**Review article**

**Treatment of Inter-trochantric Fracture by PFN or DHS**

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**Abstract:**

This is the commonest problem encountered by Orthopaedic Surgeons in patients after the age of 50. Various modalities of treatment were suggested for this fracture. Out of these, DHS & PFN are the two techniques which are being used frequently and over quite long period. Both the techniques are time tested & require significant surgical skill & precision. The advantages & disadvantages of both the techniques have minimal margin of difference. Both the techniques allow controlled concentric collapse of the fracture fragments because of the inherent sliding property of lag screw. This hastens early bone healing and allows early ambulation of patients. Both implants are analysed for strength & stability and have been found to provide more stable fixation than rest.

**Key words:** Inter trochantric fracture, Peri trochantric fractures, DHS, Proximal femoral nail

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**Introduction:**

This is commonest injury seen in Orthopaedic practice especially in patients who are above 50. Cause of injury can be domestic fall or High velocity trauma seen in vehicular accidents. This has always remained a challenging problem for most of the Orthopaedic Surgeons due high incidence of morbidity along with other co-existent medical problems. Rockwood & Green¹ has quoted in the text book “We enter in this world under the brim of pelvis & take the exit from neck of the femur.” This quotation explains as to how difficult & challenging problem this has remained, over so many years. There were so many studies, carried out to compare & standardise modalities of treatment of Inter-trochantric fractures. Also there is plenty of literature available on these techniques but still there is no unanimity as to what is the treatment of choice whether it is PFN or DHS.

The unpredictability of treatment modalities in this problem is because of:

a) Complex forces acting at the neck shaft angle,

b) Osteopenia / Osteoporosis which reduces the intrinsic strength of the bones.

c) Other co-existent medical ailments such as diabetes, hypertension, IHD, renal or hepatic disorders.

PFN being new technique is preferred by most of young surgeons while sizable no of surgeons who still prefer to use DHS. Both these techniques have been in use for quite some time & have survived the test of time. These two techniques still widely used till today.

**Historical background:**

The most initial treatment for these injuries was non operative,

i) Putting the patient on skin / skeletal traction for 6-8 weeks, followed by gradual ambulation with partial weight bearing.

ii) With the advent of X-rays, Whitman suggested careful reduction & fixation with spika cast.
The union rate with this method was estimated by Watson-Jones, was around 40%.

But it was noticed that-

a) High incidence of resultant coxa vara & rotational deformity

b) Concomitant conditions like bed sore, UTI, hypostatic pneumonitic changes, DVT, thromboembolism which are sequelae of prolonged bed ridden attitude, made the situation even worse.

c) Cost of non operative treatment for 6-8 weeks was many folds more than operative one.

d) High incidence of non union of the fractures.

That is how the research began as to how to fix these fractures.

Ordinary wood screws were tried by Davis in 1908. Quadriflanged nail was used by Hey-Grooves in 1916 but it did not survive due to the unsatisfactory material.

In 1931, Smith-Petersen\textsuperscript{2,3} introduced tri-flanged nail & reported the first series of open nailing, wherein he advocated reduction, impaction & internal fixation of fractures. The development & standardisation of biocompatible metals by Veneble & Stuck proved to be the essential step of success of this technique.

This technique was further simplified by use of cannulated nail by Johansson in 1932 & Westcott in 1934. This allowed the fracture to be fixed without opening & passing the nail blindly over guide pin under X-ray control.

Side-plate was added to Smith Peterssen nail by Thornton in 1937. This was further modified by Jewette in 1941 to fixed angle solid nail plate.

This got further modified to telescoping nail with side plate, by Richards\textsuperscript{2,3} which allowed gradual impaction of head over trochanter which was further modified to solid cannlated sliding nail with barrel as Dynamic Hip Screw (DHS). It is still being used today.

