MATERIAL AND METHODS
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A study of several neck fractures treated by
inter-trochanteric osteotomy with internal fixation by 18°
angulated Kessel plate has been conducted on the patients
reporting to the Out Patient Department of Orthopaedic
and Emergency ward under Orthopaedic Unit at M.L.B.
Medical College, Jhansi. Duration of study was from
July 1989 to July 1990.

All cases of displaced intra-capsular fracture
neck femur below 60 years of age, fresh and old who agreed
to this operation have been included in this study.

Detailed history regarding type and mode of
injury, duration of injury, massage, manipulations etc.
was recorded. Thorough local and systemic examination
was done especially regarding cardio-respiratory systems.

X-ray pelvis with both hip joint in APs Lateral
projection were done. Communion of fragments, changes
in head, Absorption of neck, displacement and osteoporosis
were examined in the X-rays. Routine pre-operative
investigation of Blood, i.e. M.B.X, T.L.C, D.L.C. E.S.R and Urine
examination for albumin and sugar were done.
All these findings were recorded in working proforms.

**Classification of Intracapsular Fracture:**

I. Pawel's Classification is based upon the angle between the fracture line and the inter-spinous line of the pelvis.

   Grade I : 0 - 30°
   Grade II : 30 - 70°
   Grade III : 70 - 90° and onward.

Angle less than 30°, fracture is impacting and will unite soundly with any type of treatment. If the angle is between 30 to 70°, there is less impaction and some shearing strain, the fracture will not unite, unless this shearing force is overcome.

If the angle is between 70 to 90°, fracture line is so nearly vertical and the effect of shearing stress is so great that non-union may be anticipated, regardless of any method of internal fixation used.

Grade I is an oblique fracture whereas grade III is vertical.

II. Linton's Classification: Linton measured the angle of the fracture line in relation to the shaft of femur as this furnished a more accurate measurement and it is not affected by the adduction or abduction of the
III. Gordon's Classification:

**Grade I** - So called abduction or impacted injury in which the fracture of the inferior cortex is greenstick in nature, and a minimal degree of lateral rotation of the neck, creates a radiological illusion of impaction. The medial trabeculae of the neck lie in abduction as compared with those in the head which appear abducted.

**Grade II** - is a complete subcapital fracture without displacement. The inferior cortical buttress is broken but there is no tilting of the head.

**Grade III** - Complete subcapital fracture with partial displacement. Lateral rotation of the distal fragment tilts the capital fragment into abduction and medial rotation as shown by the direction of the medial trabeculae in the femoral head.

**Grade IV** - is a subcapital fracture with full displacement. As the fragments become divorced from each other, the head returns to a more normal position in the acetabulum and the medial trabeculae of the femoral head lie in alignment with their fellow in the pelvis.

**AIMS OF STUDY**

1. To internally fix the inter-trchanteric osteotomy for femoral neck fracture to allow displacement along with angulation at the osteotomy site.
2. To assess the results of inter-trochanteric osteotomy with "bent Kessel plate" in femoral neck fractures.

3. To study comparative effectiveness of bent Kessel's plate with the results, by previous workers, using straight plate for fixation of osteotomy site.

Advantages of Displacement:

Line of weight bearing shifts medially, reducing weight bearing stress through the fracture. It provides an excellent arthroplasty even after non-union and avascular necrosis.

Disadvantages of Displacement:

1. Shortening of limb,

2. Varus positioning of head,

3. Adductor limp.

Advantages of Angulation:

1. It converts vertical fracture line into horizontal fracture line. This converts the shearing force into compression force which helps in fracture union.

2. Stability of hip is improved by making the abductors more taught by rotating the trochanter fragment, therefore abductor lurch is minimised.

3. Apparent length of the limb is maintained due to
Disadvantages of Amputation:

If femoral neck and head are placed in an extreme valgus position, the lever arm between the trochanter and the head shortens. The pressure on the head increases because abductors attached on greater trochanter have to increase the pull to balance the downward thrust of body weight while walking. This increases pressure on femoral head, which may produce painful abductor lurch. The secondary strain on the lumbar spine caused by this lateral lurching produce backache. Increased pressure on femoral head may predispose degeneration changes in joint.

Advantages of internal fixation of osteotomy:

1. The fragments are maintained in proper position.

2. Pulmonary, urologic and other medical complications, common in old age after immobilization is reduced, as plaster application is not required.

Disadvantages of plates:

Straight plates do not allow adduction of trochanteric fragments, thus interfering with the union of fracture whereas too much angulation of the plate may cause even distraction at fracture site due to excessive abduction of trochanteric fragments leading to non-union.

