

REVIEW of LITERATURE

Old age brings with it a whole range of medical problems and weakened osteoporotic bones. Fractures can result from trivial trauma or even spontaneously as is true in case of a fracture neck femur which may remain undetected for weeks.

Ambrose Pare,^[2] the famous French surgeon recognized existence of hip fractures more than 400 years ago. The history of management of this mysterious fracture have included management by “Skilful neglect”, reduction by dynamic traction, anatomic reduction and maintenance in plaster, use of stable internal fixation devices and finally the development of implant arthroplasty.

Phillips,^[6] introduced a technique of longitudinal and lateral traction to be used in the treatment of femoral neck fractures to eliminate “Shortening or other deformity. Internal fixation of the femoral neck fractures were started first of all by Von Langenbeck.^[8] Seen obtained higher rate of union of femoral neck fractures in dogs using internal fixation and made the following statement” The only cause for nonunion in case of intra-capsular fracture is to be found in our inability to maintain co-aptation and immobilization of the fragments during the time required for bone union to take place.” Royal Whitman in 1902,^[2] advocated careful reduction and holding of the reduced fragments in a spica cast. Cotton recommended artificial impaction of fracture fragments by blows from a heavy mallet applied to the padded trochanter before cast application.

Internal fixation of femoral neck fracture gained momentum during the early twentieth century and various internal fixation devices were developed. Smith-Peterson,^[10] using a triflange nail reported a series of open nailing in which he advocated reduction, impaction and internal fixation and was the fore-runner for the later designs. Smith-Peterson technique

was simplified by the introduction of cannulated nails by Johansson in 1932, which allowed the surgeon to reduce and fix the fracture closed. Telescoping nails or screws,^[11] which allow gradual impaction of the fracture site was introduced by Schumpelick and Jantzen,^[12] and popularized in a modified form as the sliding compression screw.

The era of arthroplasty had its beginning when John Murray Carnochan reported interposing a small block of wood in an attempt to mobilize a patient's ankylosed jaw. Inter-positional arthroplasty was tried by a variety of materials by several surgeons around the globe - John Benjamin Murphy tried fascia lata as interposing material, William S. Baer described the utilization of chromatised sub-mucosa of a pig's bladder and Robert Jones of Liverpool reported use of gold foil for covering femoral head.

A Boston Surgeon, Smith-Peterson,^[13] reported the technique of "mould arthroplasty" with glass cups as the inter-posing material for arthroplasty of hip. Discouraged by how easily by glass cups broke, he tried Bakelite, a form of celluloid.

The search for an implant material strong & chemically inert for prosthetic use ended with the development of an alloy, vitallium by Charles Venable and Walter Stuck. J. Austin Tolley Moore & Harold Ray Bohlman,^[15] inserted the first endoprosthesis of vitallium after resecting 30cm of upper end of femur in patient with recurrent giant cell tumor.

Judet Brothers of Paris,^[16] developed a new endoprosthesis made of acrylic bound to a chromium steel rod which was a failure due to rapid wear and breakage. Frederick R. Thompson,^[17] introduced a chromium-cobalt femoral endoprosthesis with a non-fenestrated intra-medullary stem that curved to fit the upper shaft of femur. Austin-Moore,^[15] introduced his "Self-locking" endoprosthesis with a wider fenestrated stem.

Mahoney et al,^[45] published his follow up study of 92 cases on immediate Moore prosthetic replacement in intra-capsular

fractures. The selection of cases was made on the basis of morphology of the fracture and depending upon the age. All these cases represented displaced intra-capsular fractures, either sub-capital or high Trans cervical, usually of unstable type. The patients were usually over sixty five years of age. 85% of the survivors had satisfactory results and failures were seen in 15% of cases.

Harold Bolton,^[46] in his study of 88 patients had suggested that the immediate replacement arthroplasty was the method of choice in very old patients with fractures of the femoral neck. For the first nineteen patients he used stamm's prosthesis but later he used Austin Moore prosthesis. He found Austin Moore prosthesis better.

Hinchey et al,^[25] studied 288 cases of fresh fractures neck femur treated by primary prosthetic replacement of head of femur using Moore prosthesis with a 1 to 8 years follow up. Modified Watson-Jones approach was used in all cases. 225 cases were followed up with excellent result in 118 cases, good in 46, fair in 24 and poor in 37 cases.

