A Long-term Follow-up Study of Four Cases who Underwent Curettage and Autogenous Bone Grafting for Steroid-related Osteonecrosis of the Femoral Condyle

HIDETAKA MURAKAMI, TAKASHI SOEJIMA, TAKASHI INOUE, TOMONOSHIN KANAZAWA, MICHIIRO KATOUDA AND KENSEI NAGATA

Department of Orthopaedic Surgery, Kurume University School of Medicine, Kurume 830-0011, Japan

Summary: We performed curettage followed by autogenous bone grafting in several cases of steroid-related osteonecrosis of the femoral condyle, and reviewed the outcome of this procedure after a mean follow-up of 9.5 years. The number of patients was 4; the mean age at the time of the operation was 30.5 years. The mean Knee Society Objective Score was 52.5 before the operation and had increased to 87.5 at the time of the review. The pre-operative radiographic stages were stage 2 in 2 patients and stage 3 in the other 2 patients. Progression in the disease stage was observed in 3 patients. MRI revealed survival of the grafted bone in only one case, and collapse of the articular surface in all cases. In conclusion, though the clinical results showed improvement, the autogenous bone graft failed to answer the purpose of preventing the progression in disease stage.

Key words steroid-related osteonecrosis, femoral condyle, bone graft

INTRODUCTION

Steroid-related osteonecrosis of the femoral condyle is known to occur after high-dosage steroid treatment for nephrotic syndrome or collagen diseases such as systematic lupus erythematosides. Conservative treatment for this type of osteonecrosis has been generally advocated, because the underlying diseases are apt to be serious and multiple joints are usually involved, and also because the clinical symptoms of the osteonecrosis are usually relatively mild. Good results are generally obtained from conservative treatment [1,2].

On the other hand, there are a small number of patients who do not respond to conservative treatment, suffering from persistent severe pain or presenting substantial collapse in the articular surface with an extensive lesion. For these cases, prosthetic replacement may be considered, but there are a number of problems associated with this approach. There is a higher infection rate because these patients are taking corticosteroids, and there is a higher revision rate because the lesion lies within the implant fixation [3,4]. The indications for prosthetic replacement have to be considered with great care, especially in young patients, because the implant survival rates are as low as 61-85% at 5 to 8.2 years after operation [3-5].

We conducted curettage of the necrotic lesion followed by autogenous bone grafting in several patients with persistent severe pain and extensive necrosis who were unresponsive to conservative treatment. This treatment method aimed at preventing progression in the disease stage as well as providing patients with relief from their symptoms. Here we reviewed the clinical results after middle to long-term follow-up in four cases.

CASE REPORT

Since 1985, we have performed curettage of the necrotic lesion followed by autogenous bone grafting...
for steroid-related osteonecrosis of the femoral condyle in 7 cases (8 knees). Four of the 7 cases were available for middle to long-term follow-up, and were reviewed in this study. All four patients were females who had been treated with steroids under a diagnosis of systematic lupus erythematoses. The mean cumulative prednisolone intake until the time when the patients began to complain of pain was 26.2 g (ranging from 9 to 43 g). The mean duration of the conservative treatment before the operation was 19 months (ranging from 9 to 24 months). The mean age at the time of the operation was 30.5 years (ranging from 23 to 47 years). The osteonecrotic lesion at the time of the operation

<table>
<thead>
<tr>
<th>Age at Operation (years)</th>
<th>Period of Follow-up (years)</th>
<th>Knee Society Objective Score at operation</th>
<th>Ficat and Arlet Radiographic Stage at operation</th>
<th>Kerboul Category (Combined necrotic angle) at operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>23</td>
<td>40</td>
<td>stage 2</td>
<td>small (115°)</td>
</tr>
<tr>
<td>Case 2</td>
<td>28</td>
<td>50</td>
<td>stage 3</td>
<td>small (125°)</td>
</tr>
<tr>
<td>Case 3</td>
<td>47</td>
<td>70</td>
<td>stage 2</td>
<td>medium (198°)</td>
</tr>
<tr>
<td>Case 4</td>
<td>24</td>
<td>50</td>
<td>stage 3</td>
<td>small (89°)</td>
</tr>
</tbody>
</table>

*Fig. 1. MRI of case 1. A) The preoperative MRI indicated a necrotic lesion in the bilateral condyles, and the lesion in the lateral condyle extended as far as the subchondral bone in the whole weight-bearing region. B) At 6 years after the operation, the T1 sagittal image showed survival of the grafted bone (white arrow), but the cartilage surface was collapsed. The pain had disappeared and the Knee Society Score was improved from 40 (preoperative) to 100 at the time of the review.*
steroid-related osteonecrosis extended from the weight-bearing surface to the posterior femoral condyle of the subchondral bone in all four cases, and had spread to the tibial portion in two cases.

The surgical technique was essentially as follows. A skin incision was made above the femoral supracondyle, and a K-wire was introduced to the center of the lesion under fluoroscopy and/or arthroscopy. Under fluoroscopy, a biopsy needle (10 mm in diameter) was inserted along with the K-wire into the subchondral bone, and curettage of the periphery of the lesion was performed. Cancellous bone collected from the iliac area was prepared into a stick form, then inserted into the lesion. The periphery was filled with bone chips. With regard to postoperative management, range of motion training was started at 2 weeks after the operation. Partial weight bearing was allowed at 8 weeks, and full weight bearing at 10 weeks after the operation.

