SUBTROCHANTERIC FRACTURES: ZICKEL NAIL OR NAIL-PLATE?

W. G. THOMAS, R. N. VILLAR

From Southampton General Hospital

Of 135 consecutive patients admitted with subtrochanteric fractures of the femur, 104 were studied; half had internal fixation with a Zickel nail and half had a nail-plate device. Fractures treated with a Zickel nail had significantly less blood loss during operation and took less time to walk with full weight-bearing, but the incidence of technical error at operation was higher. Errors included malalignment of the cross-pin, penetration of the femoral cortex and comminution of the greater trochanter. There was mechanical failure within one year of surgery in 17% of the nail-plate series but no implant failures in the Zickel nail group within the same period. The total time spent in hospital was similar in both groups.

The Zickel nail provides better fixation for subtrochanteric fractures than a simple nail-plate but, because of technical difficulty, its use should be reserved for surgeons of reasonable experience.

It is 19 years since the Zickel nail was introduced as a method of internal fixation for subtrochanteric fractures of the femur (Zickel 1967). Although the use of this device is increasing, nail-plates also are commonly employed to fix these difficult fractures. The purpose of this paper is to compare the two methods in a large concurrent consecutive series, in which 52 patients were treated with the Zickel device and 52 with a nail-plate.

PATIENTS AND METHODS

Between January 1976 and July 1983, 135 patients with subtrochanteric fractures of the femur were admitted to Southampton General Hospital, all of whom were treated by internal fixation with either a Zickel nail or a nail-plate device. The hospital notes and radiographs of 104 of these patients (77%) were obtained by reviewing theatre registers and the Hospital Activity Analysis; prophylactic procedures were excluded from this study.

Fifty-two patients (24 men and 28 women) were treated by using a standard 7- or 12-hole McLaughlin nail-plate and 52 (21 men and 31 women) with a Zickel nail: treatment of patients was determined by the policy of the consultants.

Each patient was assessed retrospectively by the method of Hall and Ainscow (1981) for the factors likely to impede rehabilitation. They were classified as independent if the patient lived without assistance from others, sheltered if the patient received substantial assistance either from relatives or from social agencies or hospitalised if the patient resided in an institution.

The fractures were classified as short oblique, short oblique with comminution, long oblique, long oblique with comminution, high transverse or low transverse (Zickel 1976). This classification was slightly adapted to include oblique fracture lines running distally from the lateral side to the medial as well as from the medial side to the lateral as originally described. Twelve of the 27 long oblique fractures treated by a Zickel nail had supplementary fixation by cerclage wire or Partridge straps: 13 (25%) of the Zickel nails and five (9.6%) of the nailplates were inserted for pathological fractures. The following information was also recorded.

1. Total time for operation, including induction of anaesthesia and return of the patient to the recovery ward.
2. Blood loss during operation.
3. Social environment to which the patient was discharged.
4. Time to mobility (the point at which a patient could walk with full weight on the leg).
5. Mortality (deaths within three months of the operation were considered to be related to the procedure).
7. Complications: these were further sub-divided into technical error, wound infection and implant failure within one year of operation.

RESULTS

The major findings of this survey are outlined for each group in Table I. The age range and the distribution of types of fracture were similar in both groups (see Fig. 1). Operation. The operating time needed for the insertion of a Zickel nail was, on average, about 10 minutes longer than that for a nail-plate, although the mean blood loss was significantly higher in the latter.
Complications. There was a technical error at the operation in five of the Zickel nail group, but none in the nail-plate group. The errors included penetration of the femoral cortex at the knee in one patient (Fig. 2), mal-alignment of the cross-pin in one (Fig. 3), comminution of the greater trochanter in two patients and rotational malalignment at the fracture site in one. Four of these five errors occurred in the 13 patients with pathological fractures fixed by a Zickel nail.

All patients had prophylactic antibiotic cover, and no deep wound infections were seen in either group. Eight superficial infections all resolved within two weeks of operation.

Table I. Clinical details, operative details and major findings of the survey of 104 patients

<table>
<thead>
<tr>
<th></th>
<th>Zickel</th>
<th>Nail-plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>Age (years)</td>
<td>66 (18 93)</td>
<td>61.5 (19 86)</td>
</tr>
<tr>
<td>Pathological fractures</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Non-pathological fractures</td>
<td>39</td>
<td>47</td>
</tr>
<tr>
<td>Fracture type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oblique</td>
<td>41</td>
<td>44</td>
</tr>
<tr>
<td>Transverse</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Concurrent illness</td>
<td>36</td>
<td>31</td>
</tr>
<tr>
<td>Operation time (minutes)</td>
<td>115 (60 180)</td>
<td>105.5 (60 180)</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>655 (300–3000)</td>
<td>1701.5 (200–12000)</td>
</tr>
<tr>
<td>Time to mobility (days)</td>
<td>5.2 (2 40)</td>
<td>13 (2 90)</td>
</tr>
<tr>
<td>Time in hospital (days)</td>
<td>29.2 (12 80)</td>
<td>25.8 (7 100)</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical error</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Superficial wound infection</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Implant failure</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Death</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

The implant failed in nine of the nail-plate group (17.3%) but in none of the Zickel nail group; this difference is significant ($P<0.001$). Five failures were due to plate fracture (Figs 4 and 5) and all of these occurred in patients with oblique fractures; four were due to screw breakage (Figs 6 and 7).

