Proximal femoral nail failures in extracapsular fractures of the hip

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ABSTRACT

Purpose. To review patients with proximal femoral nails (PFNs) in our hospital that developed complications and needed revision.

Methods. Between January 2000 and June 2006, records of 216 patients with PFN fixations for traumatic extracapsular trochanteric fractures (n=160), pathological fractures (n=23), and as a prophylactic measure for metastasis (n=33) were retrospectively reviewed. The injury mechanism, reduction technique and quality, and time to and cause of implant failure were recorded.

Results. 12 PFNs failed: 8 in the trauma group, 3 in the pathological group, and one in the prophylactic nailing group. Two PFNs broke at the proximal lag screw level at a later stage secondary to non-union of the pathological fractures. One broke at the level of the distal locking screw at an early stage, as the locking holes were too close to the fracture.

Conclusion. Poorly reduced fractures tend to fail early, whereas late failures are due to non-union.

Good reduction with minimal dissection, the use of appropriate nail length, and proper positioning of the nail and screws are necessary to avoid failure or revision.

Key words: bone nails; hip fractures; reoperation

INTRODUCTION

Internal fixation is the standard treatment procedure for extracapsular trochanteric femoral fractures. The cephalomedullary nail is biomechanically stable under loading because of the shorter lever arm, but can sometimes be associated with femoral shaft fractures below the nail. The proximal femoral nail (PFN) is designed to overcome the limitations of the cephalomedullary nail and has been used to treat trochanteric and subtrochanteric fractures, and for prophylactic nailing. These intramedullary devices minimise soft-tissue dissection and thereby reduce surgical trauma, blood loss, infection, and wound complications. Nonetheless, the PFN has recently been withdrawn from the market in most parts of the

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world. We retrospectively reviewed cases with PFN fixations in our hospital that developed complications and needed revision.

**MATERIALS AND METHODS**

Between January 2000 and June 2006, records of 216 PFN fixations for traumatic extracapsular trochanteric fractures (n=160), pathological fractures (n=23), and as a prophylactic measure for metastasis (n=33) were retrospectively reviewed. A PFN was considered failed if a revision was deemed necessary to correct the reduction or the position of the implant or to remove it. The injury mechanism, reduction technique and quality, and time to and cause of implant failure were recorded.

All patients were operated on a fracture table in the supine position under image intensifier control by either consultants or registrars using standard techniques and a protocol. Mini open reduction and stabilization with cerclage cables was performed in 16 of the 160 traumatic fractures (when closed reduction had failed or when there were intra-operative displacements or unstable multi-fragment fractures).

Anteroposterior and lateral radiographs were obtained 24 to 72 hours postoperatively, and analysed for reduction and position of the implant. Patients were followed up regularly for at least 6 months until bone union.

**RESULTS**

12 PFNs failed: 8 in the trauma group, 3 in the pathological group, and one in the prophylactic nailing group (Table).

Of the 8 failures in the trauma group, 6 occurred early (within 6 months) and 2 late (beyond 6 months). Of the 6 patients with early failures, 2 underwent open reduction and cerclage cabling. One of them had screw cut-outs secondary to deep infection and had revision surgery with a total hip replacement [THR] at 4 months; another had a delayed union and had revision surgery with a long PFN, bone grafting, and cabling at 4.3 months. The 4 others underwent closed reduction: one of them had screw cut-out at day 3 (secondary to poor reduction and varus fixation) and was not revised as the patient was unfit for surgery. Another had poor reduction and underwent revision by open reduction and cabling at 7 days. The third had nail breakage at the distal locking screw level (the nail was too short and the screw holes too close to the fracture site), for which revision with a long nail