Plates does not allow inspection of femoral fragment into trochanteric fragment during the process of
healing. This may cause non-union at osteotomy site. Complication because this can be avoided by impacting the fragments before plate application or by using compression device.

In this study osteotomy was fixed by using a bent Kassel plate straight Kassel's plate was bent to 20°. Plate was not bent to more than 20° because more acute angle provides difficulty in introducing the plate into greater trochanter. Dangers of extreme valgus were also avoided. Plate was introduced by direct blow by mallet at the end of the plate.

Good grip was obtained over greater trochanter by serrated proximal end of Kassel's plates.

Details of plate used:

Different length of Kassel's plates were used depending upon the age of the patients. Three hole-plate was used in children and four to five hole-plates were used in adults and elderly. The plates were bent just above the most proximal hole by help of plate benders to 20°.

Pre-operative Treatment:

Each patient was kept on above knee skin traction with 2–4 kg weight until operation. This was done to relieve pain, muscular spasm and to minimise shortening.
Photographic presentation of technique used.

Lateral skin incision to expose proximal third of femur.

Proximal third of femur exposed.
Intertrochanteric osteotomy has been performed which is marked by point of Artery forceps.

Kessels plate after been introduced in greater trochanter, lying in contact of shaft of femur.
First hole is being made by drill.

All screws have been introduced in their place.
Photographic presentation of X-ray of Intracapsular fracture neck femur.

Photograph of X-ray after intertrochanteric osteotomy with bent Kessel's plate fixation.
Photographic presentation of X-ray of Intracapsular fracture neck femur.

Photograph of X-ray after Intertrochanteric osteotomy with bent Kessel's plate fixation.
Operative steps:

In every case, closed reduction was tried by using one of the following techniques -

a) Whitman,
b) Leadbetter,
c) M. Flynn.

The reduction is confirmed by heel palm test.

When reduction is complete, the extended limb remains in neutral position, whereas unreduced limb springs back into external rotation. No X-rays were taken for confirmation of reduction.

Anesthesia used was either spinal or general.

Position was supine on fracture table. Incision given was standard lateral about 10 cm. extending from the tip of greater trochanter and carried distally. Bone was exposed by cutting through Vastus lateralis muscle.

Lesser trochanter was palpated and an oblique osteotomy was done just proximal to the lesser trochanter and proximal portion of shaft was displaced medially.

Blade of the Kessels plate was introduced through the cut surface of the greater trochanter and hammered in, upto the angle of the plate. Now the shaft was brought in contact with the plate and plate was fixed by means of screws. Wound closed in layers and dressed. POP boot and derotation bar were applied.
A. Fracture reduced and an oblique osteotomy done just above the lesser trochanter and proximal portion of shaft displaced medially.

B. Blade of the plate introduced through the cut end of the trochanter and hammered up directly by mallet.

C. Shaft abducted till it is in contact with the plate and upper end of shaft impacted against the trochanter and fixed with plate by screws.

D. Fracture-shaft angle increased and head attain slight valgus position.
Post-operative care:

Just after patient was shifted to bed, a pillow was put below the knee to keep the hip and knee in slight flexion. Active movements and quadriceps exercises were started soon after effect of anaesthesia was over sitting in bed was encouraged from the next day and breathing exercise was explained.

Stitches were removed after 2 weeks and exercises intensified.

After 8 weeks POP was removed and X-ray was done. Knee and ankle exercises were started on bed and patient discharged with advise to attend out patient department every 4 weeks.

X-ray was repeated every 4 weeks till the union of osteotomy site. Patient was allowed to move with bilateral axillary crutches after 8 weeks without weight bearing and was allowed to sit on chair.

Weight bearing and hip exercises were started only after osteotomy had united and the patient was advised to walk with a stick in the opposite hand.

Follow-up:

All the patients were asked through postal correspondence to report at Orthopaedic O.D.D. for a follow-up examination at the interval of 6 weeks and
finally in September 1990. Those who did not come to the hospital were contacted personally at their residence. A detailed clinical examination in terms of function was carried out for which both subjective as well as objective criteria were undertaken.

**Subjective Criteria**:

1. Presence of pain at hip
2. Ability to walk
3. Ability to squat
4. Ability to sit cross-legged
5. Ability to sit on chair
6. Ability to climb stairs.

**Objective Criteria**:

1. Ability to raise the limb in air
2. Tenderness at hip
3. Trendelenberg sign
4. Shortening of limb: Real and apparent
5. Deformities at hip
6. Deformities at knee
7. Range of movements at hip (passive)
8. Range of movements at knee.

