Blocking Screws for the Treatment of Distal Femur Fractures

MUSTAFA SEYHAN, MD; SELAMI CAKMAK, MD; FERDI DONMEZ, MD; AREL GERELI, MD

abstract

Intramedullary nailing is one of the most convenient biological options for treating distal femoral fractures. Because the distal medulla of the femur is wider than the middle diaphysis and intramedullary nails cannot completely fill the intramedullary canal, intramedullary nailing of distal femoral fractures can be difficult when trying to obtain adequate reduction. Some different methods exist for achieving reduction. The purpose of this study was determine whether the use of blocking screws resolves varus or valgus and translation and recurvatum deformities, which can be encountered in antegrade and retrograde intramedullary nailing.

Thirty-four patients with distal femoral fractures underwent intramedullary nailing between January 2005 and June 2011. Fifteen patients treated by intramedullary nailing and blocking screws were included in the study. Six patients had distal diaphyseal fractures and 9 had distal diaphyseo-metaphyseal fractures. Antegrade nailing was performed in 7 patients and retrograde nailing was performed in 8. Reduction during surgery and union during follow-up were achieved in all patients with no significant complications. Mean follow-up was 26.6 months. Mean time to union was 12.6 weeks. The main purpose of using blocking screws is to achieve reduction, but they are also useful for maintaining permanent reduction. When inserting blocking screws, the screws must be placed 1 to 3 cm away from the fracture line to avoid from propagation of the fracture. When applied properly and in an adequate way, blocking screws provide an efficient solution for deformities encountered during intramedullary nailing of distal femur fractures.

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Intramedullary nailing is regarded as one of the most convenient biological options among the alternative methods for treating distal femoral diaphyseal and metaphyseal fractures. However, inadequate reduction and malunion is frequently encountered in relation to fracture morphology because the distal medulla of the femur is wider than the middle diaphysis and the intramedullary nail cannot completely fill the intramedullary canal. Ideal reduction can be ensured using methods such as open reduction and anatomic plate application or wire cerclage, but these methods increase soft tissue and periosteal circulation damage and infection risk. If these problems with reduction can be efficiently resolved, intramedullary nailing will be the more commonly preferred treatment for distal femoral fractures. This article describes how blocking screws can offer a solution for reducing these fractures. Successful results were obtained from studies conducted on the use of blocking screws. The requirement of blocking screws mostly emerges intraoperatively. Therefore, a surgeon must have detailed information about deformity types and their blocking screw correction methods. The purpose of this study was to use pictorial descriptions and clinical examples to demonstrate fracture deformities that are common in the distal femur and how to create solutions for them by using blocking screws.

**MATERIALS AND METHODS**

Thirty-four patients with distal femoral fractures underwent intramedullary nailing at the authors’ institution between January 2005 and June 2011. Seven of 18 patients treated with antegrade nailing and 8 of 16 patients treated with retrograde nailing needed 1 or 2 blocking screws. While performing antegrade or retrograde intramedullary nailing in distal diaphyseal or metaphyseal fracture of femur, if reduction is not achieved, the nail is removed and the guidewire is left inside. The nail is reinserted after a blocking screw is placed at a suitable location under fluoroscopy. The blocking screw guides the intramedullary nail toward the desired direction inside the large intramedullary canal while ensuring the reduction of the displaced fragment. Blocking screws are more often applied to shorter and larger fragments from wide-angle corners formed by fracture lines with bone cortices on the concave sides of the deformities. Sometimes, a second blocking screw may be applied to a long fragment from a wide-angle corner formed by the fracture line with the bone cortex on the concave side of the deformity. If the screw is placed this close to the fracture, the fracture may become more complex. To prevent fracture propagation, it is necessary to insert the screw 1 to 3 cm away from the fracture line. This distance may differ according to fracture type and bone quality. Fluoroscopically controlling the insertion point after drilling is useful before inserting the blocking screw because the localization can be changed if concerns exist regarding the localization.

When inserting the blocking screws from the lateral to medial direction, surgeons must be aware of the saphenous nerve lying medially and the sural nerve lying laterally around the knee. For blocking screws inserted from the anterior to posterior direction, avoiding injury to the patellofemoral joint is essential. The authors inserted anteroposterior screws from the point localized at 3 cm away from the superior pole of the patella. To prevent damage to the medial and lateral superior geniculate arteries and their branches localized anteriorly just above the articular level, the authors also made a blunt dissection after skin incision for the subcutaneous tissue and muscles.

