The use of an Intramedullary Nail vs. Dynamic Hip Screw in the treatment of Intertrochantric fractures; a case cohort study

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Abstract

Background: Intramedullary nails in the treatment of intertrochanteric fractures have become popular over the last two decades. The question is whether they have surpassed the dynamic hip screw in the treatment of these fractures.

Aims: To compare the intra-operative use, immediate postoperative rehabilitation and outcome between intertrochanteric fractures treated with gamma intramedullary (IM) nails and dynamic hip screws (DHS). The study also endeavors to suggest modifications in the Gamma nail technique to prevent commonly mentioned complications.

Settings and Design: A case-cohort study design was selected.

Methods and Materials: Per-operative parameters that were compared include, adequacy of reduction, screw position in the head and blood loss. Postoperative complications like screw cut-out, peri-prosthetic fractures were noted and associations were drawn to the quality of reduction, screw position, seniority of surgeon and the degree of osteoporosis.

Results: A significantly higher number of complications, including three (13.36%) screw cut-outs and three (13.36%) periprosthetic fractures were noted in the IM nail group. A higher number of varus reductions were also noted in the same group. Two patients in the same group also showed features of delayed union.

Conclusions: This pilot study revealed a higher complication rate among patients who were operated with IM nails than with DHS for intertrochanteric fractures. As of today the DHS device is the gold standard for treatment of routine intertrochanteric fractures.

Keywords: Intertrochanteric fractures, Gamma nail, screw cut-out, periprosthetic fracture

Introduction

Surgical stabilisation of the intertrochanteric fracture is the optimal treatment today, except in patients with medical problems in whom surgery is contraindicated (1). The goal of surgery is to provide fracture stability to allow early mobilisation and some weight-bearing. The introduction of the Dynamic Hip Screw was a quantum leap in the operative treatment of the same. Intramedullary fixation with the Gamma Nail (2) in the management of intertrochanteric fractures was introduced in the late 1980s. The biomechanical advantage that is frequently cited which is questionable with today’s materials is the decreased bending moment on an intramedullary implant compared to a side plate. However the
nail can act as a significant buttress in unstable fractures, preventing collapse.

Initial trials and results however, failed to show the expected benefits of this device. Following significant changes in design and instrumentation, the gamma nail device has been reintroduced in various centres for use in intertrochanteric and subtrochanteric fractures. In India too, the use of intramedullary (IM) nails in the treatment of intertrochanteric fractures have become popular over the last two decades. Most centres are using the same and their popularity is on the rise. However evidence based medicine (3) suggests a higher complication rate, higher learning curve and a higher reoperation rate with the use of cephalomedullary nails in the treatment of intertrochanteric fractures.

This study was undertaken at a tertiary referral centre in south India as a pilot study to compare the use of an Intramedullary (IM) nail with a Gamma nail design and the dynamic hip screw (DHS) in the treatment of intertrochanteric fractures. The dynamic hip screw has remained the gold standard in the treatment of these fractures. The core question that needed to be addressed was whether the cephalomedullary nail had surpassed the DHS in the treatment of these fractures.

The specific objectives of this study were to compare, between the two groups the

1. **Intra-operative use:** duration of surgery, blood loss, peri-operative complications.
2. Immediate post op. rehabilitation.
3. **Outcome:** Time to union or post op. complications.
4. To describe techniques and modifications to prevent commonly mentioned complications and to improve the operative technique in the IM nail group.

**Subjects and Methods:**

A case control study design was used to compare the intra-operative use, post operative complications among a non randomised group of patients with intertrochanteric fractures operated using DHS and IM Nails. The sampling and analysis was made by the author who was not involved in any of the above surgeries. The data pertaining to the two groups were obtained from the case records, personal interviews and patient examination in the postoperative follow up period.

The inclusion criteria were:

- All patients above the age of 50 yrs with intertrochanteric fractures undergoing surgery.
- Only isolated intertrochanteric fractures were included in the study. Cases with concomitant upper limb fractures were excluded.

It was hypothesised that the Proximal Femoral Nail was a technically easier surgery to do with less blood loss, requiring less surgical time and would have fewer peri-operative complications compared to that of the DHS group. The primary end point of the study was considered to be radiological union while the secondary end points were mortality or a complication associated with the fracture or device.

