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Study of treatment of fracture neck of femur with Bipolar / Austine Moore's Prosthesis

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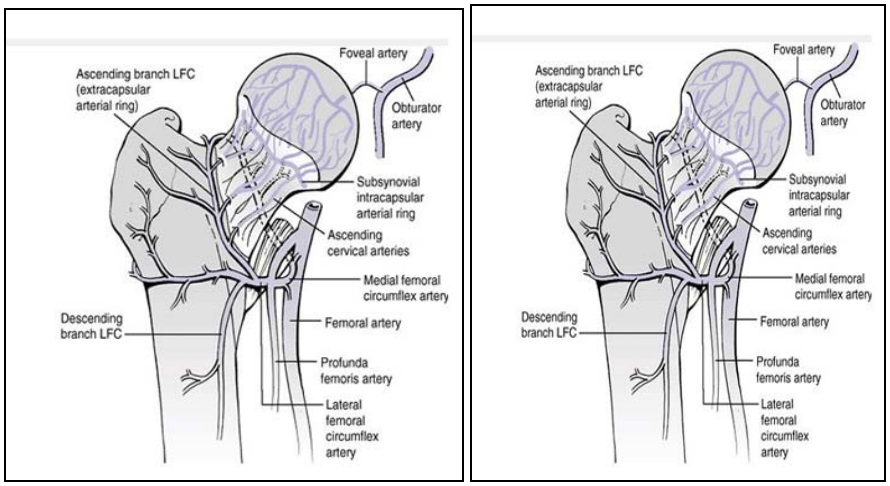
Abstract
Fracture of the neck of femur is common problem faced by orthopaedic surgeons in their clinical practice. It is seen in patients in 5th & 6th decades of life [1]. The primary cause is osteopenia / osteoporosis with trivial trauma liking slipping or missing of step [2]. The typical blood supply of the head of femuris responsible of failure of fixation & avascular necrosis of head of femur.
The replacement of the head of femur is ideal line of management. In young age the fracture is fixed with cannulated cancellous screws. The rate of non union / failure of fixation is very high. Hence the replacement of the head of femur is the treatment of choice.
Replacement is done by bipolar prosthesis, Austin Moore's Prosthesis, or THR.

Keywords: Fracture neck of femur, Austin Moore's Prosthesis, Bipolar prosthesis, THR, Modified Harris hip score

Introduction
Fracture of neck of femur (NOF), is a common problem especially seen in patient of 5th / 6th decade. The cause of injury was trivial or low velocity trauma. This was not very common in young or middle aged patients. There are some peculiar things about this injury.

1. Osteopenia / Osteoporosis is common feature in 5th & 6th decade.
2. Fracture can occur with low velocity trauma / trivial trauma.
3. The fracture is intra-synovial, the synovial fluid prevents healing of fracture.
4. The vascular supply to head of femur is invariably compromised.
5. Surgical risk in patients in 5th & 6th decade is increased because of co-morbidities [3].

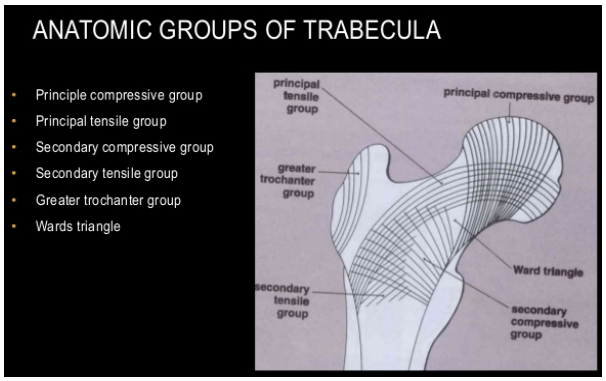
Blood supply of head of femur

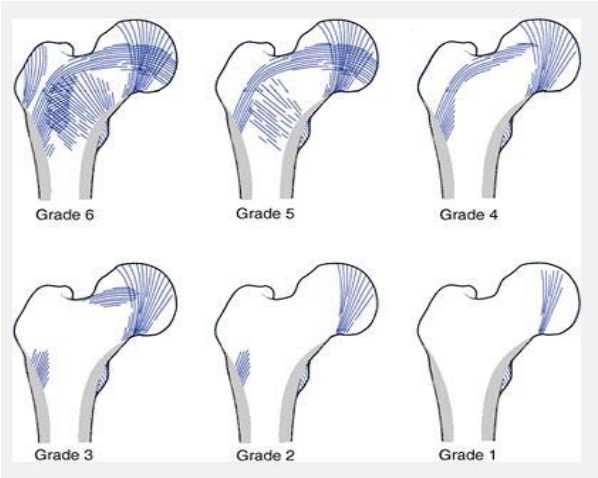


The vascular supply to head of femur is from ascending branch of lateral circumflex femoral & medial circumflex femoral arteries. They form together a extracapsular vascular ring at the base of the neck. From this vascular ring arise the trabecular vessels, which pass along the anterior & posterior surface of the neck of femur. These vessels form subsynovial intracapsular vascular ring at the junction of neck & head of femur. This ring sends perforators to the head of femur. Head of femur also derives blood supply from foveal artery which is branch of obturator artery.

