment. We report the long-term follow-up results in a consecutive series of patients in whom posttraumatic lateral depression and valgus deformity of the proximal part of the tibia was treated with a combination of an intra-articular corrective osteotomy and an opening wedge varus proximal tibial osteotomy.

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Materials and Methods

From 1977 through 1998, a combined intra-articular elevation and opening wedge varus osteotomy was performed for the treatment of painful lateral depression and valgus malunion of the proximal part of the tibia in twenty-three consecutive patients. All patients had been referred to our clinic because they were functionally disabled and had substantial pain. The majority of the patients also had giving-way. Poor general health, older age (more than seventy years), severe loss of knee function with an extension deficit of >20° and/or a flexion deficit of >60°, poor soft-tissue status, and previous infection of the knee joint were contraindications. Furthermore, when the entire lateral tibial condyle had displaced distally in either the frontal or the sagittal plane (in contrast to a depressed zone in a normally positioned lateral tibial condyle), we preferred to use an elevating monocondylar osteotomy rather than the technique described in this study.

The mean age at the time of the correction osteotomy was forty-one years (range, sixteen to sixty-nine years); the deformity was posttraumatic in all patients. The primary fracture treatment had been conservative in ten patients and open surgical in twelve; no treatment had been provided for one patient because of a missed diagnosis (see Appendix). All patients described knee pain originating in the lateral tibiofemoral compartment. The pain was not graded with a scoring system.

In order to evaluate the degree of knee deformity, standing full-length anteroposterior radiographs of the lower extremities as well as lateral and oblique radiographs were made for all patients. Preoperative and postoperative radiographs were analyzed to assess the degree of osteoarthritis, the degree of valgus deformity (the tibiofemoral angle), and the amount (in millimeters) of depression of the lateral tibial plateau. The function of the knee joint was assessed with the knee-rating scores described by Neer et al., Insall et al., and Lysholm and Gillquist.

Two patients had an early failure of the procedure; one of them underwent an arthrodesis after two years, and one underwent a total knee arthroplasty after six years. Both patients were considered to have had a poor result, and those results were included as such in the scoring of knee joint function.

Preoperative Workup

Radiographic assessment was performed with use of weight-bearing full-length anteroposterior radiographs of both lower extremities; oblique radiographs; and, later in the study, computed tomography scans. Computed tomography scans can be helpful to evaluate the width and depth of the intra-articular depression zone in the lateral tibial plateau. Limb alignment and knee stability, which influence the size of the opening wedge varus osteotomy, must be assessed intraoperatively since they depend on the intra-articular correction that is achieved after elevation of the tibial plateau to the level of the lateral femoral condyle; therefore, exact preoperative planning is not possible. All patients received a standard clinical assessment and antibiotic prophylaxis.

Operative Technique

All but one operation was performed by the senior author (R.K.M.). We start with an oblique osteotomy of the middle third of the fibula. Then a lateral arthrolysis of the knee joint is performed through a straight lateral or parapatellar approach, and the intra-articular depression zone is identified. Most deformities can be reached through a simple lateral arthrolysis; if necessary, an osteotomy of Gerdy’s tubercle can be performed in order to reach further posteriorly on the lateral tibial plateau. The performance of the proximal tibial varus osteotomy with the previously described technique is the second step. An AO bone spreader is used to open the osteotomy site to the degree that is necessary. The depression of the tibial plateau

Fig. 1-A

Figs. 1-A through 1-G Case 7 (see Appendix).
Fig. 1-A Anteroposterior radiograph of an AO/ASIF type-41-C.3.1 fracture caused by a skiing accident.
Anteroposterior (Fig. 1-B) and lateral (Fig. 1-C) radiographs made at one year after open reduction and internal fixation of the fracture. The patient complained of a painful valgus malalignment, had serious giving-way problems, and had to walk with the aid of two crutches. There is a distinct depression of the lateral compartment, which can be seen clearly on the lateral radiograph.