Anderson et al,^[47] published a review of 356 operations of femoral head prosthesis. He used both Moore's prosthesis as well as Thompson prosthesis. The average age for the whole series at the time of operation was 65.7 years. Excellent to good results were shown in 87.5% of cases with Moore Prosthesis and 82.4% of cases with Thompson Prosthesis after placing cement in the femoral shaft. Two patients could not be saved and on postmortem examination showed petechial hemorrhages on the visceral pleura and histological examination showed massive pulmonary fat embolism.

Mears and Cruses,^[48] evaluated the use of acrylic cement in anchoring the endoprosthesis in hemi-arthroplasties. 192 prosthesis were inserted. 115 cemented and 77 uncemented. On follow-up they noticed that 11. 7% of the uncemented prosthesis became loose compared to 6.10% of cemented prosthesis. They recommended the use of Methylmethacrylate

for anchoring the stem of prosthesis but that its use should not be a routine.

Evarts,^[49] published the role of endoprosthesis as primary treatment of femoral neck fractures. He stated that age alone is not an absolute indication. He recommended endoprosthesis as treatment in high sub capital fractures, pathological fractures, secondary avascular necrosis and nonunion of fracture neck femur.

Narayan et al,^[50] in his study of 61 patients of endoprosthetic replacement, for fracture neck of femur between May 1997 and Dec. 2002 that were followed –up prospectively. 29 patients were treated with total hip replacement and 32 were treated with bipolar arthroplasty. The period of follow up ranged from 24 months to 90 months, with a mean of 58.5 months. The mean Harris Hip Score for the bipolar group was 86.93 and for the total hip group were 83.82.

Dorr et al,^[51] in a randomized, controlled trial that have compared internal fixation, with either total hip replacement or hemi-arthroplasty have demonstrated inferior results for internal fixation, with re-operation rates ranging from 18% to 47%. The reported rates of acetabular erosion have ranged from 0% to 26% for bipolar designs and from 2.2% to 36% for unipolar designs. The major early complication of total hip arthroplasty is dislocation. At the time of the final follow-up, the hemi-arthroplasty group had significantly greater hip disability, represented by higher oxford hip scores ($p=0.033$) and shorter self-reported walking distances ($p=0.039$), than the total hip arthroplasty group did.

Ravi Kumar et al,^[52] in a randomized, prospective study of octogenarians, who had sustained a displaced fracture of the femoral neck, reported that the rate of acetabular erosion at two years postoperatively was 2.2% for hips that had been treated with a unipolar prosthesis and 0% for hips that had been treated with a bipolar prosthesis. However, Soreide et al reported an acetabular protrusion rate of 26% for patients

older than seventy five years of age who had been managed with a bipolar Christiansen prosthesis. The lowest dislocation rates (2%) were reported for total hip replacement, using the transgluteal approach in patients who had sustained a displaced intra-capsular fracture of the femoral neck. These findings suggest that total hip arthroplasty is superior to hemi-arthroplasty for the treatment of mentally competent, independent, and active patients. Both groups experienced functional deterioration post-operative as compared with pre-operative levels. However patients in THR group have less deterioration and maintained their walking distances.

Baker et al,^[53] in their prospectively randomized study, 81 patients who had been mobile and lived independently before they had sustained a displaced fracture of the femoral neck were randomized to receive either a total hip arthroplasty or a hemi-arthroplasty. The mean age of the patients was 75 years. Outcome was assessed with use of the Oxford hip score, and final radiographs were assessed. After a mean duration of follow-up of three years, the mean walking distance was 1.17 miles (1.9 km) for the hemi-arthroplasty group and 2.23 miles (3.6 km) for the total hip arthroplasty group, and the mean Oxford hip score was 22.3 for the hemi-arthroplasty group and 18.8 for the total hip arthroplasty group. Patients in the total hip arthroplasty group walked farther ($p = 0.039$) and had a lower (better) Oxford hip score ($p = 0.033$) than those in the hemi-arthroplasty group. 20 patients out of 32 living patients in hemi-arthroplasty had radiographic evidence of acetabular erosion at time of final follow up. None of hips in hemi-arthroplasty group dislocated whereas in 03 patients in THR dislocated. In hemi-arthroplasty group, 02 patients were revised to THR and 03 additional hips had acetabular erosion severe enough to indicate revision. THR conferred superior short term clinical results and fewer complications as compared to hemi-arthroplasty in this study.