**Radiological Criteria**:

1. Union at osteotomy site
2. Union at fracture site
3. Neck-shaft angle
4. Fracture-shaft angle (Linton's angle)

5. Changes in head of femur:
   - deformation
   - rarefaction / increased density.

6. Conditions of hip joint (joint space).

Criteria for Evaluation of Results:

The criteria for evaluation of results of intertrochanteric osteotomy with bent Kassel plate were derived with additions and modifications in the criteria laid down by Shephard (1954). In evolving these criteria, due consideration was also made to those laid down by Mehrotra et al (1982), Mishra (1979), Chatterjee (1979) and Chaturvedi and Gupta (1969).

B.M.
(Black Marks)

1. Pain:
   - No pain 0
   - Mild 1
   - Moderate 2
   - Severe 3

2. Activity of daily life:
   - Sitting cross-legged 0
   - Sitting on chair 1
   - Squatting 0
   - Inability to squat 1
3. **Gait**

<table>
<thead>
<tr>
<th>Description</th>
<th>BM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td>with one stick</td>
<td>1</td>
</tr>
<tr>
<td>with two sticks</td>
<td>2</td>
</tr>
<tr>
<td>with axillary crutches</td>
<td>3</td>
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</tbody>
</table>

4. **Knee shortening**

<table>
<thead>
<tr>
<th>Description</th>
<th>BM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1.5 cm.</td>
<td>0</td>
</tr>
<tr>
<td>1.5 to 2.5 cm.</td>
<td>1</td>
</tr>
<tr>
<td>2.6 to 4.0 cm.</td>
<td>2</td>
</tr>
<tr>
<td>More than 4.0 cm.</td>
<td>3</td>
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5. **Movements at Hip**

<table>
<thead>
<tr>
<th>Description</th>
<th>BM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitation by less than 15%</td>
<td>0</td>
</tr>
<tr>
<td>Limitation by 15 - 25%</td>
<td>1</td>
</tr>
<tr>
<td>Limitation by 26 - 50%</td>
<td>2</td>
</tr>
<tr>
<td>Limitation by 51 - 75%</td>
<td>3</td>
</tr>
<tr>
<td>Limitation more than 75%</td>
<td>4</td>
</tr>
</tbody>
</table>

6. **Movements at Knee**

<table>
<thead>
<tr>
<th>Description</th>
<th>BM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full movements</td>
<td>0</td>
</tr>
<tr>
<td>Limitation of flexion</td>
<td></td>
</tr>
<tr>
<td>0 - 30°</td>
<td>1</td>
</tr>
<tr>
<td>31 - 45°</td>
<td>2</td>
</tr>
<tr>
<td>More than 45°</td>
<td>3</td>
</tr>
</tbody>
</table>
7. **Radiological Criteria:**

- Union of fracture and osteotomy both: 0
- Union of osteotomy alone: 1
- Non-union of fracture and osteotomy both: 3

**Score:**

Results are evaluated as excellent, good, fair and poor.

- **Excellent:** 0 - 1 B.M.
- **Good:** 2 - 8 B.M.
- **Fair:** 9 - 12 B.M.
- **Poor:** 13 - 21 B.M.
PROFORMA

Case No. 7

Name: Sarju Bai  
Age/Sex: 35 yrs./f

Body Build: Medium  
V.R.D. No.: 22287

Profession: Housewife

Address: W/o Brahm Kishore,  
Vill. Jatoli, Police Station-Sirsa Kalan,  
Dist. Jalaun, U.P.

Date of injury: 26.11.69  
Date of admission: 7.12.69

Nature of injury: Moderate  
Date of operation: 23.12.69

Time elapsed before operation: 28 days

History of massage/manipulation: Negative

Complete diagnosis: Intracapsular fracture  
Neck femur Left.

Pre-operative Examination

Shortening of Limb: 0.5 cm.

Knee and ankle status: Normal

General Examination: Satisfactory

X-ray: Transcervical, Garden's  
Grade IV, non-committed,  
No rarefaction, No absorption  
of neck.

Pre-operative treatment: A/K skin traction

Post-operative

X-ray: Fracture reduced, Linton's  
gle 45°, angle of  
estectomy 25°.

Period of follow-up: 28 weeks.

Subjective: No pain in hip, able to walk with one stick,  
can sit on chair, can squat, can sit cross- 
legged, able to climb stairs.
Objective: Able to raise the limb in air. Tenderness at hip absent. Trendelenberg sign negative.


Decrease in hip movement after operation: Less than 15%.

Movements at Knee: Full flexion.

Shortening: Real: 0.5 cm.
    Apparent: 0.5 cm.

Radiological: Fracture site united, osteotomy site united, Neck shaft angle 135°. Hip joint space maintained. No avascular necrosis.

Black Marks: 1

Result: Excellent

Complication: NIL