Proximal IM nailing of unstable trochanteric fractures: minimally invasive reduction aids - a review.

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Proximal femoral nailing is indicated for unstable trochanteric fractures (AO 31-A2, A3) such as fractures with a large posteromedial fragment, with three or four fragments, reverse oblique fractures, and those with subtrochanteric extension. The advantages of nailing are ease and speed of application together with minimal exposure and better biomechanical properties. Instability is the likelihood of difficulties in achieving accurate fracture reduction and of loss of reduction after fixation. As bone fragility, i.e., osteoporosis, and fracture instability facilitate fixation failure, unstable trochanteric fractures should undergo anatomical reduction & proximal femoral nailing with a femoral neck-head sliding component to produce a bone-implant construct stable enough to provide for early painless full weight-bearing.

Primary Closed Reduction in the Fracture Table

Some unstable trochanteric fractures may be reduced with traction, abduction/adduction, and internal rotation on a fracture table and a few in external rotation (extradigital fractures of Ottolenghi), thus adjusting varus/valgus frontally and rotation laterally. Posterior sag, i.e., apex posterior angulation, may eventually be reduced by posterior to anterior elevation of the fracture site pre- or per-operatively using a crutch or a platform attached to the fracture table. However, these manoeuvres sometimes fail to reduce these displacements and, on the other hand, there are other displacements that can never be reduced by closed attempts in the fracture table. For these residual displacements additional minimally invasive reduction with several instruments should be used before creating the entry points for the nail components.

Reduction-aid Techniques

Proximal fragment tipped in varus: A ball spike introduced through a short skin incision from lateral to medial, pressing on the lateral trochanteric wall or a Schanz screw inserted in a decentralized position of the fragment, to provide place for the instruments and the nail components, are usually efficient for varus correction. Whenever the lateral wall is fragmented a percutaneous hook applied to the fossa piriformis reduces varus [1, 2].

Proximal fragment tipped in valgus: A hook introduced percutaneously at the level of the lesser trochanter and pulled laterally reduces valgus of the proximal fragment [3].

Proximal fragment rotational displacement: This residual displacement should be corrected with a Schanz screw or K-wire inserted in the fragment [1, 4].

Posterior and proximal displacement of the greater trochanter fragment: Is associated with loss of mobility and must be reduced [5-7]. Percutaneous reduction may be achieved with a ball spike or a hook.

Proximal and medial displacement of the lesser trochanter: As a result of the pull of the iliospsoas retraction in A2 trochanteric fractures, should be reduced in order to restore medial stability of the trochanteric fracture, and also because it is the usual mechanism of injury to the common femoral, superficial femoral and deep femoral arteries or veins and the perforating branches [8]. Recently, Kim et al., have reported good results using a safe minimally invasive lateral approach, at the lag screw insertion site, below the greater trochanter, reducing the fracture under fluoroscopy with a Hohmann retractor and a careful Candy-packaging wiring of the lesser trochanter using a clerclage passer [9].

Proximal fragment flexion: Caused by non-compensated psoas-iliac muscle traction when the lesser trochanter is not separated from the proximal fragment. Anterior tilting of the proximal fragment is reduced with a Hohmann retractor or a Wagner raspatory or a jocher elevator inserted through the standard proximal incision and slid anterior to the fragment and exerting downward pressure over it [3, 4, 6, 10]. Another manoeuvre to accomplish this goal is inserting a ball spike or a Steinmann pin through a short anterior incision over the fragment and pushing the anterior cortex of the fragment downwards [2, 11, 12].

Posterior sagging: May be the result of posterior displacement of either both, the proximal and distal fragments, or the distal fragment only, and it can be reduced by using a Hohmann, a Bennett retractor or a jocher elevator introduced through the incision for the lag screw, and placed under the displaced fragments or the distal femur only, levering them upwards [1-3, 10, 13].

Proximal fragment flexion and posterior sagging: Can be reduced associating the use of joy-sticks and manoeuvres described in the two precedent paragraphs.

Proximal fragment with anterior cortex disruption and posterior displacement engaged into the distal fragment: Carr described this fracture pattern and suggested to disimpact the proximal fragment by pulling the shaft laterally with a bone hook [10]. However, varus resulted and further correction was necessary. Kim et al. proposed a more simple reduction aid with percutaneous insertion of the hook onto the anterior cortex of the proximal fragment and introduction of its tip into the fracture site. The hook, engaged with the proximal fragment, is rotated and this bone fragment is levered upward, disimpacting it and reducing the fracture [14].

Medial displacement of the distal femur in A3 fractures: A hook introduced through the incision for the lag screw engages the distal femur and reduces its medial displacement [2, 3, 12].

A further tip to aid reduction: In extremely difficult cases, with severe instability, a pin from the proximal fragment into the acetabulum may assist in easing reduction of the distal fragment [13].

Maintenance of reduction throughout reaming and nailing: Reduction should be maintained during reaming, nailing and nail interlocking. Therefore, provisional fixation of the reduced fracture is recommended using minimally invasive pins, cerclages or clamps. If pins are used, they should be near to the anterior cortex in order not to disturb the pathway of the reamers and the nail [12, 14-17].

Poller screws: In the trochanteric canal acting as a fulcrum may also be considered as aids for fracture reduction [18].

Recommendations

Some final suggestions should be emphasized: Consider contralateral hip anatomy; reduction should proceed step by step, reducing one by one the various displacements; reaming should not be initiated until the fracture is reduced in all planes and secured; and do not hesitate to proceed to open reduction if minimally invasive procedures fail-reduction is of almost importance to prevent fixation failures.

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