Blomfeldt et al,^[54] studied 120 patients with a mean age of 81 years (70 to 90) with an acute displaced intra-capsular

fracture of the femoral neck. They were randomly allocated to be treated with either a bipolar hemi-arthroplasty or total hip replacement. Outcome measures included peri-operative data, general & hip specific complications, hip function and health quality life. The patients were reviewed at four and 12 months intervals. The duration of surgery was longer in the total hip replacement group (102 minutes (70 to 151)) versus 78 minutes (43 to 131) ($p < 0.001$), and the intra-operative blood loss was increased 460 ml (100 to 1100) versus 320 ml (50 to 850) ($p < 0.001$), but there were no differences between the groups regarding any complications or mortality. There were no dislocations in either group. Hip function measured by the Harris hip score, which was significantly better in the total hip replacement group at both follow-up periods ($p = 0.011$ and $p < 0.001$, respectively). The health related quality of life measures was in favor of THR group but did not reach statistical significance. These results indicate that THR provides better function than bipolar as soon as one year post-operative without increasing complication rate.

Squires et al,^[55] compared the outcome of the total hip replacement with hemi-arthroplasty in the mobile and socially independent patient with displaced fractures of femoral neck and made note of caution, that there is a higher rate of dislocation when using the total hip arthroplasty. There is no definite conclusion as to the more appropriate treatment for less mobile population. Gerhard cautioned that the better outcome results obtained with the total hip replacement should be assessed in concern with the troubling higher rate of dislocation and deep and persisting infection. Preoperative ambulatory status also correlated well with outcome. Of patients walking independently before injury, 30.8% of patients had a good outcome as compared to only 14.2 % of patients who had to rely on aided ambulation. So, pre-fracture mobility is often a predictor for short term complications. As an extension, long term mortality was also found to co-relate well with pre-morbid ambulation as a facet of multi-factorial

causation. Hemi-arthroplasty is a good option for fracture neck of femur in elderly with 66% of patients obtaining satisfactory results.

Parker,^[56] studied of 3154 consecutive patients with fracture neck of femur, 908 patients were treated by hemi-arthroplasty; 4.8% required revision surgery within the first year for dislocation (1.7%), peri-prosthetic fracture (1.2%), loosening (0.8%) and infections (1.2%). Pain and mobility in patients who undergo hemi-arthroplasty are inferior to total hip replacement in short term and long term. A meta-analysis reported a mean dislocation rate of 6.9% following total hip replacement for a fracture of neck femur. The 6.6 years survival rate of THR for fracture neck of femur is 96.6% according to Swedish joint registry.

Sayaana et al,^[35] in his study of 65 to 80 years old individuals, managed with internal fixation, or THR or HA for treatment of displaced fracture of neck of femur. THR is an option to manage this fracture in old frail dementiated individuals, but some co-morbidity poses a significant surgical dilemma. HA should an ideal choice in individuals with many co-morbidities & shorter life expectancy. Out of 55812 THR recorded in England and Wales National joint registry in year 2005, 746 operations was performed for fracture neck of femur i.e. 1.3% of hip replacement. In Norway out of 10000 incidence of hip fracture per annum, only 654 THR are performed for fracture neck of femur. The opinion regarding the use THR is divided. However in Sweden and Norway, THR is more widely used in management of fracture neck of femur. There is increasing evidence that THR is superior surgical management option in 65-80 years old, active lucid ambulant patient with dislocated fracture neck of femur.

Hunter,^[57] made a comparison of the use of internal fixation and prosthetic replacement for fresh fracture neck of femur. In this study, 200 cases were taken. In 100 cases prosthetic replacement was done and in 100 others internal fixation

done. He found that mortality and morbidity was higher in prosthetic replacement group as compared to internal fixation group.

Naidu and McQueen,^[58] in their follow up study on hemi-arthroplasty of the hip evaluated the effectiveness of the treatment in various hip conditions. A total in 169 hemi-arthroplasty of the hip performed at the Medical College of Georgia were taken up for study. Hips were evaluated by Harris' hip evaluation method. The patients were divided into various diagnostic groups. The hips with idiopathic avascular necrosis followed by the hips with fresh fracture showed the best overall results. The results were not as good when the acetabulum was damaged, but acetabuloplasty was beneficial in these patients. The hips with rheumatoid and degenerative joint disease did poorly with hemi-arthroplasty.

Gingras et al,^[59] published a comparative study of cemented versus non-cemented prosthesis. He had illustrated a favorable trend when the endoprosthesis is cemented in the treatment of fresh femur neck fractures. There is no difference of morbidity and mortality between the two groups. In cemented prosthesis, fixation of the prosthesis to femur gets improved. Pain and loosening are far more less in cemented group. In cemented pain was found in 8 percent of cases while in non-cemented in 28 percent. Incidence of loosening was 18 percent in cemented and 69 percent in non-cemented.

