Case Report

Report of successful application of the chipping technique in atypical femoral fracture prophylactic surgery☆

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ABSTRACT

Treatment using intramedullary nail (IMN) is challenging for atypical femoral incomplete fractures with the bowed femur. Although IMN is the first choice for atypical femoral fractures, there is often a mismatch between the shape of the femur and the implant. Therefore, for prophylactic surgery of atypical femoral incomplete fracture we used IMN with a chipping technique, which is used for non-unions of the longitudinal fracture.

We report a case of an 87-year-old woman who presented with bilateral thigh pain that lasted 3 months and gradually worsened. She had a medication history of bisphosphonates for 10 years. In addition, radiography showed severe curvature in her femurs, with radiolucent fracture lines in the diaphysis. We obtained good results by using IMN with the chipping technique. Thigh pain was promptly relieved postoperatively. Four months after surgery, each bone had fused without the need for additional treatment.

The chipping technique in prevention surgery of atypical femoral fracture can eliminate the mismatch with the implant by grinding the limited lesion, including the radiolucent fracture line. Moreover, it promotes bone healing.

Introduction

Impending fracture of the bowed femoral shaft associated with atypical femoral fractures (AFFs) is rare and difficult to treat. Although the intramedullary nail (IMN) method is the most common prophylactic surgery for this condition, the bowed femoral shape often does not match the nail. Therefore, the IMN method is usually combined with corrective wedge osteotomy to conform to the femoral shape. Wedge osteotomy requires experience and is highly invasive in general. Thus, we used the chipping osteotomy technique instead of wedge osteotomy because it is a less-invasive procedure. We report the excellent progress of healing fracture using the chipping osteotomy technique.

Case presentation

An 87-year-old woman presented to the orthopedic outpatient department with exacerbation of bilateral meralgia from 3 months. Her medical history included bilateral total knee arthroplasty for osteoarthritis 7 years previously, osteoporosis, and hypertension. She had a medication history of bisphosphonates for 10 years. Her subjective symptom began without any trigger. Her pain started in...
the left thigh and later in the right leg. Although she could walk with a pushcart before symptom onset, she visited our outpatient in a wheelchair. Radiographs showed a strong curve and radiolucent fracture line in the anterolateral bone cortex of the distal diaphysis on both sides (Fig. 1). The femoral bowing angle was 13° on the right and 15° on the left. As a treatment strategy, we planned prophylactic surgery from the left side, where the pain was severe and fracture appeared to be imminent on imaging.

The surgical technique was performed in the same way on both sides, with an interval of 3 months after the initial surgery. Each operation was performed under subarachnoid anesthesia. The patient was positioned supine on a traction table in the same manner as routine IMN surgery. We inserted a guidewire and reamed the medullary cavity firmly to the optimal size. We chipped the part of the incomplete fracture using a bone chisel into a wedge shape from the anterolateral to the posteromedial while leaving the guidewire in place. After chipping, we inserted the nail (T2 Reconstruction Nailing system, recon mode; Stryker, Kalamazoo, MI, USA; Fig. 2). Table 1 lists the details of the operation, including operation time, change in pre- and postoperative hemoglobin levels, and blood transfusion requirements.

Postoperatively, we allowed full weight-bearing the day after surgery. Her complaints of pain ceased promptly after surgery. She was discharged home at 46 days and 28 days postoperatively, respectively. She was able to walk using a two-handed cane at each discharge without thigh pain. Although we did not prescribe any bone morphogenetic agents and used low-intensity ultrasound stimulation, each of the bones fused 4 months after surgery (Fig. 3). At 10 months after her initial surgery, the patient could walk independently, (indoors while walking alongside something and outdoors using a pushcart) at the time of her outpatient visit.

Discussion

The IMN method is the first choice for complete fracture of AFFs [1]. On the other hand, for incomplete fractures, it is not certain whether plate fixation or IMN is the preferred method of prophylactic surgery [2]. In particular, incomplete diaphyseal fractures with severe curvature such as observed in this case are difficult to treat using either an IMN or plate fixation. We mainly treat with an IMN and use the chipping technique. This method has been used for the treatment of non-union as reported by Watanabe et al. [3] We use the chipping technique for two purposes: first, to correct the curvature and eliminate the mismatch between the implant and the femur and, second, to promote fracture healing.

In general, corrective wedge osteotomy is the standard method of mismatch resolution. However, correction by wedge osteotomy without excess or deficiency requires experience and is highly invasive. On the other hand, with the chipping technique, we make only a small skin incision to insert the chisel. Moreover, damage to the periosteum is also limited to a narrower area than with wedge osteotomy. For this type of prophylactic surgery, we have devised a combination of the chipping technique and wedge osteotomy (Supplementary Fig. 1), because we do not believe that full circumferential chipping is necessary. We crush only the lateral cortex, including the radiolucent fracture line, and crack the healthy medial bone cortex to the extent that bony contacts are maintained. This
device has three benefits: (1) it does not create extreme differences in leg length, (2) it does not require postoperative weight-bearing limitations, and (3) it is not dependent on the type of IMN.

The original chipping technique method is used for the treatment of non-unions after a longitudinal fracture. This procedure is advantageous for bone healing for at least two possible reasons. The first is that it protects the periosteum, which is an essential factor in bone fusion. The second is that the fracture is crushed and agitated in the bone cortex and bone marrow, which is thought to promote bone formation. These would clearly be useful in the treatment of AFFs, in which a combination of several factors (e.g., medications and bone morphology) has reduced the biological activity of the bone. We also believe that this osteogenic promoting effect is the reason why the concomitant use of teriparatide or low-intensity ultrasound stimulation is not necessary.

Conclusion

We presented an effective prophylactic surgical technique for incomplete fracture of AFFs. The chipping technique, in combination with IMN therapy, is a useful treatment for incomplete AFFs with bowed femur.

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Consent for publication

Not applicable. Data and figures in this work do not reveal identity/personal details of the participant. Patient confidentiality and
The work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). Written informed consent for participation was obtained from patient. The privacy rights of human subjects are observed. Institutional Review Board approval is not applicable for this study.

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Declaration of competing interest

None.

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