Anteroposterior (Fig. 1-D) and lateral (Fig. 1-E) radiographs made after the opening wedge varus osteotomy of the proximal part of the tibia in combination with a monocondylar corrective osteotomy of the lateral tibial condyle and intra-articular elevation of the depressed area. Elevation of the depression is depicted on the lateral radiograph as a dotted line.
can best be identified with the knee in 100° of flexion. Through the lateral arthrotomy, approximately 60% of the lateral plateau can be viewed, and the depression zone is marked circumferentially with a 2.0-mm drill-bit. Then the depression zone is osteotomized with a small osteotome, vertically into the tibia and guided by the drill-holes. With use of a curved impactor inserted through the opening wedge osteotomy site, the depression is brought to an anatomic position, and any fibrocartilage overgrowth is removed. Correction is deemed to be sufficient when the elevated depression zone is fully congruent with the surface of the lateral femoral condyle. The correction is maintained as the elevated fragments are supported by impacted cancellous bone graft. If necessary, internal fixation is performed to add to the intrinsic stability achieved by the impacted corticocancellous grafts (Figs. 1-A through 1-G).

Postoperative Management
Functional passive motion is started forty-eight hours postoperatively and is performed until the postoperative swelling is reduced sufficiently and the preoperative range of motion of the knee joint is regained. Functional bracing and toe-touch weight-bearing with crutches are then started and maintained for eight to ten weeks. This is followed by progression to full weight-bearing as tolerated.

Radiographs are made on the first postoperative day and at eight to ten weeks.

**Results**

The amount of valgus alignment (the tibiofemoral angle) as measured preoperatively on the standing anteroposterior radiograph ranged from 8° to 20° and averaged 13°. Depression of the lateral tibial plateau as measured preoperatively on the lateral and oblique radiographs ranged from 3 to 21 mm and averaged 7.7 mm (Table I). Measurement of the preoperative and postoperative tibiofemoral angles as well as the depression depth documented that the deformities had been corrected. Between the preoperative and latest follow-up evaluations, fifteen patients showed no progression of radiographic signs of osteoarthritis¹, four showed slight progression, and two showed substantial progression (Table I).

Postoperatively, two patients had a superficial wound infection, which resolved without surgical intervention. No deep infections developed, and there were no nonunions.

The ranges of motion assessed preoperatively and at the time of the latest follow-up are shown in the Appendix.

At the time of the latest follow-up, the knee score according to the system of Insall et al.² was excellent for fourteen patients (61%), good for six (26%), and poor for three (13%). According to the system described by Neer et al.³, the result was excellent for twelve patients (52%), good for eight (35%), fair for one (4%), and poor for two (9%). According to the scoring system described by Lysholm and Gillquist⁴, the subjective result was excellent for seventeen patients (74%), good for three (13%), fair for one (4%), and poor for two (9%) (see Fig. 1-F, Lateral radiograph made after removal of the metal internal fixation device at eleven years postoperatively. The elevation of the lateral plateau is well maintained.)

![Image of lateral radiograph](https://example.com/lateral_radiograph.png)

Fig. 1-F

![Image of anteroposterior radiograph](https://example.com/anteposterior_radiograph.png)

Fig. 1-G

Anteroposterior radiograph made at twenty years postoperatively. The correction of the tibiofemoral angle and the elevation of the lateral plateau have been maintained.
In this long-term follow-up study, reconstruction of a depressed and valgus malunion of a lateral tibial plateau fracture in a small group of severely disabled patients yielded good functional results that compare well with the results of primary total knee arthroplasty after tibial plateau fracture. Obvious advantages of the reconstructive osteotomies are maintenance of the native knee joint with a good functional outcome as well as restoration of the alignment and preservation of bone stock to facilitate an eventual total knee arthroplasty in the future. As with all osteotomies, potential hazards include overcorrection or undercorrection of the valgus deformity, which may compromise the functional result. The infection rate in our series of twenty-three patients was very low, with only two superficial wound infections. This infection rate is lower than that reported in studies of total knee arthroplasties in patients with a prior tibial plateau fracture. Those reports included only patients who had been treated operatively before the index operation, while we included patients in whom the original fracture had been treated either conservatively or operatively. Weiss et al. also reported a lower infection rate in a mixed population of patients previously treated either conservatively or operatively.

We are convinced that secondary reconstruction of a malunited intra-articular fracture can delay joint replacement and create better conditions for an eventual replacement. In contrast, although a proximal tibial varus osteotomy is still possible for patients with posttraumatic osteoarthritis who present without an intra-articular and valgus malunion and with normal alignment, a primary total knee arthroplasty is also a good option for such patients. In our experience, knee-joint-preserving osteotomies such as the one that we described here can provide satisfactory long-term results in active patients with a painful and disabling posttraumatic lateral depression and valgus malunion of the proximal part of the tibia.

Appendix

A table showing clinical details on all study patients is available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on “Supplementary Material”) and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM).

References