Intra-medullary devices were broadly divided into 2 types

i. Condylo-cephalic nails

ii. Cephalo-medullary nails

Condylo-cephalic nails\textsuperscript{2} like Ender’s nail are inserted from medial condyle where cortex is thinner & soft tissue is less. (Kuntscher) In 1970, Ender, Simo-Weidner published the first report of fixing Inter-trochantric fractures with 3 pins those were smaller in diameter & flexible. Later these pins were modified wherein the end near medial condyle was flattened & with a hole in flattened part so as to allow the extractor. Ender suggested that 3-4 pins are inserted from medial condyle to proximal end to diverge in head of femur. The greater curvature of the nails & their flexibility allowed the fixation to be much easier than earlier used Kuntscher’s nails. These nails were widely popular but the sequelae / complication reported of this technique were

a) Knee irritation with or without stiffness.

b) Decreased ROM of knee joint.

c) Proximal / distal migration of nails.

d) Penetration of hip joint by these nails

e) Cortical # at point of insertion of these nails.

Levy et al reported the following results -

76% had significant knee pain

36% had ext.rotated amlunion

Distal pin migration more than 2 cm was seen in more than 50% cases. Studies by Richmond, kazes & MacAusland found & Chapman similar observations.

Cephalomedullary nails:

Intra medullary nail with triflanged nail known as “Zickel nail”\textsuperscript{2} was introduced in late 90’s. It was then called as signal arm technique. The intra medullary nail had slot at the proximal end through which the triflanged nail was passed in the neck of
the femur. Finally the assembly was locked by the top screw provided at the proximal tip of intramedullary nail. Later “Gamma nail” was introduced with necessary modifications. In 2000, Haberneck & Wallner et al did comparative study of fixation of peri-trochantric fractures by Gamma nail, DHS, Enders nails and found that Gamma nail was a better option of fixation than the rest, so far as the absolute stability at the fracture site was concerned. But it was also noted that
i) Gamma nail was technically more demanding,
ii) It required more precision
iii) It involved more intra operative complications.
Later intra medullary hip screw (IHS) was introduced. Finally in 2001, Proximal femoral nail (PFN) was introduced which was similar to IHS but additional anti rotation pin / set pin was used to prevent the rotational strain at the fracture site. Due to the better understanding of bio-mechanics of hip & fracture geometry this technique could provide better results. From 2003 onwards PFN became the treatment of choice in peri-trochantric fractures.

**Biomechanical Principles:**

It was found that the previous techniques of fixation of peri-trochantric fracture had high incidence of failure because
i) Those did not allow the fracture fragments to collapse thus resulted in non union.
ii) Also there was significant amount of strain at the junction of plate & the pin inserted in neck.
iii) It used to result in coxa vara.
iv) Incidence of implant cut out was much higher.

These two techniques i.e. DHS & PFN allowed controlled concentric collapse of the fracture fragments\(^1,5\) due to the sliding property of the screw within barrel as well as in intra medullary nail. The construct of the screw with barrel & screw with the intra medullary nail prevented the tensile forces acting on the fracture site. The sliding of the screw within the barrel or within the nail allowed controlled concentric collapse at the fracture site, thereby hastening the process of fracture healing. As the process of healing progresses, the elastic modulus at the fracture correspondingly increases, thereby increasing the stability at the fracture site. Also it has reduced the incidence of implant cut out. The neck shaft angle was maintained at an angle of 130 to 135 degrees. The sliding of the implant due to collapse of the fracture fragments, is found to be more in DHS than in PFN, because PFN being intramedullary, the implant restricts the collapse of the fragments, thus prevents excessive sliding. While in DHS the barrel being extra medullary cannot arrest / limit the collapse of the fragments. Hence the neck shortening is found to be more in DHS than in PFN. The bio mechanical strain on the implant found to be more in DHS than in PFN due to long lever arm in DHS as compared to shorter lever arm in PFN, which resulted in less incidence of fatigue failure in PFN than in DHS. The tip apex distance (TAD) has to be maintained below standard limit of 25 mm otherwise the incidence of implant cut out increases exponentially.