Whenever there is fracture of neck of femur / posterior dislocation of hip these trabecular vessels are injured & results in variable degree of avascular necrosis of head of femur.

Radiological Assessment of Osteoporosis of the head of the femur is done by Singh's & Maini's Index (M.Singh & P S Maini). They had formulated 6 grades of osteoporosis of the head of femur [4].





- **grade 1:** only thin principal compression trabeculae visible
- **grade 2:** principle compression trabeculae present, other trabeculae nearly resorbed
- **grade 3:** principle tensile trabeculae thinned and breakage in continuity present
- **grade 4:** principal tensile trabeculae thinned without loss of continuity
- **grade 5:** principle tensile and compression trabeculae readily visible with prominence of Ward triangle
- **grade 6:** all trabeculae visible and of normal thickness

Grade 3 and below indicate definite osteoporosis.

The fundamental cause of fracture depends on

1. Velocity of the impact

In road traffic accidents, the impact is sustained at high velocity & results in comminution of the fractures. Also the impact is of so high velocity that while dissipating the impact there are associated soft tissue injuries or other systemic injuries.

2. Intrinsic strength of the bone

In osteopenia or osteoporosis, the intrinsic strength of the bone is reduced, hence a trivial trauma such as minor jerk or missing of step can cause fracture of NOF.

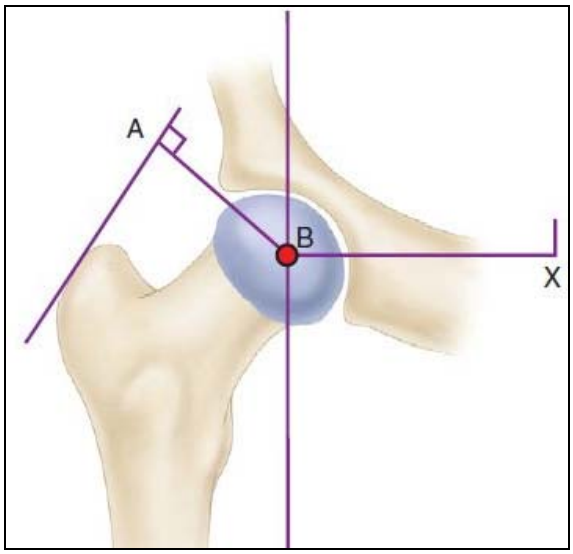
3. Impact absorbing system (Muscles)

When the muscles are weak, the impact sustained during fall/ trauma does not get properly dissipated by the muscles, hence the bone gets fractured.

Hence these type of fractures are usually seen in 5^{th} &6^{th} decades of life even after a trivial trauma, when osteoporosis is marked, the intrinsic strength of bone is reduced. Other type of injury is high velocity vehicular accidents.

These fractures are intra synovial / intracapsular injuries. Whenever there is fracture, it results in hematoma. In quite a few cases, this hematoma causes tamponad effect on the head & neck of femur, thereby causing further vascular embarrassment. Hence in such case, if they are to be fixed especially in young age groups, it should be with relative emergency.

Biomechanics of Hip



(Courtsey – Campbell's Orthop)

X-B: Lever arm from the cetre of gravity to centre of hip.

A-B: Lever arm from centre of hip to lateral greater trochanter.

- The ratio of the lever arm X-B: A-B is 2.5:1. This implies that when the weight is borne on single extremity in stance phase, it is 3 times the normal body weight. This is force the force exerted on the hip in order to keep the pelvis balanced.
- Charnley advised concept of low friction arthroplasy wherein there was

i) Medialisation of head of the prosthesis
ii) Lateral displacement of trochanter.

The aim in doing this was to bring the ratio of these 2 lever

arms nearing to 1: 1. Now the trochantric osteotomy is not done nor there is attempt for medialistion. Minor alteration in lever arm relative to offset of head of prosthesis to stem is done so as to allow the stress transfer from prosthesis to bone in more biologic manner.