Taine and Armour,^[60] used primary total hip replacement for independently mobile making patients of 65 year or above. A total of 163 cases, operated on over a period of four years were reviewed. Only seven revision operations were required out of 57 patients who were interviewed after an average of 42 months after replacement, 62% had excellent or good results as assessed by the Harris hip score. It was concluded that total hip replacement is the best management for a select group of patients with fracture neck femur and further prospective studies were indicated.

Dorr et al,^[61] conducted a prospective study of displaced femoral neck fractures with patients randomized into three groups: cemented total hip replacement (THR), cemented hemi-arthroplasty (UHR-C), and non-cemented hemi-arthroplasty (UHR-NC). Eighty-nine patients were treated for displaced (Garden Type-4) fracture with prosthesis; 39 patients had THR, 37 had UHR-C and 13 UHR-NC. No difference was found in the level of pain, ambulation between the THR group and the UHR-C group, except for active community ambulators, who demonstrated decreased endurance capability when treated with UHR-C. The patients treated with UHR-NC had increased pain and decreased ambulation and required assistive devices. The most significant complication was dislocation, which occurred in 7 patients with THR and 2 with UHR-C.

Gebhard et al,^[62] reported a series of 166 acute nonpathologic displaced femoral neck fractures in elderly patients treated with either unipolar hemi-arthroplasty (122 operations, 77 cemented, 45 uncemented) or total hip arthroplasty (THA), 44 operations all cemented. The average age (75.2 years of age in the THA group, 76.2 years of age in the hemi-arthroplasty group), anesthesia risk classification, in-hospital mortality, early complications and dislocation were comparable in each treatment group. In an average long-term follow-up of 56 months, pain, walking, and function scores were higher with THA than with cemented or uncemented hemi-arthroplasty. Revision rates were 2.2% after THA, versus 7.9% for cemented hemi-arthroplasty and 13% for uncemented hemi-arthroplasty. He stated that hemi-arthroplasty be recommended for occasionally active patients and THA for healthy active patients.

Gregory et al,^[63] studied a series of 46 patients with 45 displaced sub capital femoral fractures of the age group between 65 and 79 years who were treated with total hip replacements. Mean Harris hip score of 33 patients reviewed at 3 years was 83. 6-months mortality was 9 percent. Postoperative mobility was

well maintained and there was no evidence of deep sepsis or loosening.

Nehrer et al,^[64] studied 120 patients who underwent total hip replacement after suffering from fractures of the femoral neck: 61 patients did not have any previous surgery, 59 patients had joint preserving surgery, results showed that the primary stabilizing operation to preserve the joint did not have any negative effect on the survival probability of the total hip replacement in comparison to primary implantation. If the joint preserving primary intervention fails, total hip replacement is a good choice for secondary surgery.

Ekulund et al,^[65] observed 162 total hip arthroplasties in people of 80 years age group & older, for one year. In 80% of the patients, no complications were recorded during the first year. Three patients died within the first three months of surgery. Two developed deep infections (12.2%). The dislocation rate was 9.2% (15/162). After one year, 88% (112/127) of the patients who could be observed had good or excellent results. They concluded that total hip arthroplasty in the elderly is a reasonably safe method and yields good functional results.

Hui et al,^[66] compared the re-operation rate after internal fixation for minimally displaced or impacted intra-capsular fractures of the femoral neck in patients aged 80 years and above with that in similar patients aged 65 to 79 years. They also compared the results of internal fixation with those of hemi-arthroplasty for displaced intra-capsular fracture in an age-and sex-matched group of elderly patients. They found that a significantly greater proportion of the old patients treated by internal fixation required re-operation than either the younger group or the age-matched group treated by hemi-arthroplasty. They recommended that internal fixation may not be the best treatment for elderly patients with minimally displaced or impacted fractures.

Warwick et al,^[67] reviewed the records of 56 patients in whom a hemi-arthroplasty, carried out for a femoral neck fracture, had been revised to a total hip replacement. The mode of failure was femoral loosening in 21, acetabular erosion in 26 and both in 5, loosening tended to occur earlier than acetabular erosion. The median time to the onset of symptoms was 12 months and to revision 33 months. There were 38 major operative or postoperative complications at revision in 27 of the patients (48%).

Broos,^[68] made an analysis of 778 unstable fractures of the femoral neck, Garden type III or IV in 736 patients over 70 years of age they have been treated surgically. 447 patients were treated with hemi-arthroplasty and 301 patients with total hip replacement. The complications noted after prosthetic replacement were dislocation (2%) requiring an early revision arthroplasty and deep infection (<1%).

