ORIGINAL ARTICLE

Femur malunion treated with open osteotomy and intramedullary nailing in developing countries

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KEYWORDS
Diaphyseal malunion of the femur;
Open intramedullary nailing;
Femoral osteotomy

Summary
Introduction: In developing countries, malunion, after diaphyseal femur fractures initially untreated by internal fixation, is not rare. Their difficult management contrasts with the deficiency of the technical operating room facilities.
Patients and methods: Our prospective study, conducted over a 1-year period, reports 16 open osteotomies fixed using Küntscher intramedullary nailing in patients who presented malunion of the femoral diaphysis. Twelve males and four females (mean age, 34.5 years; range, 18–67 years) were managed with a mean time to surgery of 8 months (range, 4–14 months). All had initially consulted a bonesetter. The mean length inequality was 3 cm (range, 2–6 cm); the mean knee flexion limitation was 90° (range, 10°–120°).
Locking of the rotation was obtained by the obliquity of the osteotomy line. No bone filling was added but reaming and decontaminations were systematic. The patients were clinically and radiographically assessed at D21, D45, D90, and D120, based on the evaluation of the length inequality, mobility, and bone union. Rotational malunion or deformity were not analyzed.
Results: Fifteen patients had achieved union in 90 days. In one case, secondary incurvation of the nail led to changing the nail, allowing union with no axis deformity at D120. The mean postoperative knee flexion was 120° (range, 45°–130°). The mean gain in length was 2 cm (range, 1.5–4 cm).
Discussion: This open technique using non-interlocking material allowed us to obtain bone union while improving joint mobility and length inequality.
Level of evidence: Level IV. Retrospective study.
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Introduction

Fracture of the femoral diaphysis is a frequent injury whose well-conducted treatment provides good results [1–3].

In developing countries, neglected forms are not rare and present as non-union or malunion [4,5]. The problems treating malunion are related to restoring the axis, the limb length, and joint mobility in the knee and hip. Our old Küntscher non-interlocking intramedullary nailing osteosynthesis method necessarily requires an osteotomy technique providing the site with its own stability.

We report the results of a prospective study of 16 open osteotomies with non-interlocking intramedullary nailing in patients presenting malunion of the femoral diaphysis. The objective of this study was to assess bone union, mobility, and correction of unequal limb length.

Patients and methods

From November 2009 to November 2010, 16 patients (12 males and four females; mean age, 34.5 years; range, 18–67 years) were treated for malunion of the femoral diaphysis (Fig. 1). The left side was involved in seven cases and the right in nine cases. All had initially consulted a bonesetter. None had had prior osteosynthesis.

The mean time to consultation was 8 months (range, 4–14 months). In all cases, there was limb length inequality with a mean difference of 3 cm (range, 2–6 cm), knee stiffness with mean flexion of the knee equal to 90° (range, 10°–120°).

The radiographic evaluation systematically included standard AP and lateral preoperative x-rays of both femurs.

Surgery was performed by the same team, under spinal anesthesia, with the patient installed in the lateral decubitus position on a standard surgical table.

After a lateral approach to the malunion site, decortication and oblique plane osteotomy at the malunion were performed, then repermeabilization of the femoral shaft, reaming, placement of the Küntscher nail after reduction by hyperflexion of the fracture site, placing the two fragments end-to-end, followed by extension so as to align the fragments (Fig. 2). No bone grafting was done. Since a Küntscher nail was used, no interlocking procedure was performed.

The knee was systematically mobilized under anesthesia at the end of the procedure. A Redon drain was placed for 2 days.

Postoperative care systematically included enoxaparin sodium thromboembolic treatment (4000 IU/day) and an antibiotic treatment: 2 g of ceftriaxone per day for 3 days. Pain control treatment comprised 1 g injectable paracetamol associated with an ampoule of nefopam 20 mg four times a day.

Walking with partial weight-bearing was initiated on D2 with two crutches and joint mobilization on D7.

Radiographic follow-up occurred on D21, D45, D90, and D120 after surgery.

We studied bone union quality, residual length inequality, return to walking, and knee joint mobility.

Results

The results are detailed in Table 1.

The patients’ mean hospital stay was 6 days (range, 4–9 days). The only postoperative complication at D45 was the bending of an intramedullary nail with a poorly adapted diameter, with varus of the osteotomy site, in a patient for whom crutch use had become difficult because of radial nerve paralysis in a context of humeral diaphysis malunion. Changing the nail without opening the fracture site provided bone union with no femur axis deformity at 120 days.