All patients had routine antibiotic prophylaxis with a first generation cephalosporin (Inj. Cefazolin) and a second drug either an aminoglycoside (Inj. Gentamycin) or a quinolone (Inj. ciprofloxacin). The patients were either operated under general anaesthesia or regional anaesthesia. In both types of fixation, the patient was placed in a supine position on the fracture table and closed reduction of the fracture was obtained by traction. Standard operative procedures were employed in both types of surgeries. The IM nail group required a procedure for the entry and reaming of the proximal portion of the femur up to 17 mm and additional reaming of the distal medulla to two mm greater than the distal diameter of the nail. An image intensifier was used in both cases for guide wire and final screw placement in both types of surgeries. The objective was to place the lag screw below the centre of the femoral head on the anterior-posterior view and centrally on the lateral view (4). A set screw was inserted through an opening in the targeting device in the IM nail group to prevent rotation of the lag screw. The final position of the both implant was checked using the image intensifier and the wounds were closed over one suction drain. Active and passive mobilisation of the lower limbs was started.
immediately. The drain was removed within the first 48 hours. Walking was initiated by the third day in cases with stable fractures.

The AO classification (5) has been used in this study. All Intertrochanteric fractures are classified as “type 3 1A”. The subtypes depend upon comminution & stability. All fractures belonging to AO class 3 1A 2.2 and above were considered unstable in this study.

After surgery, an anatomical alignment (Figures 1, 2) of the fracture or a valgus type or a Diamond-Hughston variety of reduction were considered as acceptable reductions, which provided immediate stability. A poor reduction was that with no medial cortical contact and a varus of more than ten degrees compared to the opposite side. For measurement of the screw position the femoral head was divided into nine sectors (Figure 3). Inferior and posterior as well as central placement of screws (Figure 4) within the head was considered acceptable (i.e. sectors 5, 6, 8 & 9). All the other sectors were considered poor placement.

The adequacy of reduction was associated to the AO class of fractures. The adequacy of reduction and screw position were also correlated with the type of implant used and the seniority of the surgeon (consultant/registrar). Blood loss was measured from the number of soaked mops and the content from the drain prior to wound closure, an estimate made by the anaesthetist. The surgical time and duration of stay was obtained from the inpatient records.

The postoperative complications were noted and associations were made comparing these complications with the seniority (experience) of the surgeon, the position of the screw in the head, the adequacy of reduction of the fracture and the degree of osteoporosis (6). The Fisher’s Exact Test was applied for the statistical analysis of the same.

Results

There were 59 patients who were operated for intertrochanteric fractures during the during a four year period. 14 patients did not fulfil the inclusion criteria. There were 45 patients in the study, 22 (10 women & 12 men) in the IM nail group and 23 (10 women & 13 men) in the DHS group.
The right hip was involved in 22 cases (10 IM nail, 12 DHS) and the left in 23 (12 IM nail, 11 DHS). The average age in the IM nail group was 68.36 yrs (SD 12.43) and 70.15 (SD 11.30) in the DHS group.

The patient profiles with respect to gender distribution, age, medical co-morbidities are summarised in Table 1. The patients were either operated under GA or regional anaesthesia in both the groups. All cases were operated by senior registrars or by consultants. The IM nail group had more number of cases done under General anaesthesia (10 cases, 45%) than the DHS group (7, 30%), P=0.1359. More IM nail surgeries were done by consultants (9, 41%) than the DHS group (4, 17%). The difference was not found to be significant (P=0.1075). Peri-operative parameters that were studied included: reduction on table, screw position, peri-operative fracture shaft of femur, operative time and blood loss (Table 2).

The mean surgery time or the IM Nail surgery (123.40 min) was marginally lower than that for DHS (134.25 min) which was not significant (P=0.2185). The blood loss was also marginally lower in the IM Nail group (329.54 ml) compared to the DHS group (337.5 ml) which was also not statistically significant (P=0.8543). The number of patients with poor reductions were higher in the IM Nail group (6, 27.27%) than the DHS group (1, 4.34%) which was significant (p=0.04). We tried to correlate this to the seniority of the surgeons who operated the same. The calculated Odds ratio was 0.6429 and the P value was 1.0000, considered not significant.

