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CASE REPORT

Additional distal femoral osteotomy for insufficient correction after high tibial osteotomy

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SUMMARY

A 70-year-old man who was treated with a closed-wedge high tibial osteotomy (HTO) had recurrent right medial knee pain 12 years after the initial osteotomy. We planned a recorection osteotomy because the patient led an active lifestyle, had well-preserved range of motion and the lateral compartment was still intact. According to preoperative deformity analysis, which indicated a tibia in slight valgus and a femur in moderate varus, recorection of the distal femur was chosen. Seven degrees of biplanar distal femoral osteotomy (DFO) was performed using a contralateral version of the TomoFix Medial Distal Femur. At 1 year follow-up, the femorotibial angle had improved from 178° to 170°, and the Japanese Orthopaedic Association score had improved from 75 to 95 points. Additional DFO could be a viable alternative for total knee arthroplasty or recorection HTO when the centre of the deformity is located at the distal femur.

(figure 1A). The preoperative MRI showed an extensive cartilage defect on the medial femoral condyle, a focal cartilage defect at the edge of the medial tibial plateau and an extruded medial meniscus over 6 mm (figure 1B). The cartilage of the lateral compartment and the lateral meniscus was well preserved (figure 1B). On full-length AP weight-bearing radiographs, the femorotibial angle (FTA, lateral angle between the femoral shaft and the tibial shaft¹¹), weight-bearing line ratio (WBLR¹²), mechanical lateral distal femoral angle (mLDFA¹³), joint line convergence angle (JLCA¹³) and mechanical medial proximal tibial angle (mMPTA¹³) were 178°, 42.0%, 91°, 0° and 92°, respectively (figure 2A). On analyses of these parameters, the centre of the varus deformity was found to be located at the distal femur. The tibial correction from the previous HTO was considered adequate because the mMPTA was over 90°.

BACKGROUND

In recent years, high tibial osteotomy (HTO) for medial compartment osteoarthritis (OA) has become an increasingly frequent surgical technique, with the introduction of locking plates specifically designed for HTO.^{1,2} However, complications such as delayed union, overcorrection, undercorrection (UC) or correction loss (CL) are still well-described bone-related complications after HTO.³⁻⁷ Although the most common procedure for progressed OA after UC/CL would be total knee arthroplasty (TKA),⁶ there are some reports on recorection HTO.^{5,7} However, distal femoral osteotomy (DFO) could be a viable alternative when the deformity centre is located on the femoral side. Here, we report such a case treated by recorection osteotomy using lateral closed-wedge DFO (LCWDFO).

TREATMENT

As the lateral compartment OA had not progressed and a good range of motion was still present, a recorection valgus osteotomy was planned. In European countries, around-knee osteotomies (AKOs) are usually indicated for patients around 50 years of age.¹ However, AKOs for patients older than 70 years are widely accepted in Japan because of the necessity for deep knee flexion in their Japanese-style activities of daily living.^{3-5 11 12 14} According to the preoperative deformity analysis mentioned above, 8° of LCWDFO was performed. The surgical procedure for LCWDFO was based on the report by van der Woude *et al.*¹⁵ After making a 15 cm straight skin incision on the lateral aspect of the thigh, the iliotibial band was split. The vastus lateralis muscle was then elevated anteriorly and the osteotomy site was exposed. A radiolucent retractor was placed posteriorly to protect the popliteal neurovascular bundle. Under fluoroscopic control, two Kirschner wires were inserted for an oblique down-sloping wedge, with the 7 mm wedge base at the lateral cortex. The starting point for the distal osteotomy was 4 cm above the lateral femoral epicondyle. The wires converged just proximal to the medial femoral condyle, ending 5 mm short of the medial cortex. A biplanar osteotomy was then completed and the wedge was gradually closed. A TomoFix Medial Distal Femur (Synthes GmbH; Solothurn, Switzerland) for the left knee was installed on the lateral side of the femur. Just before the plate installation, it was bent about 10° because the angle between the cortex of the shaft

CASE PRESENTATION

A 70-year-old man who had undergone a closed-wedge HTO 12 years ago presented with progressive knee pain. When he visited our hospital, his Japanese Orthopaedic Association (JOA) score^{8,9} was 75 points and the knee range of motion was 130°. As the patient led an active lifestyle and the lateral compartment of the knee was well preserved, we decided to perform a joint-preserving surgery.

