DISCUSSION

Femoral neck fracture, though common in occurrence and known since time immemorial, has always been posing challenge to orthopaedic surgeons. Inspite of voluminous work and various modalities of treatment available, significant differences of opinion regarding the best method of treatment persists even today. Anatomical reduction, impaction and rigid internal fixation are considered to be the pre-requisites for union of femoral neck fractures. Non-union and avascular necrosis of femoral head are the frequent complications faced by the orthopaedic surgeons, irrespective of the method of treatment. Most orthopaedic surgeons also agree that viable femoral head has good functional results, as compared to prosthetic head. To overcome these problems, many surgeons (Hestadius, 1942; Stuck and Hinchey, 1944; Baadsgaard and Medgyesi, 1965) came up with the idea of increasing the vascularity of femoral head by viable muscle pedicle bone graft.

Femoral neck fracture, though occurs at all the ages, is common in young and elderly persons. The higher incidence of femoral neck fracture in old age, is well established (Frangakis, 1966; Barnes, 1976; Brown, 1976;
Garden, 1976; Preston and Nicoll, 1976). Our observations showed the higher incidence in young adult males which is in contradiction to the established fact of higher incidence in elderly females (Frangakis, 1966; Barnes, 1976; Brown, 1976; Garden, 1976; Preston and Nicoll, 1976). Both these contradictory findings are because the persons beyond the age of 60 years were not included in our study and majority of the patients of this study sustained injury in roadside accidents, to which the young or adult males are more predisposed.

The comminution of posterior cortex was observed as a frequent finding (70%). The frequency of comminution of posterior cortex has also been observed by Frangakis (1966), Barnes et al (1976), Scheck (1979) and Garden (1974). The posterior comminution posed problem in anatomical reduction as well as in fixation. The comminuted fragments either obstructed, and thus made the reduction difficult or the gap created posteriorly posed a problem in assessing the accuracy of reduction. The difficulty in achieving open reduction in presence of posterior comminution has also been observed by Frangakis (1966), Scheck (1979).

The muscle pedicle bone graft apart from providing a viable pedicle, served as a bone graft to fill up the gap in secured fixation of the fragment and to prevent posterior tilt of the femoral head (Meyer's, 1979; Baksi, 1986).
Baksi (1936) also reported that the viable inlay muscle pedicle bone graft encourages osteosynthesis and revascularization of the femoral head. Fixation of muscle pedicle bone graft to the recipient site has been done by silk (Baksi, 1986), screws (Meyer's, Harvey and Moore, 1973) and pins. We fixed muscle pedicle bone graft with the staple as it provides better fixity of graft to recipient site as well as fixed two fragments of fracture when proximal fragment was big. Baksi (1986) reported that fixation of muscle pedicle bone graft by silk appeared more advantageous than that achieved by screws or pins.

Twenty five percent of cases had interposition of the capsule in between fragments and if not removed, would have caused the problem in union of the fractures by the procedure in which open reduction was not done. The interposition of capsule at fracture site has also been reported by Campbell's Operative Orthopaedics, Volume three, seventh international Student edition, edited by A.H. Crenshaw, page 2084.

Open reduction thus provides an opportunity to inspect the fracture site and removal of the interposed soft tissue if any, which is known to cause nonunion.

Sclerosis at fracture site and absorption of neck were also observed in old neglected cases, which are the established features of nonunion. The open reduction gave
the opportunity of refreshing of fracture surfaces and drilling of sclerosed bone which are again the pre-requisites for osteosynthesis.

Posterior capsulotomy did not hamper the vascularity at fracture site as revealed by the fact that there is no appreciable bleeding on capsulotomy. Similar observations were reported by Baksi (1986). Open reduction also gave an opportunity of drilling the femoral head through fracture surfaces which decompressed any necrotic bone and encouraged the growth of vascular granulation tissue and packing of free cancellous bone grafts between the fracture surfaces helped to restore the femoral neck length. Baksi (1986) also described the above advantages of open reduction.

Inspite of meticulous care, good reduction could be achieved only in 75% of cases. Posterior comminution, absorption of neck, small proximal fragment (only head) and anatomical architecture of the area are the main obstacles. Difficulty in achieving anatomical reduction has also been observed by Frangakis (1966), Barnes (1976) and Scheck (1979).

Good reduction and rigid internal fixation were the pre-requisites for union, as in one case where the fixation was not secured and in another case in which reduction could not be achieved landed up in nonunion, as also reported by

Upto $20^\circ$ of coxa valga was considered to be acceptable position and satisfactory reduction. Extreme valgus reduction was avoided and varus reduction was not accepted as also suggested by Bunata et al (1959). Garden (1966) also warned against severe valgus reduction which increases the risk of avascular necrosis and nonunion. Angle smaller than $160^\circ$ denotes unacceptable varus reduction and angle more than $180^\circ$ denote severe valgus reduction.

Frangakis (1966) also stressed upon accuracy of reduction and considered an angle of $165^\circ$ as normal relation between head and neck in this plane. Any reduction above this angle was considered as imperfect reduction. He also observed that fixation in more than $20^\circ$ valgus malposition has catastrophic effect on the viability of head.