- Calculated Peak contact force on the hip joint in single limb stance is on an average 3.5 to 5 times the body weight. The act of running & jumping tend to increase this to 10 times the body weight.
- Centre of the hip joint is 15 -20 degrees anterior to the anterior border of S2 vertebra which is the plane of centre of gravity of the body.this means that the forces exerted on the head of prosthesis during gait are directed 15 -20 degrees anterior to the sagittal plane of the prosthesis. These are further increased during stair climbing or straight leg raising.
- The implant has to withstand all these forces during cyclical loading & unloading [5].

Evolution of Prosthesis

- Earlier designs such Judet's prosthesis or mould were tried but were not successful.
- Austin Moore's Prosthesis was accepted for quite some time in many countries.

Thompson's Prosthesis had variable acceptance. But that during period much standardisation of implant material, quality, & design was achieved hence the acceptance was much better [6].

- Bipolar prosthesis has been one design which had maximum clientele.
- Various modification were done in original design of Bipolar prosthesis such as

Cemented prosthesis, Porous coated stem, uncemented prosthesis, modular Bipolar prosthesis [7-8],

- Advances in cementing techniques improve the results dramatically, & given great leap in acceptance of Bipolar prosthesis.
- There was always controversy between use of cemented prosthesis & uncemented prosthesis for many years & is still continuing till today.
- Bipolar prosthesis has variable designs of porous coated stem which promotes rapid bone in growth with the prosthesis.

Types of porous coating

A. Sintered beads B. Fibre mesh design C. Hydroxyapatite crystal coated design.

- The average size of pores is 100 µm, & average thickness of coating is 50 to 155 µm.
- Although the hydroxyl apatite crystal coating is latest, there is no objective evidence of benefits of one type of coating over other.
- Latest innovation in bipolar prosthesis was the modular design. In this type of prosthesis surgeon has an advantage of changing the size of head & neck of prosthesis so that it will mach to the anatomical centre of hip joint [9].

Material & Methods

In 38 cases, 34 cases were treated with Bipolar prosthesis, while 4 cases were treated with Austin Moore's prosthesis. (Indian make made available at hospital). The incision was with standard postero-lateral approach. The average blood loss during surgery was around 150 -200ml. Average time for surgery was 90 -120 min. The cementing (Simplex) was with dough pressurised manually. Post operatively the patient was immobilised with A K brace in abduction.

Judet's Prosthesis

Austine Moore Prosthesis

Thomson prosthesis

Bipolar Prosthesis

Sample Size
34 cases using bipolar prosthesis,
4 cases using Austine Moore Prosthesis
Total no of cases 38.

Duration of Study: This study was conducted at Rural Medical College Loni, Tal Rahta, Dist Ahmednagar, between Jan 2015 to Jan 2017 over a period of 2 years.

Inclusion criteria
i) Age of the patient in 5th and 6th decade & above.
ii) Intracapsular (Trans cervical/Subcapital) fracture neck of femur
iii) Fall from trivial trauma.
iv) AVN less than Gr II.

Exclusion Criteria
i) Age less than 40 yrs
ii) Degenerative changes in acetabulum.
iii) AVN more than Gr II
iv) Acetabular fractures
v) Associated pelvic injuies
vi) Pathological fractures.
vii) Inter-trochantric fractures.

Observation & Results

Average age of the patient	23 cases between 58- 70 yrs,
	15 cases above 70 years
Age of Injury	31 cases between 8 -15 days.
	7 cases between 1month / more
Sex	Male 16(42.10%)
	Female 22(57.90%)
Associated co-morbities	IHD 8 (21.05%)
	Diabetes mellitus 22 (57.89%)
	Both 3 (7.89%)
	Others- CRF 2 (5.26%)
	None 3(7.89%)
Time of Surgery	6 -15 days from the injury
Duration of surgey	90-120 minutes
Average blood loss	150-200ml
Blood transfusions	
a) Pre operative	If haemoglobin is less than 10 gm%
b) Intra /post operative	
Romovac neg suction	Around 80 -120 ml.
Average stay in hospital	15 days
Supportive ICU care	34 cases – No ICU
	4 cases required for 2-3 days.
Implants used	34 cases Biolar prosthesis
	04 cases – Austin Moore prosthesis
Technique	Cemented Bipolar 29
	Uncemented Bipolar 05
	Austin Moore 04
Complications	1 death after 9 days (myocardial infarction)
	2 superficial infection
	2 Deep Vein Thrombosis
Mobilisation of knee	Quadriceps drill 2nd day
	Mobilisation on bed after 5 days
	Bed side mobilisation after 10 days
Ambulation of patients	Cemented Bipolar
	Between 12 – 15 days

