Letter to the Editor

Failure of PFNA: Helical blade perforation and tip-apex distance

To the editor,

Since the clinical introduction of proximal femoral nail antitrotation (PFNA) by AO group in 2004 and PFNA-II (Asian version) in 2008, this type of cephalomedullary nail with single head-neck helical blade were commonly used in unstable pertrochanteric and intertrochanteric fractures in geriatric patients. Recently, severe complications of helical blade perforation through the femoral head, into the hip joint or even the pelvis, were reported in several case reports. After review of the PFNA literature in English, we found a total of 12 cases helical blade perforation in 6 papers (Table 1).1–6

From the provided data and radiographs, we can summarise that most patients were old women, the fracture reduction and caput-collum-diaphyseal angle were acceptable, and most patients took full weight bearing immediately after operation. Four perforations occurred after a fall on the affected hip, one with subclinical low-grade infection, one with helical blade tail abutting the lateral cortex, and six had none aetiology. Most perforations occurred within 6 weeks. Furthermore, blade tip-apex distance (TAD) in four available patients was less than 20 mm or even 15 mm.

Contrast to femoral head lag screws (blunt head, wrench-in, large axial contact area and move cancellous bone), the helical blade has its own unique characteristics in insertion mode and morphological design (relative sharp head, hammer-in, large circumference contact area and compact cancellous bone). These features make the helical blade more likely to move axially (medial perforation) than vertically (superior cutout) under loading (weight bearing). Biomechanical studies proved that the helical blade system showed a significantly increased stability of fracture fixation.7,8 For example, Strauss et al.8 performed a biomechanical test in 6 paired cadaver femurs. They found that inferior femoral head displacement was significantly less in helical blade group compared with lag screw group after each cyclic loading with 750 N applied for 10, 100, 1000 and 10,000 cycles. Born and coworkers further demonstrated that under cyclic loading, the hip screws migrated predominantly in a cephalad direction, and in contrast, the helical blades exhibited a distinct migration in their axial direction.9

From 2006 to 2010, our hospital performed more than 500 cases of PFNA and PFNA-II for geriatric pertrochanteric and intertrochanteric hip fractures. No cutout or medial perforation was encountered. Besides the beginning time of weight bearing was relatively late, usually 1 month after operation, we think, our good results were mainly attributed to two technical factors. The first is TAD. In our opinion, TAD between 20 mm and 25 mm is optimal for helical blade. We never insert the helical blade much deeper. Thus, a shorter blade should be chosen, rather than recommended in the manufacturer’s operative guidelines. The second is no pre-reaming of the head-neck fragment, only a lateral cortical entry hole is drilled. This avoids cancellous bone removing from the route which the helical blade will pass under hammer impaction.

In conclusion, we believe that the helical blades should be placed centrally in the femoral head in both AP and lateral views, but not so deeply as recommended for lag screws. Blade TAD between 20 mm

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Table 1
Summary of 12 cases in literatures with helical blade perforation in PFNA.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Journal</th>
<th>Sex/age</th>
<th>AO/OTA code</th>
<th>Fracture reduction</th>
<th>CCD angle</th>
<th>Blade TAD (mm)</th>
<th>Time of weight bearing</th>
<th>Perforation time after PFNA</th>
<th>Aetiology</th>
<th>Revision surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simmermacher 2008</td>
<td>Injury</td>
<td>4/313</td>
<td>NA</td>
<td>A2, A3</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Most immediate fully</td>
<td>3 within 6m</td>
<td>3 fall on affected hip</td>
<td>Yes, no detail</td>
</tr>
<tr>
<td>Brunner 2008</td>
<td>JOT</td>
<td>3</td>
<td>F/89</td>
<td>A2</td>
<td>AP 153 Lt 180</td>
<td>129</td>
<td>14.6</td>
<td>Immediately fully</td>
<td>6w</td>
<td>Fall on affected hip</td>
<td>Subclinical low-grade infection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F/88</td>
<td>A2</td>
<td>AP 162 Lt 180</td>
<td>131</td>
<td>19.32</td>
<td>Immediately fully</td>
<td>6w</td>
<td>None</td>
<td>THR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F/69</td>
<td>A2</td>
<td>AP 155 Lt NA</td>
<td>140</td>
<td>NA</td>
<td>Immediate fully</td>
<td>6w</td>
<td>None</td>
<td>THR</td>
</tr>
<tr>
<td>Merebby 2009</td>
<td>Injury</td>
<td>2/62</td>
<td>NA</td>
<td>A2, A3</td>
<td>Poor</td>
<td>NA</td>
<td>AS placement of blade</td>
<td>NA</td>
<td>4w</td>
<td>6w</td>
<td>None</td>
</tr>
<tr>
<td>Cheung 2011</td>
<td>JOT</td>
<td>1</td>
<td>M/81</td>
<td>A2.2</td>
<td>AP 166 Lt 178</td>
<td>128</td>
<td>16</td>
<td>1 month with cane</td>
<td>2m</td>
<td>Blade abutting cortex</td>
<td>THR</td>
</tr>
<tr>
<td>Takigami 2011</td>
<td>JOT</td>
<td>1</td>
<td>F/92</td>
<td>A2</td>
<td>NA</td>
<td>15.8</td>
<td>Immediate fully</td>
<td>3m</td>
<td>None</td>
<td>THR</td>
<td></td>
</tr>
<tr>
<td>Frank 2011</td>
<td>JOT</td>
<td>1</td>
<td>F/87</td>
<td>A2</td>
<td>NA</td>
<td>NA</td>
<td>Immediate fully</td>
<td>3w</td>
<td>None</td>
<td>THR</td>
<td></td>
</tr>
</tbody>
</table>

GA angle, Garden-Alignment angle; AP, anteroposterial; Lt, lateral; AS, anterosuperior; CCD angle, caput-collum-diaphyseal angle; THR, total hip replacement; NA, not available.

0020–1383/$ see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.injury.2011.10.024

and 25 mm is excellent, and this may play a great role in avoiding its medial migration and perforation postoperatively.

**Conflict of interest statement**

The authors report no financial disclosures related to this manuscript.

**References**


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