The clinical results, the changes in the extent of the lesion and the progression in the radiographic disease stage were investigated to evaluate the effects of this operation after a mean term of 9.5 years (ranging from 3.5 to 16 years). The objective rating scale of the Knee Society was used to define the level of clinical function [6]. A score of 90 or higher was classified as excellent, of 80-89 as good, 70-79 as fair, and of 69 or lower as poor. Radiographs were classified according to a modified Ficat and Arlet staging [7] (Stage 1: normal appearance, but presence of a lesion was detected using MRI. Stage 2: presence of cystic or osteosclerotic lesion. Stage 3: crescent sign or subchondral collapse. Stage 4: osteoarthrotic change in the contralateral tibia). For the evaluation of the size of the lesion, the combined necrotic angle was determined according to the method described by Mont et al. [8]. The angles from the center of the condyle to both margins of the epiphyseal lesion were measured on MRI coronal and sagittal images, and classified by Kerboul category (small: ≤150, medium: ≥151 and <250, or large: ≥250). In the most recent MRIs, survival of the

---

Fig. 2. MRI of case 2. A) The preoperative MRI detected a necrotic lesion in the medial center of the weight-bearing surface, extending to the subchondral bone. The articular surface already demonstrated depression. B) At 3.5 years after the operation, the grafted bone had not survived (superior white arrow). The necrotic lesion and articular surface collapse had spread into the posterior region (posterior white arrow). Though she still experienced pain after a long walk, the Knee Society Score was improved from 50 (preoperative) to 90 points at the time of reviewing.
grafted bones and compatibility to the articular surfaces were also assessed.

Overall results are shown in Table 1. The mean Knee Society Objective Score was 52.5 before the operation and had increased to 87.5 at the time of review, indicating a clinical improvement in all four cases. Cases 1-3 were excellent or good and case 4 was fair. The patient assessed as fair (case 4) presented physical limitations in walking and had to use a side handrail when going up or down stairs. The pre-operative radiographic stages were stage 2 in cases 1 and 3 and stage 3 in cases 2 and 4. Progression in the disease stage was found in cases 1, 3 and 4. According to the Kerboul category classification, no increase in the lesion was observed in cases 1 and 3, whereas a spread in the lesion from small to medium was observed in cases 2 and 4.

The most recent MRIs showed that the grafted bone survived in only case 1 (Fig. 1), and that collapse of the articular surface had occurred in all four cases (Fig. 2).

**DISCUSSION**

The indications for prosthetic replacement must be considered with great caution because this treatment method, when osteonecrosis is extensive, has been reported to be associated with such problems as a high infection rate and sinking of the implant due to the lesion being present within the implant fixation site. Furthermore, relief from pain by prosthetic replacement leads to increased activity because the patients are generally young [3-5]. Accordingly, various techniques including debridement [9], core decompression [10], vascularized fibular graft [11], osteochondral graft [12] and resurfacing using an iliac bone graft [13] have been attempted in order to postpone prosthetic replacement.

Generally, debridement that does not touch the necrotic lesion can achieve only temporary pain removal. However, core decompression that decreases the pressure on the necrotic site is expected to bring about relatively stable clinical improvement. Mont et al. [14] performed core decompression alone in 48 patients and reported that the clinical results were excellent or good in 73% of their cases. Based on the positive clinical results and the low invasiveness of this method, they recommended that core decompression be applied at a comparatively early stage. They also reported that this technique was more successful in preventing progression in radiographic stage than conservative treatment. However, it is still unclear whether decompression could prevent progression in patients with extensive necrosis in the subchondral bone or with articular surface collapse.

In patients with extensive necrosis, we performed curettage of the necrotic lesion with additional autogenous bone grafting, rather than core decompression. In this follow-up study, the clinical results were improved in all four cases, and these effects were considered to have been achieved by a mechanism similar to that of the core decompression technique. However, the autogenous bone graft failed to answer the purpose of preventing progression of the disease stage. In fact, the results were no better than those reported by Mont et al. [14] who conducted core decompression. This may be partly due to continued steroid administration in 3 of 4 cases even after the operation, resulting in a poor environment for the survival of the grafted bone. Another reason may have been insufficient curettage because the lesion spread from the weight-bearing surface to the posterior of the condyle, consequently fixation of grafted bone might have been insufficient within the poor-quality bone. Furthermore, retrograde curettage extending as far as the site under the chondral layer was difficult. Even in the patient whose grafted bone had survived, depression in the necrotic lesion that remained between the grafted bone and chondral layer was not prevented.

There have been a few reports of other procedures. Ochi et al. [9] reported a case of vascularized fibular graft that resulted in new bone formation in the necrotic lesion. However, this technique does not appear appropriate for a patient with osteonecrosis in the bilateral condyles or with an extensive lesion. In a case at stage IV that had already demonstrated collapse of the articular surface, Bayne et al. [15] reported using an osteochondral allograft. However, their osteochondral allograft failed due to the abnormal vascularity of the host bone. Fukui et al. [13] reported a technique to reconstruct an articular surface using autogenous iliac bone en bloc. In such a case, there is a risk of arthropathic changes in the long term because of the resurfacing of the articular surface with cortical bone.

In light of the results reported in the literature and those reported in this study, it appears to be very difficult to prevent progression of the disease stage in a patient with an extensive lesion. Thus, at present, it should be recommended that core decompression be performed at an early stage.
CONCLUSION

To relieve patient symptoms and to prevent progression in the disease stage in steroid-related osteonecrosis in the femoral condyle, we performed curettage followed by autogenous bone grafting. Though the clinical results were improved, the bone grafting failed to prevent the progression in disease stage.

ACKNOWLEDGMENTS: The authors would like to thank Dr. Akio Inoue, Professor Emeritus of Kurume University School of Medicine, who kindly allowed us to investigate his valuable cases in this study. This work was supported in part by a Grant-in-Aid for Scientific Research (14770755) from the Ministry of Education, Culture, Sports, Science, and Technology of Japan.

REFERENCES