Mortality. Five patients in the Zickel nail group (9.6%) died within three months of operation; they had all been significantly ill before operation, three with a tumour, one with rheumatoid arthritis while one had diabetes. Within the same three-month period only three patients (5.8%) of the nail-plate group died; none of them had had a significant pre-operative illness.

Rehabilitation. All patients were mobilised as soon as possible, but those in the Zickel nail group were allowed to take full weight an average of eight days sooner than those in the nail-plate group. The average time in hospital, however, was 29.2 days for the Zickel nail group and 25.8 days for those with nail-plates.
A short oblique fracture was fixed with a 7-hole nail-plate. Two months after operation there was implant failure due to a fracture of the upper part of the plate.

A long oblique fracture was fixed with a 12-hole nail-plate. Six months after operation the plate and one screw had fractured.
Social environment. Both groups were admitted from and discharged to similar levels of social environment (see Figs 8 and 9).

DISCUSSION
The unacceptably high incidence of varus malunion and the complications of prolonged bed rest have led surgeons to abandon the conservative treatment of subtrochanteric fractures of the femur in favour of internal fixation. However, the nail-plate devices which have been satisfactory for the management of trochanteric fractures have not been successful with subtrochanteric fractures (Boyd and Griffin 1949; Boyd and Anderson 1961; Fielding and Magliato 1966).

Mechanical failure of the implant led to the development of stronger devices such as the Holt nail (Holt 1963) but even with this massive device Johnson, Lottes and Arnot (1968) reported a 40% implant failure rate in 12 comminuted subtrochanteric fractures. The huge stress in the subtrochanteric area has been discussed by Koch (1917), Cochran (1969) and again more recently by Fielding, Cochran and Zickel (1974). Cochran has shown that the stress on a nail-plate acting as a tension band under any condition other than perfect bone reduction is highly sensitive to loading. Stresses may exceed 40 000 lb/in$^2$ under a load of 100 lb, which is equivalent to that in a single-leg stance. Failure of nail-plate devices is thus almost assured if early weight-bearing is allowed. Other authors have shown that Künstcher nailing also is an unsatisfactory method of treating these difficult fractures and they do not recommend its use for fractures less than 5 or 6 cm from the lesser trochanter (Sage 1968; Watson, Campbell and Wade 1964). The Künstcher-Y nail has not enjoyed widespread use (Künstcher 1967). Its insertion is considered to be more difficult than the Zickel nail (Wilson 1982) whilst the standard signal arm only allows the insertion of a 10 mm-diameter nail. The major complication of the Künstcher-Y nail is the distal migration of the intramedullary nail, although this may be prevented by the insertion of a bolt through the upper end of the nail (Cuthbert 1976). The difficulty of treating these fractures led Zickel to develop his device.

In our series a 17% incidence of implant failure in the nail-plate group compared with none in the Zickel nail group. Surprisingly, the amount of blood loss during operation was on average twice as great in the nail-plate group as in the Zickel nail group: this may reflect the need for greater femoral exposure in nail-plating procedures and also the difficulty surgeons may have in controlling the perforating vessels from the profunda femoris artery in the supine, rather than the lateral, position. One patient in the nail-plate group lost an estimated 12 000 ml.

Full weight-bearing was achieved much more rapidly in the Zickel nail group. Although the length of time in hospital was similar for both groups, this early return to walking is another advantage of the Zickel device.
Despite these advantages, however, nail-plates are still used for subtrochanteric fractures. Technical difficulties and errors during the operation are fewer when a nail-plate is used, partly because the surgeon presumably is more familiar with the technique used to treat the more common trochanteric fracture.

Reluctance to use the Zickel device may stem from the difficulty of its insertion and the high incidence of intra-operative complications. We confirm the experience of Zickel (1976) that comminution of the greater trochanter may be a problem during the insertion of his device: he suggests that underreaming of the trochanteric fragment may cause this, although our findings suggest that, even when the proximal fragment has been reamed to 18 mm, comminution may still occur. The Zickel nail is unforgiving and, if it is inserted in incorrect rotational alignment, the pronounced valgus offset of the proximal part of the nail may impinge on the anterior or posterior cortex of the greater trochanter, act like a wedge and split the bone. Splitting is more likely to occur during prophylactic nailing for a subtrochanteric secondary tumour, since the absence of a fracture means that proximal and distal parts of the femur cannot displace relative to each other during final insertion of the nail.

Difficulty may also be experienced in inserting the cross-pin into the femoral neck at the correct degree of anteversion. This can be made easier by placing a guide-wire along the femoral neck and ensuring that the tunnel-locator guide remains strictly parallel to this during the insertion of the medullary nail. Palpation of the femoral neck between finger and thumb will help with orientation at all stages. In this series all the Zickel nails were inserted with the patient lying in the lateral position; this allows easy radiographic screening in the anteroposterior plane with the C-arm of the image intensifier arched over the patient. True lateral views cannot be obtained because it is not possible to rotate the femur through 90° from the neutral position. The position of the cross-pin within the femoral neck in the lateral view therefore depends on the surgeon’s skill and experience.

We have found that, when compared to a nail-plate, the benefits of the Zickel nail are great, especially in terms of the security of fracture fixation, implant reliability, early full weight-bearing and intra-operative blood loss. However, its insertion is difficult and the technique is not easily learned. For the inexperienced we would still recommend that subtrochanteric fractures be fixed by a nail-plate, but that additional medial support be provided by a bone graft or cement, and that there should then be a long period before full weight-bearing is resumed.

The authors wish to express their thanks to the Orthopaedic Consultant staff of Southampton General Hospital for their encouragement and assistance in the preparation of this paper.

REFERENCES