INVESTIGATIONS

A preoperative anteroposterior (AP) radiograph revealed Kellgren-Lawrence¹⁰ grade II OA



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Figure 1 Anteroposterior (AP) radiograph and preoperative MRI. (A) Kellgren-Lawrence grade II osteoarthritis was seen on the preoperative AP radiograph. (B) Preoperative MRI (fat-suppressed proton-density-weighted MR image) revealed medial osteoarthritis with meniscal extrusion.



Figure 2 Full-length radiographs. (A) A preoperative, full-length, weight-bearing radiograph showed a mild varus deformity caused by the femur. (B) Valgus correction was achieved on the full-length view 6 months after the osteotomy. (C) A full-length radiograph after plate removal at the 1 year follow-up. The correction was maintained.



Figure 3 Postoperative CT. (A) Coronal slice of the multiplanar CT 6 months after surgery. The trabecular continuity was obtained. (B) Sagittal slice of the multiplanar CT 6 months after surgery. Callus formation was seen on the posterior aspect of the osteotomised site.

and the proximal aspect of the condyle is larger on the lateral side than on the medial side. Otherwise, the proximal two screws of the plate head may be inserted into the osteotomy plane, and plate irritation may occur due to inappropriate fitting. After putting the prebent plate on the lateral condyle according to the procedure described by Brinkman *et al*¹⁶ and Woude *et al*,¹⁵ a temporary lag screw was applied to provide compression to the hinge. Finally, locking screws were inserted in all of the locking portions of the combi-hole of the plate.

OUTCOME AND FOLLOW-UP

Partial and full weight-bearing were allowed at 4 and 8 weeks after surgery, respectively, according to the protocol described by Nakamura *et al*.¹⁴ After the DFO, the FTA, WBLR and mL DFA were corrected to 170°, 64.8% and 83°, respectively (figure 2B). As the mature trabecular continuity was confirmed both on the coronal and sagittal views of the multiplanar reconstruction CT 6 months after the LCW DFO (figure 3A, B), the plate was removed 1 year after surgery. There was no recurrence of the varus deformity at 1 year follow-up (figure 2C). At the latest follow-up at 14 months, the JOA score had improved to 95 points with 135° of knee flexion.

DISCUSSION

First, we defined insufficient correction as a knee with remaining varus in spite of an HTO being performed, including both UC and CL. In general, UC occurs during the surgery, while the CL refers to a change in postoperative alignment. Therefore, insufficient correction can be divided into the following six types: (1) intraoperative UC induced by inappropriate preoperative planning; (2) intraoperative UC due to technical error(s); (3) CL at the osteotomy site; (4) progressive bony deformity at another site of the tibia; (5) progressive bony deformity in the femur and (6) medial joint closing/lateral joint opening during weight-bearing because of loss of the medial compartmental cartilage/meniscus/bone, increased lateral instability and/or weak muscles around the knee.

Because the former osteotomy was performed 12 years prior at another hospital, we cannot be certain how much insufficient correction there was in the present case. According to the deformity analysis, the insufficient correction in this case may have been mainly caused by the femur. In addition to that, the lateral compartment was still intact and the range of motion was preserved. Therefore, we chose to perform a recorection with an additional DFO. Despite the reoperation, this procedure was the first osteotomy of the femur, as the initial osteotomy was performed on the tibia. Thus, there were no adhesions in the femoral osteotomy site and no unmanageable postoperative sclerotic bones. That was the great advantage of this procedure. Furthermore, if TKA had been indicated in this case, the medial tibial bone resection would have been thicker than on the lateral side because the mMPTA was 92°. Therefore, it would have been difficult to obtain an appropriate soft tissue balance in this case and there would be some possibility that a constrained prosthesis may be required.¹⁷

A conversion to uni-condylar knee arthroplasty (UKA) could be a potential option for this case. However, high failure rates of UKA conversion from HTO have been reported¹⁸ because of technical problems associated with ligamentous instability, or lateral wear and subsequent failure. Therefore, we selected a joint preserving surgery as the initial treatment.

In cases of UC/CL with non-union, recorection should be considered first since the fixation of the non-union would be required.⁵ However, in the case of UC/CL without non-union, TKA is usually performed,⁶ and there have been few reports of recorection osteotomy.⁷ To our knowledge, no report has suggested DFO as a possible treatment for UC/CL when the centre of the deformity is in the femur. However, we sometimes encounter older female patients with progressive femoral varus deformities.¹⁹ Therefore, CL after HTO caused by femoral deformity, or type 5 CL after HTO as described above, are not rare situations in the super-aged Japanese society. In conclusion, despite only a 1 year short-term follow-up, the additional LCWDFO for UC/CL after HTO provided satisfactory outcomes for our patient.