In the IM nail group (Table 3) a significantly

| Table: 1. | Pre morbid patient profiles in both groups |
| --- | --- | --- | --- |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Female | IM nail | DHS | Standard error(P=) |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Mean Age | 10 | 45.45 % | 10 | 43.7 % | 1.0 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;SD = 12.43 | 70.15 | 11.30 % | 6.163 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Hypertension | 9 | 40.90% | 7 | 30.43% | 0.542 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Ischaemic heart disease | 1 | 4.54% | 2 | 8.69% | 0.579 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Diabetes | 3 | 13.63% | 4 | 17.39% | 1.000 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Cancer | 2 | 9.09% | 0 | 0% | 0.4902 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Fracture Type - A1 | 4 | 18.18% | 7 | 30.43% | 0.4909 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Fracture Type - A2 | 16 | 72.72% | 15 | 65.217% | 0.7494 |
| &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;Fracture Type - A3 | 2 | 9.09% | 1 | 4.347% | 1.0000 |

Figure: 4. 66 yr old patient treated with DHS fixation for trochanteric fracture at last follow up showing good union. The screw tip is in sector-6, the ideal position for the same.
higher number of unstable fractures (3 cases, 75%) had a poorer reduction compared to the stable fractures (3 cases, 16.66%). An association of poor reduction with higher AO class (unstable) fractures is known since fracture reduction on table is difficult. Lastly poor reductions in unstable fractures were correlated with the type of implant used for surgery (IM Nail / DHS). P value was 1.0000, Odds ratio = 0.3333.

Depending on the adequacy of reduction, post operative ambulation was advised in patients with, anatomical or acceptable reduction. This did not differ in either group. It was not evident whether the patients in the IM Nail group had a faster rehabilitation. The mean duration of stay was 7.77 days (SD 4.36) in the IM Nail group and 6.3 days, (SD 1.949) in the DHS group and the difference was not significant (S Error of means 0.158).

Since the sample size of the study was small, only a few complications were noted. Neither of the two groups had wound infection. There were three cases (13.63%) of supero lateral cut out in the IM nail group (Figure 5). The first two cases had an unacceptable screw placement in the superior and anterior quadrant of the head. These two cases also had a varus reduction of the fracture. The osteoporosis was graded as Singh’s 2 in both these cases. The third case had a bad screw placement but acceptable reduction of the fragments. In patients with screw-cut out, the screw placement in the head emerged as the single most important factor that lead to the same (p=0.0130). The lack of reduction although contributory did not show statistical significance (p=0.0727), nor did degree of osteoporosis.

Three cases of periprosthetic fractures (13.36%) were noted in this study in the IM nail group (Figure 6). One occurred in the OR while two others occurred in the postoperative period, in the third and fourth month respectively. The latter two occurred following falls at home. One fracture was a long spiral isthumus level fracture of the femur that started at the tip of the prosthesis. The other was a fracture that occurred lower down in the femur about three cm distal to the tip and was not considered a true peri-prosthetic fracture, rather an isolated fracture shaft of femur. The fracture that occurred in the OR was a uni-cortical fracture near the tip of the nail which occurred while transferring the patient from the operating table to the transfer trolley. This fracture occurred in a patient in whom a 12 size nail was used. The patient was advised non weight bearing ambulation for six weeks and partial weight bearing crutch walking thereafter. The fracture healed without incidence.

Two of the patients in the IM nail group had shown significant callus formation at their subsequent visits, akin to a hypertrophic non union (7, 8). One patient was lost to follow up while the other went on to unite and was allowed full weight
in the pre morbid period. The mechanism of injury in forty one patients was a fall on the level ground while two patients sustained a hip trauma after being butted by a bullock during farming. Two other patients presented late; two and four weeks after the fall, respectively. All patients in the study were ambulant bearing after six months.

Symptomatic lateral backing out of the cervical screw is a complication reported in literature in the use of DHS instrumentation. This was seen in two patients (8.69%) in the DHS group (Figure 7) in their final review radiographs. Both patients had an AO type A2.3 fracture.