**RESULTS**

Of the 15 patients, 10 were men and 5 were women. Mean patient age was 38.8 years (range, 22-58 years). Six patients had distal diaphyseal fractures and 9 had distal diaphyseo-metaphyseal fractures. All fractures were extra-articular. Other than in 3 patients, all fractures resulted from high-energy trauma, and 4 patients had polytrauma. Of these fractures, 5 were open. Most commonly, blocking screw application from the anterior side on the distal femoral fragment due to recurvatum on the sagittal plane (n=7) was performed. Blocking screws were placed on required locations due to varus on the coronal plane in 2 patients, valgus on the coronal plane in 2 patients, and translation on the coronal plane in 2 patients, in association with or without the above-mentioned deformity. Mean follow-up was 26.6 months (range, 12-48 months). Mean time to union was 12.6 weeks (range, 8-32 weeks). Delay to union was observed in a 31-year-old polytrauma patient who was a smoker. In this patient, union was achieved at week 32, and no additional surgical intervention was required. In 2 patients, implants were removed due to implant discomfort after union was achieved. No additional complication was related to the added blocking screw. Screw applications were replaced due to inconvenience of their locations, but no fragmentation increased in any patient due to the blocking screws. No infection was observed.

Patient demographics are shown in the Table. Based on the anatomic soft tissue features of the region and morphology of the fracture, recurvatum, varus and valgus deformities, or translation are often encountered in the distal femur. A pictorial description of reduction and blocking screw application for deformities on the sagittal and coronal planes are shown in Figures 1 and 2. Sample radiographs for both deformities are shown in Figures 3 and 4. When sagittal and coronal plane deformities are concurrently found, blocking screw application on 2 different planes is combined at locations required by the deformity.

**DISCUSSION**

Closed antegrade or retrograde nailing is a recognized treatment for distal femur...
fractures. However, malunion or non-union are not rare because the medulla of the distal femur is wider than the middle diaphysis and the nail may not completely fill the intramedullary canal. The risk of malunion proportionally increases as the distal fracture segment becomes shorter.4,5,14,15 Recurvatum on the sagittal plane due to stretching the gastrocnemius, translation, and varus or valgus on the coronal plane based on morphology of the fracture are often encountered deformities in distal femur fractures. It may not be always possible to completely correct those deformities with standard closed intramedullary nailing.6

Blocking screws are often applied to remove the problem of reduction in intramedullary nailing of fractures close to enlarged ends of long bones. Blocking screws were first reported for use in the tibia by Krettek et al.9,10 Stedtfeld et al7 reported the applications of blocking screws at the distal region of other long bones. Ostrum and Maurer6 reported treating distal femur fractures with retrograde intramedullary nailing and blocking screws. Blocking screws are aimed to guide the intramedullary nail to the desired direction by narrowing the intramedullary canal and obtaining better reduction. Blocking screws also increase stabilization.7,9,11

### Table

<table>
<thead>
<tr>
<th>Patient No./ Sex/Age, y</th>
<th>Etiology</th>
<th>OTA AO Fracture Type</th>
<th>Open/ Closed</th>
<th>Deformity During IM Nailing</th>
<th>Technique</th>
<th>Blocking Screw</th>
<th>FU, mo</th>
<th>Fracture Union Time, wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/28</td>
<td>Traffic accident, polytrauma</td>
<td>32 B2</td>
<td>Closed</td>
<td>Varus at coronal plane</td>
<td>Antegrade</td>
<td>1 to distal from medial side</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>2/M/49</td>
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<td>32 A3</td>
<td>Closed</td>
<td>Recurvatum at sagittal plane</td>
<td>Antegrade</td>
<td>1 to distal from anterior side; 1 to proximal from posterior side</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>3/M/31</td>
<td>Traffic accident, polytrauma</td>
<td>32 C3</td>
<td>Open; type 2</td>
<td>Recurvatum at sagittal plane</td>
<td>Antegrade</td>
<td>1 to distal from anterior side</td>
<td>12</td>
<td>32</td>
</tr>
<tr>
<td>4/M/53</td>
<td>Fall from height</td>
<td>32 A2</td>
<td>Closed</td>
<td>Recurvatum at sagittal plane</td>
<td>Antegrade</td>
<td>1 to distal from anterior side</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>5/M/38</td>
<td>Gunshot</td>
<td>33 A3</td>
<td>Open; type 3C</td>
<td>Recurvatum at sagittal plane</td>
<td>Retrograde</td>
<td>1 to distal from anterior side</td>
<td>12</td>
<td>16</td>
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<tr>
<td>6/F/30</td>
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<td>Open; type 3A</td>
<td>Medial translation at coronal plane</td>
<td>Retrograde</td>
<td>1 to distal from lateral side</td>
<td>48</td>
<td>8</td>
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<td>Closed</td>
<td>Recurvatum at sagittal plane</td>
<td>Retrograde</td>
<td>1 to distal from lateral side</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>8/M/35</td>
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<td>33 A3</td>
<td>Open; type 3C</td>
<td>Recurvatum at sagittal plane</td>
<td>Retrograde</td>
<td>1 to distal from lateral side</td>
<td>48</td>
<td>8</td>
</tr>
<tr>
<td>9/M/58</td>
<td>Falling down</td>
<td>33 A1</td>
<td>Closed</td>
<td>Valgus at coronal plane</td>
<td>Retrograde</td>
<td>1 to distal from lateral side</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>10/M/22</td>
<td>Motorcycle accident</td>
<td>33 A2</td>
<td>Open; type 3A</td>
<td>Recurvatum at sagittal plane</td>
<td>Retrograde</td>
<td>1 to distal from anterior side; 1 to distal from anterior side</td>
<td>48</td>
<td>13</td>
</tr>
<tr>
<td>11/F/27</td>
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<td>Closed</td>
<td>Recurvatum at sagittal plane</td>
<td>Retrograde</td>
<td>1 to distal from anterior side</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>12/M/37</td>
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<td>Closed</td>
<td>Varus at coronal plane</td>
<td>Antegrade</td>
<td>1 to distal from medial side</td>
<td>36</td>
<td>14</td>
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<tr>
<td>13/M/55</td>
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<td>33 A2</td>
<td>Closed</td>
<td>Recurvatum at sagittal plane</td>
<td>Antegrade</td>
<td>1 to distal from anterior side</td>
<td>14</td>
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<td>Closed</td>
<td>Recurvatum at sagittal plane</td>
<td>Antegrade</td>
<td>1 to distal from anterior side</td>
<td>32</td>
<td>15</td>
</tr>
<tr>
<td>15/F/38</td>
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<td>33 A2</td>
<td>Open; type 2</td>
<td>Valgus at coronal plane</td>
<td>Retrograde</td>
<td>1 to distal from lateral side</td>
<td>18</td>
<td>8</td>
</tr>
</tbody>
</table>