Parker et al,^[69] conducted a study of 455 patients aged over 70 years treated by either hemi-arthroplasty or internal fixation. Internal fixation had a shorter length of anesthesia (36 minutes versus 57 minutes), lower operative blood loss (28 ml versus 177ml). In internal fixation group 90 patients required 111 additional surgical procedures while only 15 additional operations were needed in 12 patients in the arthroplasty group. At one, two and three years after injury there was no difference with regard to pain and mobility in both groups. Limb shortening was common after internal fixation. They recommended that displaced fractures in the elderly should generally be treated by arthroplasty but internal fixation may be appropriate for those who are very frail.

Rogmark et al,^[70] made a prospective, randomized study of 68 patients aged 70 years or older, with displaced cervical hip fractures. The patients were randomized to internal fixation with hook pins,^[36] or primary arthroplasty,^[32] (total or partial) and followed for 2 years. In the internal fixation group, 15/36 was considered failures, as compared to 1/32 in the

arthroplasty group. The mean 2 years cost for a patient with internal fixation was US\$ 21,000 and for one with primary arthroplasty US\$ 15,000. They concluded that primary arthroplasty is a cost effective treatment and considering the very much higher failure rate after internal fixation-leading to increased suffering for these patients, primary arthroplasty stands out as the best method for displaced fractures of the femoral neck.

In a study by Mishra et al,^[71] Fifty-one consecutive socially independent and mentally alert patients of average age of 74 years with displaced sub capital fractures were treated by primary THR, from April 1997 to March 2000, at a single hospital. This study had a mean follow-up of 33 months (range 20-54). This study had the lowest reported dislocation rate (2%) and an acceptable 1-year mortality rate of (6%) confirming the place of primary THR in treatment of these select patients with a displaced hip fracture.

Mabry et al,^[72] reviewed 99 patients who had been managed with total hip arthroplasty with use of a cemented Charnely acetabular component and a cemented Charnley monoblock femoral component for the treatment of a femoral neck nonunion retrospectively in age group of sixty-eight years. The rate of component survival, free of revision or removal for any reason was 93% at ten years and 76% at twenty years. It was concluded that total hip arthroplasty is an effective method for the treatment of nonunion of the femoral neck and provides satisfactory long-term results.

Healy and Iorio,^[73] studied 186 displaced fractures of the femoral neck in elderly patients who were treated surgically with internal fixation (in 120 patients), hemi-arthroplasty (in 43 patients), and total hip arthroplasty (in 23 patients). One hundred twenty patients with displaced fractures treated with internal fixation were compared with 66 patients with displaced fractures treated with arthroplasty. Arthroplasty was associated with more independent living and was more

cost-effective than internal fixation. They concluded that total hip arthroplasty was the best treatment for displaced fractures of the femoral neck in elderly patients in this series.

Patel et al,^[74] reviewed a retrospective study of 50 Muller straight stem total hip replacements performed for femoral neck fracture over a 10 year period. In 25 radiographs available for review there were no cases of radiological loosening? None of replaced hips required revision surgery. Two patients had suffered early dislocations and there were three major medical complications. The mean Merle D'Aubigne-Postel score was 15.1. They concluded that total hip replacement in the right hands provides good results for the treatment of displaced intra-capsular fracture neck femur.

Hardas et al,^[75] evaluated the prognosis among different age groups in elderly patients aged 65yrs and above treated for hip fractures. Replacement arthroplasty, either hemi-arthroplasty or total hip replacement was found to be ideally suited for the elderly population as a primary procedure to tackle the problem of fixation failure, non-union and AVN. THA is advocated in cases where life expectancy is significant and when acetabular disease is present.

Richard et al,^[76] performed controlled trials at 2yrs post operatively have shown that a primary total hip replacement is superior to internal fixation for the treatment of displaced femoral neck fracture. They evaluated one hundred and two patients (mean age, eighty years), who had acute displaced femoral neck fracture, were randomly allocated to be treated with total hip replacement or internal fixation. The mortality rate was 25% in both groups. At the forty-eight-months follow-up evaluation, number of hip complications was 4% in patients treated with total hip replacement and 42% in those treated with internal fixation ($p < 0.001$) and the re-operation rates were 4% and 47%, respectively ($p < 0.001$). The total hip arthroplasty group had no additional hip complications or re-operation between the 24 to 48 months follow-up visits. In

the fixation group, the percentage of re-operation increased from 4% to 47% during the same period. The hip function was significantly better and the decline in health-related quality of life was less pronounced in arthroplasty group than it was in the fixation group at the four, twelve, and twenty-four-months follow-up evaluation.