Similar findings were observed in the present study as two cases in whom the reduction could not be achieved or lost in post-operative period ultimately landed in nonunion and had poor results (It is not possible to comment on viability of femoral head, as follow-up period was short).

Deyerle (1965), on the contrary, recommended valgus reduction because it shortens the neck and decreases the lever arm of proximal fragment which decreases the
amount of motion at fracture site. Barnes et al (1976) reported the higher incidence of late segmental collapse when the fracture was fixed with Garden angle more than 180°.

Frangakis (1966) on the other hand, said that rotation in horizontal plane has no significant effect on avascular necrosis of the femoral head.

Retention of reduction obtained by internal fixation though was not difficult but rotation of femoral head with striking of first pin and occasionally of second pin posed some problem especially when the proximal fragment was short. Introduction of subsequent pin did not cause any rotation of the femoral head, thus the fixation by multiple pins provides rigid internal fixation, a pre-requisite for union of fracture. Multiple pin fixation has also been recommended by Deyerle (1965), Neufield (1973), Arnold (1984) and many others.

Deyerle (1986) mentioned the principle of multiple peripheral pin fixation in relation to the distribution of stress in femoral head. With a triflanged nail, it is comparable to breaks applied on the axle. With multiple peripheral pins, it can be likened to breaks applied to the peripheral drum.

The pins take up a smaller area of the neck and cause negligible damage to blood supply of the femoral head as compared to triflanged nail as was also reported
Enough cancellous bone grafts could be taken from greater trochanter except when there was marked absorption of neck and amount of bone grafts needed was more. With the use of greater trochanter as a donor site, advantages were - the grafts could be removed by same incision, from same operative field, did not cause much bleeding, did not add to the operative time, did not cause any harm and at the same time provided good quality of cancellous bone. Baksi (1986) has also used the cancellous bone grafts from greater trochanter and reported good results.

Good reduction and rigid fixation permitted early physiotherapy and majority (except those with marked absorption of neck) of patients could be out of the bed within 6 - 12 weeks with crutches. Full unsupported weight bearing, however, was not permitted before the consolidation at the fracture site (4 - 6 months). Early weight bearing was not possible where there was marked absorption of neck or reduction and fixation was not accurate. These cases had to be immobilized with plaster spica for 2 - 4 months till the fragments became sticky. Immobilization by hip spica in cases of absorption of neck and unsecured fixation was recommended by Baksi (1986). Plaster boot and de-rotation bar as a method of immobilization was not used as there was risk of mechanical disadvantage in the form of rotation.
at the fracture site. However, Baksi (1986) used plaster boot and de-rotation bar and reported good results.

Few complications were encountered in this procedure in the form of superficial infection (15%), loss of fixation (5%), avascular necrosis (5%) and extrusion of pins (5%).

Bending and breaking of pins did not occur in any case of our study. However, Baksi (1986) reported bending and breaking or extrusion of the pins in 16% of cases and attributed them to premature weight bearing.

Collapse of femoral head occurred only in one case where Mc Murray's osteotomy had already been done earlier but the femoral neck fracture did not unite and this procedure was done 2 years after the fracture. Baksi (1986) also reported segmental collapse in 2 out of 56 cases, treated by this procedure, which was detected 18 - 22 months after the operation. In our study, the collapse occurred only in one case, though the follow-up is short. Scheck (1967) believes that open reduction is usually associated with higher incidence of nonunion, possibly because of interference with remaining retinacular blood supply. However, the present study and that of Baksi (1986) shows lower rate of nonunion and avascular necrosis of femoral head. Probably due to the viable muscle pedicle bone grafting.
Results were evaluated on the basis of union, functions, residual disability, pain, movements, shortening and gait.

Union occurred in 85% of cases. All except one (5%) were able to walk unsupported, had good painless range of movements of hip, could squat and sit cross-legged and hence were graded as good results. One case (5%) who had union but restriction of adduction, internal rotation with pain at extremes of movements, had difficulty in squatting and was unable to sit cross-legged, could walk unsupported, was graded as satisfactory result. The restriction of movement was probably because of lack of cooperation of patient and physiotherapy. Baksi (1986) also reported union in 87.5% of cases (satisfactory union in 75% and delayed union in 12.5% of cases). Meyer et al (1974) reported rate of union as 90%.

In 3 (15%) cases, fracture failed to unite. but one of them who had undergone Mc Murray's osteotomy earlier could walk unsupported but had painful range of movements was happy as stability of hip improved and pain was relieved (probably by fixation of fragments by pins) was also graded as satisfactory result. Two (10%) cases had nonunion, one due to technical failure and other due to faulty fixation. Both these patients had shortening, were unable to walk unsupported, with restriction of movements at hip, were graded as poor results. Baksi (1986) also reported nonunion in 12.5% of cases and technical failure in two (2) cases.
A published study at the Los Angeles County University of Southern California Medical Centre, reports 35% incidence of nonunion in a study of 250 cases before introduction of muscle pedicle bone graft technique. Significant improvement in these results was noted following introduction of muscle pedicle bone graft technique and reported rate of union as 95% and late segmental collapse in 5% of cases that united.

This technique thus provides higher rate of union, reduces the risk of avascular necrosis and segmental collapse, retains the natural head and provides better quality of life.