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**Table**

Patient characteristics and outcomes

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Traumatic fractures (n=160)</th>
<th>Pathological fractures (n=23)</th>
<th>Prophylactic nailing (n=33)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-revised (n=152)</td>
<td>Revised (n=8)</td>
<td>Non-revised (n=20)</td>
</tr>
<tr>
<td>Mean age (range) [years]</td>
<td>71 (17–101)</td>
<td>71 (57–86)</td>
<td>75 (37–94)</td>
</tr>
<tr>
<td>Gender</td>
<td>Male (n=88)</td>
<td>61</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Female (n=128)</td>
<td>91</td>
<td>6</td>
</tr>
<tr>
<td>Affected limb</td>
<td>Right (n=112)</td>
<td>79</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Left (n=102)</td>
<td>71</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Bilateral (n=2)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Mean operating time (range) [minutes]</td>
<td>117 (39–385)</td>
<td>131 (75–167)</td>
<td>94 (47–165)</td>
</tr>
<tr>
<td>Reduction technique</td>
<td>Closed reduction (n=200)</td>
<td>139</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Open reduction and cabling (n=16)</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Mean time to failure (range) [weeks]</td>
<td>-</td>
<td>15 (0.4–39)</td>
<td>-</td>
</tr>
<tr>
<td>Follow-up status</td>
<td>Discharged (n=121)</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Died within the first year (n=89)</td>
<td>52</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Still being followed up (n=6)</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

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and cabling was carried out at 3 weeks. The fourth had varus migration of the head (secondary to poor reduction) and underwent revision with a Trigen nail at 3 weeks. Both the late failures were due to non-union, despite good closed reduction. One underwent revision with a long PFN with grafts and cables at 6.8 months, and the other had a deep infection for which revision with a THR was undertaken at 9.8 months (Fig. 1).

Regarding the 3 failures in the pathological group, one had poor positioning of the lag screws that were repositioned at 3 weeks; another had nail breakage at the proximal lag screw level (secondary to non-union) and underwent revision with a THR at 9.3 months (Fig. 2). The remaining patient had nail breakage at the proximal lag screw level (secondary to deep infection and non-union), which was revised with a new PFN and bone grafting at 13 months (Fig. 3).

The one failure in the prophylactic nailing group had a distal locking screw replaced at 5 days.

**DISCUSSION**

In a multi-centre study, the failure rate of PFN secondary to poor reduction, malrotation or wrong choice of screw was reported to be 5%, whereas the screw cut-out rate varied from 0.6% to 10%.

The union rates of pathological fractures were 67% in patients with multiple myeloma and 37% in patients with breast cancer. Non-union is a known complication in pathological fractures. In our series, 2 PFNs broke at the proximal lag screw level at a later stage secondary to non-union of the pathological fractures. A similar incidence of implant failure at the same level (secondary to non-union) has been reported by others. Dynamisation should have been carried out in cases with non-union, which could have helped healing, as over-rigid fixation may result in non-union. Poor selection of the appropriate length of the PFN led to an early failure; one nail broke at the distal locking screw level as the locking holes were too close to the fracture site.

In our series, early revisions were mainly due to poor reduction or mal-position of the screws. In some
complex fractures, open reduction was recommended when closed reduction was inadequate. The high incidence of open reduction was mainly due to the complexity of fractures, and not to delayed operations. In PFN fixations, proper alignment between the 2 main fragments and proper placement of the lag screws in the femoral head should be ensured. Late failures were mostly associated with implant failure secondary to non-union or infection. Although 77% of infected fractures ultimately united following intramedullary nailing, in our study those with infections did not respond to conservative measures and underwent revision.

It so happened that all failed PFN fixations were performed by registrars. Most failures could have been avoided with proper reduction using closed or open means. It is imperative to reduce fractures with minimal dissection to achieve a stable fixation, with an emphasis on good closed reduction. Open reduction increases the risk of infection, soft-tissue devitalisation, and non-union, particularly in patients with malignant disease. Restoration of the axis and rotation between the head-neck fragment and the shaft is mandatory, but anatomic reduction prior to nail insertion is not. Restoration of height can be compromised. A long nail is needed for fractures that extend distally. Proper training of surgeons in reducing complex fractures and inserting PFNs is recommended. Regular follow-up should focus on non-union in pathological fractures, so as to enable early intervention when necessary.

Poorly reduced fractures tend to fail early, whereas late failures were due to non-union. Good reduction with minimal dissection, the use of appropriate nail length, and proper positioning of the nail and screws are necessary to avoid failure or revision.

REFERENCES