The other patients achieved union within a mean 90 days (Fig. 3) with walking possible without canes and return to professional activities.

Knee mobility was improved in all patients, with a mean flexion of 120° (range, 45°–130°) (Fig. 4).

Figure 1: Mid-diaphyseal malunion with significant overlap.

Figure 2: Immediate postoperative aspects. Note the oblique osteotomy.
Table 1  Results of femoral diaphyseal malunion treatment.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Time to surgery (months)</th>
<th>Malunion site</th>
<th>Shortening (cm)</th>
<th>Knee flexion (°)</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td>Preop</td>
<td>Postop</td>
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<tr>
<td>1</td>
<td>M</td>
<td>27</td>
<td>4</td>
<td>Middle 1/3</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>31</td>
<td>7</td>
<td>Proximal 1/3</td>
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<tr>
<td>3</td>
<td>M</td>
<td>43</td>
<td>9</td>
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<td>4</td>
<td>F</td>
<td>46</td>
<td>11</td>
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<tr>
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<td>M</td>
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<td>Proximal 1/3 and distal 1/3</td>
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<td>8</td>
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<tr>
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<td>4</td>
<td>Proximal 1/3</td>
<td>4</td>
<td>1.5</td>
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</table>

Figure 3  Union at D90.

Length inequality was reduced in all cases with 1 cm (range, 0.5–2 cm) mean residual shortening. The mean gain in length was 2 cm (range, 1.5–4 cm).

Discussion

Treatment of recent femoral diaphyseal fractures is well codified. The choice treatment is closed interlocking intramedullary nailing [2,3]. In the neglected fractures complicated by malunion, osteotomy is indispensable and is performed in an open procedure [4,5]. Such cases are described most particularly in developing countries [4,5]. Mahaisavariya and Laupattarakasem [5] and Gahuakamble et al. [4] respectively report 14 and four cases of femoral diaphyseal malunion treated with intramedullary nailing.

The difficulty treating femoral diaphyseal malunion correcting limb shortening involves carrying out the procedure in a single operation. Traction of the limb is transmitted to the soft tissues and can lead to a number of neurovascular complications [6,7].

Our length gain was obtained intraoperatively in a single procedure on a standard surgical table.

Technically, our reduction maneuver allowed us to do without an orthopaedic table, with hyperangulation of the two fragments placed end-to-end followed by reduction by extension. In their series, Gahuakamble et al. [4] reported a case of continuous traction over 14 days after osteoclasis in a patient with 5 cm of shortening, followed secondarily by osteosynthesis. We obtained a mean length gain of 2 cm (range, 1.5–4 cm) with no nerve or blood vessel complications.

No bone grafting was done. Osteoperiosteal decortications as described by Judet and Patel [8] as well as compression of the osteotomy site with walking resulted in...
Femur bone union. Iliac bone graft and three local grafts were used in the four patients reported by Gahuakamble et al. [4].

We encountered the problem of stabilization in rotation by a non-interlocking intramedullary implant. Use of the interlocking nails available to us would have prevented secondary rotation of the site. The osteotomy that we carried out obliquely, corresponding to oblique plane osteotomy, after impaction made it possible to stabilize rotation with three pressure points oriented along the osteotomy line. This impaction was obtained by verticalization and partial weight-bearing on the 2nd postoperative day. The absence of pre- and postoperative CT scans prevented us from studying any residual rotational deformity.

Postoperative knee flexion was improved because of the systematic mobilization at the end of the procedure. Maximum caution should be taken, notably in cases of an old fracture, because of the risk of fracture around the knee and patellar ligament rupture. This type of complication was reported by Gahuakamble et al. [4] after correction of malunion, length gain, and knee mobilization.

In all our patients, knee mobility was improved, with, however, stiffness in one patient at 45° flexion, related to the patient’s age and noncompliance with the prescribed rehabilitation program.

The only complication observed in this series was the bending of a nail whose diameter was less than desired in a patient with associated ipsilateral radial paralysis. Since walking with a pair of canes was impossible, the stresses were maximal on the osteotomy site.

Conclusion

Malunion in general and femoral diaphysis malunion in particular are frequent lesions in orthopaedic in developing countries. Despite unfortunately limited means, a well-conducted surgical strategy can obtain good results with an oblique plane osteotomy and open non-interlocking Kuntscher intramedullary nailing. In absence of interlocking nailing, a plane oblique osteotomy can stabilize rotation of the osteotomy site.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References