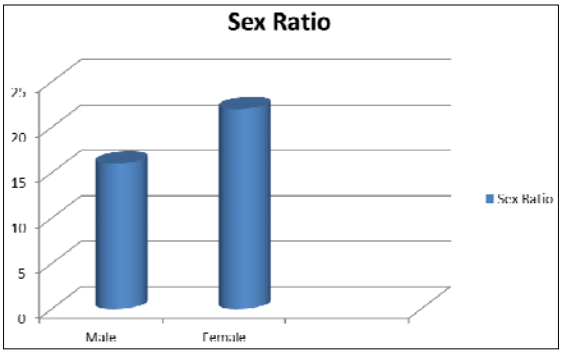
	Standing with walker 2-3 days
	Partial wt bearing with walker thereafter.
	Uncemented Bipolar / Austin Moore
	Weight bearing after 6-8 weeks.

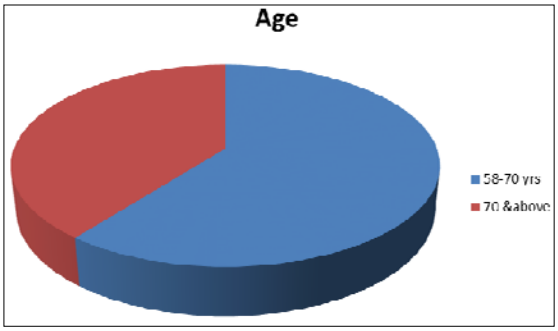
Assessment of the results was done by Modified Harris hip score.

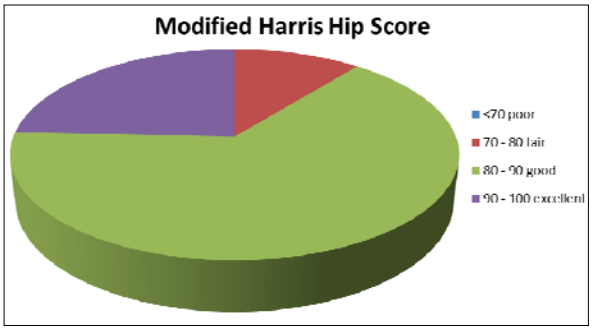
Harris hip score is calculated under 4 heads

Pain	44 points
Range of motion	5 points
Function	47 points
Dormity	4 points
Score less than 70 points	Poor results
Score between 70 – 80	Fair
Score between 80 – 90	Good
Score between 90 – 100	Excellent results.

Modified Harris hip score	No of cases
Less than 70	Nil
70 – 80 score	04 (10.52 %)
80- 90	24 (63.15%)
90 -100	09 (23.68%)
	1 (death)
	Total 38 cases







Bipolar

Austine Moore

Discussion

There is huge literature available on treatment of fractures of neck of femur in geriatric age group. But there is no uniform protocol in the management of these fractures, so that one can decide for THR or hemi-arthroplasty. Earlier these cases were treated with Austin Moore's Prosthesis. The prosthesis did well for 10-12 yrs. Some patients noted e/o Protrusio but that percentage was miniscule. Later came bipolar prosthesis it also gave good results. It had a definite advantage over Austin Moore prosthesis. The Bipolar system has wear at two levels. One at the 22 mm low friction torque bearing with polyethylene cap, other at Prosthesis & acetabulum, thereby reducing the shearing stresses on acetabular cup significantly. Latest was THR. It is difficult to choose one technique over other because results were more or less same in THR & Bipolar. Same is the case whether to use cemented or uncemented device [10]. The proponents of both the techniques are increasing.

Western literature advocates for THR. But in our country the percentage of the patients insured for health is now coming up. The low socio economic strata is availing benefit of prevalent Govt schemes. Hence cost of treatment is a major decisive factor in choosing modalities of treatment. Another factor is the incidence of aseptic loosening of the acetabular component which is quite significant in THR due to which the incidence of revision hip is also increasing.

The primary aim in the treatment of these fractures is to give the patient

i) Painless stable hip joint.
ii) Pain free movement at the hip joint.
iii) To make patient ambulatory.
iv) To allow the patient to his pre-fall status.

Bipolar hemiarthroplasty has advantage on few counts. The procedure involves

i) Less dissection,
ii) Less blood loss,
iii) Less duration of surgery,
iv) Less cost [11-13].

Conclusion

In the treatment of fracture of neck of femur in geriatric age group, hip joint replacement is the treatment of choice. But the economic constrains, less risk of surgery, less duration, gives advantage to Bipolar hemiarthroplasty over THR [14-16]. The conversion of failed bipolar arthroplasty to THR is easier & economical than revision hip. Hence, in a place like India, where 90% of the patients are from low socio economic class, Bipolar hemiarthroplasty is the treatment of choice in these cases.

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