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Advantages / Disadvantages:
Various studies have been conducted at different places to compare the advantages & disadvantages of these two procedures. Following are the few commonly seen advantages disadvantages of PFN & DHS.5,6,7.

<table>
<thead>
<tr>
<th>Sr.no</th>
<th>Particulars</th>
<th>PFN</th>
<th>DHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Duration of surgery</td>
<td>55-58 min.</td>
<td>90-120 min.</td>
</tr>
<tr>
<td>2</td>
<td>Average blood loss in surgery</td>
<td>100-115 ml.</td>
<td>250-300 ml.</td>
</tr>
<tr>
<td>3</td>
<td>Soft tissue dissection</td>
<td>Minimal</td>
<td>Significant</td>
</tr>
<tr>
<td>4</td>
<td>Shortening of the extremity</td>
<td>10%</td>
<td>24%</td>
</tr>
<tr>
<td>5</td>
<td>Non union</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>6</td>
<td>Infection</td>
<td>6%</td>
<td>14%</td>
</tr>
<tr>
<td>7</td>
<td>Implant failure</td>
<td>2%</td>
<td>4.5%</td>
</tr>
<tr>
<td>8</td>
<td>Hip pain</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>9</td>
<td>Implant cut out</td>
<td>Much less</td>
<td>Seen</td>
</tr>
<tr>
<td>10</td>
<td>Sliding properties</td>
<td>5.4 mm</td>
<td>7.5 mm</td>
</tr>
<tr>
<td>11</td>
<td>Mechanical strain on the implant</td>
<td>Less</td>
<td>More</td>
</tr>
</tbody>
</table>

Discussion:
- Both the techniques are time tested procedures & have been evolved after series of modifications & rectifications.
- Both of these techniques allow the implants to slide thereby allowing controlled concentric collapse of the fracture fragments. This facilitates & hastens fracture healing.
- Sliding is restricted in PFN the nail being intra medullar while in DHS there can occur excessive sliding which results in shortening of the neck.
- PFN is more technically demanding procedure & requires more precision.
- PFN can be comfortably used in Gr. IV or even higher grades of osteoporosis.
- Less duration of surgery, minimal incision & relatively lesser intra operative blood loss, PFN can be comfortably used in elderly patients with other co-morbidities.
- Placement of the Lag screw & anti rotation screw should be central in lateral view, while in AP view; the position of lag screw should be nearer to calcar so that anti rotation screw can be comfortably fixed. Lag screw to be fixed first after which anti rotation is fixed.
- Anti rotation is always shorter than Lag screw.
- TAD (tip – apex distance) has to be less than 25mm so as to have good fixation.2
- If the fracture is properly reduced & fixed then very rarely “Z effect or Reverse Z effect” is noted. In Z effect the antirotation screw comes out laterally & the lag screw perforates the cortex medially.
- In DHS the placement of the lag screw, should be ideally central in AP & lateral view. Screw placement in post. & inferior quadrant is acceptable, while placement in sup. & ant. Quadrant is poor. The incidence of implant cut out is high.
- Integrity of the lateral wall of greater trochanter should be perfect. Otherwise incidence of revision surgery in first 6 months is around 22%
• Both the systems of fixation have been biomechanically tested & found to be effective for fixation of proximal femoral fractures.\textsuperscript{8,9}

**Conclusion:**
It is most difficult task to assess and decide as to which technique is better out the two. Some studies reveal DHS to be better than PFN, while some studies show vice versa. Both the techniques are precise, time tested & require reasonable amount of surgical skill. The complications in both the techniques had very narrow margin of difference.

General condition of the patient, physiological age, fracture geometry will decide the choice of implant. PFN requires longer learning curve, for a surgeon, to be comfortable with that technique. Lastly I would put this way that it is treating surgeon’s choice whether to use PFN or DHS. If the treating surgeon is comfortable with either of the procedures, he can deliver his best.
References:
1. Fractures in adults by Rockwood & Green. 3rd edition Page 1481