**Abbreviations:** FU, follow-up; IM, intramedullary.
In the current study, patients with blocking screws most commonly sustained high-energy traumas, and many patients had polytrauma and open fractures. Blocking screws were mostly required for unstable fractures with higher displacements. In such patients with higher complication risks, treatments were successfully completed with no significant complications.

Because the medullary canal of the distal femur has a larger diameter than the intramedullary nail, the nail cannot fully fill the canal; therefore, distal locking of the nail should be performed. Locking should be performed with at least 2, or preferably 3, locking screws on more than 1 plane if possible.6,7,16,17 Strong distal locking retrograde nails in the shape of spiral wedges are preferred. Ostrum and Maurer6 reported the combined use...
of blocking screws with retrograde intramedullary nailing. Retrograde nailing is more convenient in distal femur metaphyseal fractures. However, antegrade nailing is also often used in distal diaphyseal fractures. Therefore, the authors preferred to address both retrograde and antegrade nailing cases.

Before making a decision on whether to use blocking screws, the authors focused on achieving closed reduction. If achieving closed reduction was not possible, they applied or inserted supplemental surgical equipment, such as ball-spike pushers, Schanz screws, Steinmann pins, bone hooks, or Weber reduction clamps, percutaneously. If these equipment did not help gain and maintain reduction, blocking screws were used as a final solution. The main purpose of using blocking screws was to achieve reduction, but they were also useful for maintaining permanent reduction. Loss of adequate reduction can be seen after removing supplemental equipment that keeps the fracture reduced. In some patients, blocking screws were also used for this purpose.

An important potential risk in blocking screw applications is that a new fracture lying from the blocking screw to the fracture line occurs when the intramedullary nail is advanced through the narrow intramedullary canal after the blocking screw is placed. This can be prevented by accurately selecting the point where the blocking screw will be placed. Both screws should be close to the mid-line to efficiently direct the intramedullary nail to the contralateral side, and the intramedullary nail should fit the remaining canal. However, an adequate distance should be left between the screw and the fracture line. If the location of the screw is not appropriate during application or if the intramedullary nail does not advance next to the blocking screw, the location of the screw should be changed. If desired reduction cannot be ensured despite all attempts, it should be replaced with another technique, such as wire cerclage.

An important disadvantage of this method is that it is necessary to perform it under fluoroscopy throughout the whole procedure and that the patient is exposed to more radiation. A limitation of this
study was that intraoperative radiation exposure time was not reported.

CONCLUSION

The aim of this study was to clarify how blocking screws should be placed in different types of fractures. With better understanding of blocking screw functions, surgeons will observe better reduction than that obtained by standard nailing. Unless a more complex fracture is created due to placing a screw in an inadequate location, it does not seem possible that a blocking screw will not positively contribute to the treatment. The contribution to the maintenance of reduction and to the stabilization should be noted.

REFERENCES