Learning points

- ▶ Additional distal femoral osteotomy for insufficient correction after high tibial osteotomy was successfully performed without recurrence of varus.
- ▶ This procedure could be a viable alternative for total knee arthroplasty when lateral compartment osteoarthritis has not progressed and a good range of motion still exists.
- ▶ It is crucial to analyse the deformity centre when recorection osteotomy is planned.

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REFERENCES

- 1 Staubli AE, De Simoni C, Babst R, *et al.* TomoFix: a new LCP-concept for open wedge osteotomy of the medial proximal tibia—early results in 92 cases. *Injury* 2003;34 Suppl 2(Suppl 2):55–62.
- 2 Han JH, Kim HJ, Song JG, *et al.* Locking plate versus non-locking plate in open-wedge high tibial osteotomy: a meta-analysis. *Knee Surg Sports Traumatol Arthrosc* 2017;25:808–16.
- 3 Takeuchi R, Ishikawa H, Kumagai K, *et al.* Fractures around the lateral cortical hinge after a medial opening-wedge high tibial osteotomy: a new classification of lateral hinge fracture. *Arthroscopy* 2012;28:85–94.
- 4 Nakamura R, Komatsu N, Murao T, *et al.* The validity of the classification for lateral hinge fractures in open wedge high tibial osteotomy. *Bone Joint J* 2015;97-B:1226–31.
- 5 Nakamura R, Nishimura H, Katsuki Y. Re-correction osteotomy with osteophyte graft for correction loss with non-union after high tibial osteotomy. *BMJ Case Rep* 2017;2017:bcr-2017-221870 <http://casereports.bmj.com/content/2017/bcr-2017-221870.long>.
- 6 Song SJ, Bae DK, Kim KI, *et al.* Conversion total knee arthroplasty after failed high tibial osteotomy. *Knee Surg Relat Res* 2016;28:89–98.
- 7 Watanabe K, Tsuchiya H, Matsubara H, *et al.* Revision high tibial osteotomy with the Taylor spatial frame for failed opening-wedge high tibial osteotomy. *J Orthop Sci* 2008;13:145–9.
- 8 Okuda M, Omokawa S, Okahashi K, *et al.* Validity and reliability of the Japanese Orthopaedic Association score for osteoarthritic knees. *J Orthop Sci* 2012;17:750–6.
- 9 Goldhahn S, Takeuchi R, Nakamura N, *et al.* Responsiveness of the Knee Injury and Osteoarthritis Outcome Score (KOOS) and the Oxford Knee Score (OKS) in Japanese patients with high tibial osteotomy. *J Orthop Sci* 2017;22:862–7.
- 10 Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis* 1957;16:494–502.
- 11 Ogata K, Yoshii I, Kawamura H, *et al.* Standing radiographs cannot determine the correction in high tibial osteotomy. *J Bone Joint Surg Br* 1991;73:927–31.
- 12 Takeuchi R, Ishikawa H, Aratake M, *et al.* Medial opening wedge high tibial osteotomy with early full weight bearing. *Arthroscopy* 2009;25:46–53.
- 13 Paley D, Herzenberg JE, Tetsworth K, *et al.* Deformity planning for frontal and sagittal plane corrective osteotomies. *Orthop Clin North Am* 1994;25:425–65.
- 14 Nakamura R, Fujita K, Omi R, *et al.* Closed wedge distal femoral osteotomy with a polyaxial locking plate designed for the proximal tibia: Minimum 5-year outcomes. *Knee Surg Relat Res* 2017;29:232–6.
- 15 van der Woude JA, Spruijt S, van Ginneken BT, *et al.* Distal femoral valgus osteotomy: bone healing time in single plane and biplanar technique. *Strategies Trauma Limb Reconstr* 2016;11:177–86.
- 16 Brinkman JM, Hurschler C, Staubli AE, *et al.* Axial and torsional stability of an improved single-plane and a new bi-plane osteotomy technique for supracondylar femur osteotomies. *Knee Surg Sports Traumatol Arthrosc* 2011;19:1090–8.
- 17 Ranawat AS, Ranawat CS, Elkus M, *et al.* Total knee arthroplasty for severe valgus deformity. *J Bone Joint Surg Am* 2005;87 Suppl 1(Pt 2):271–84.
- 18 Rees JL, Price AJ, Lynskey TG, *et al.* Medial unicompartmental arthroplasty after failed high tibial osteotomy. *J Bone Joint Surg Br* 2001;83:1034–6.
- 19 Nagamine R, Inoue S, Miura H, *et al.* Femoral shaft bowing influences the correction angle for high tibial osteotomy. *J Orthop Sci* 2007;12:214–8.

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