**Discussion**

The two groups, i.e. the DHS group and the IM Nail group were comparable in terms of sidedness, sex, age and the class of fractures. There were two patients with malignancy in the IM nail group, one with ca prostate and the other with secondary adenocarcinoma. The groups were comparable in terms of prevalence of hypertension, diabetes, ischaemic heart disease. The single most prevalent grade of osteoporosis in both the groups was Singh’s grade three. Most patients presented within the first 48 hrs of injury. Two patients presented late; two and four weeks after the fall, respectively. All patients in the study were ambulant

<table>
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<th>Reduction</th>
<th>AO stable</th>
<th>AO unstable</th>
<th>Total</th>
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<tbody>
<tr>
<td>Poor reduction</td>
<td>3 (16.66%)</td>
<td>3 (16.66%)</td>
<td>6</td>
</tr>
<tr>
<td>Acceptable</td>
<td>15 (83.33%)</td>
<td>1 (25%)</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>18 (82%)</td>
<td>4 (18%)</td>
<td>22 (100%)</td>
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**Figure: 5.** 4th month follow up radiograph of a trochanteric fracture in a 68 yr old female treated with gamma nail showing supero lateral cut-out and hypertrophic callus at denoting delayed union.

**Figure: 6.** 3rd month follow up radiograph of a trochanteric fracture treated with gamma nail showing periprosthetic fracture, following a second fall at home.

**Figure: 7.** Symptomatic lateral backing out of the lag screw causing pain in the trochanteric area in an 82 year old female. The same patient refused implant removal surgery.
patients sustained closed injuries to the hip following minor road traffic accidents.

On comparison of the peri-operative parameters, the average blood loss and the surgical time was marginally less in the IM Nail group. However these values were not found to be significant. No difference in the immediate postoperative rehabilitation was noted between the two groups. The IM Nail group had significantly more complications than the DHS group (3, 9, 10). Three cases of supero-lateral cut out and three cases of periprosthetic fractures were noted in the Gamma nail group. The high incidence of screw cut out in the IM nail series was not statistically significant (p=0.1085) but the incidence is note worthy. Cut-out as a complication is known to occur with a superior or anterior placement of the screw in the head (1, 11). In this study cut-out was correlated with: the type of implant used; degree of osteoporosis; screw placement and adequacy of reduction of the fracture. The single most important factor that determined screw cut out in this study was the poor placement of the screw in the head (11, 12). There was no association of the seniority of the surgeon with the adequacy of reduction in this study. There was no obvious association between the IM Nail and poor reduction in the unstable fracture group when compared with the DHS.

Three patients in the Gamma nail group had peri-prosthetic fractures. Two fractures were revised to long Gamma nails [Figure 8]. The causes of these fractures given in literature include; excessive length of the straight nail causing anterior impingement of the tip; excessive bowing of the proximal femur and forceful impaction of the nail in an under reamed femur. The bone surrounding the tip of the nail is a common site of fracture that would occur in these patients following a significant second trauma. It is suggested that a shortening of this nail by two cm (13) and beveling of the tip would go a long way in decreasing the chance of tip impingement in these cases. None of the patients in the group were interlocked distally except one AO type A 3 fracture. Studies (9, 14) done in the past that has shown a high incidence of periprosthetic fractures with IM nails.

The operative procedure for the IM nail had its problems. There was less manoeuvrability after nail insertion and an unreduced fracture could not be manipulated into a better reduced position leading to a higher number of varus reductions in the nail group. No intra-operative compression of the fracture fragments could be achieved with the nail, unlike the DHS instrumentation.

Since the sample size of this study was small the outcome cannot be generalised. However the values of the parameters analysed did show definite trends with clinical relevance. There is a general interest among Orthopaedic surgeons in the use of intramedullary nails for trochanteric fracture fixation. The proposed benefits like better biomechanics, less blood loss and operating time have generated great interest in this implant. However recent meta- analysis (15) reviewing various clinical trials comparing the use of both these implants have not shown significant benefits in the use of the IM nail. On the contrary the higher learning curve, greater incidence of periprosthetic fractures and screw cut out rates in most studies and corroborated by this pilot study cautions surgeons against using the IM nail in routine trochanteric fracture fixation. The use of the same in unstable fractures (16) though, is promising.

Figure: 8.  15th month follow up radiograph of the periprosthetic fracture showing union after revision to a long gamma nail.
References:


15. Parker MJ, Handoll HHG. Gamma and other cephalocondylive intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Cochrane Database of Systematic Reviews 2010, Issue 9. Art. No.: CD 0 0 0 0 9 3 . DOI: 1 0 . 1 0 0 2 / 1 4 6 5 1 8 5 8 . CD 0 0 0 0 9 3 . pub5.


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