REVIEW
OF
LITERATURE
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Fracture neck of femur, known since the time of Hippocrates (6BC) has been under study since around 16th century and still present a problem in treatment. Its treatment and results are still a matter of controversy and inquiry among surgeons, and although results obtained today show a considerable improvement, they are not at all comparable to those of other fractures.

A positive approach to femoral neck fractures aims at bony union. Nicholas Senn (1889) had concluded through his experimental work, that to obtain bony union it was necessary, “firstly to bring the fractures ends into accurate reduction as soon as possible after the accident and, secondly, to maintain uninterrupted approximation by permanent immobilization. Unfortunately, Senn failed to impress the profession, and his work, only recently, has been appreciated.

Banls (1974) has shown that the periosteum does not have a cambium layer in the femoral neck, which accounts for the lack of callus formation after fracture in this region. The fracture of femoral neck heals entirely from intramedullary endosteal callus, which, in undisplaced or anatomically reduced fracture is
characterized by absence of cartilage of fibrous tissue. Fracture healing from viable distal fragment to dead head is quite possible provided the fracture is anatomically reduced, firmly impacted and rigidly fixed by implants.

Crock (1980) described the blood supply of proximal end of femur and divided it into three major groups:

1) Extracapsular arterial ring (Trueta and Harrison, 1953) located at base of femoral neck.

2) Ascending cervical or retinacular branches of the arterial ring on the surface of femoral neck.

3) Arteries of ligamentum teres, which contributes little in the adult to nourishing the femoral head.

As ascending cervical vessels approaches the femoral head, a second, distinct ring of vessels is formed, commonly referred to as the subsynovial intraarticular ring of Chung (1956). From this ring the epiphyseal arteries arise, which penetrate the head and of which the lateral epiphyseal arterial group supplying the lateral weight-bearing portion of femoral head are most important. In fractures of femoral neck with displacement, intraosseous vessels must be disrupted and the retinacular vessels, on the surface of femoral neck
are in jeopardy. Fracture fragments may crush lateral epiphyseal arteries. Thus, disruption of blood supply to the femoral head totally or partially is extremely common in displaced femoral neck fractures.

Femoral neck fractures occurs more frequently in females, Betterberg found the female to male ratio for the femoral neck fracture is 3.4:1. The annual incidence of femoral neck fracture for 1000 person in 1981 was 7.4 for female and 3.6 for males. The increase have been higher in urban (6%) than in rural (3%) population. Rates of femoral neck fracture seems to higher in Whites than in Blacks and a portion of the increase risk can be explained by upper femoral geometry.

Left side fractures are more common than right side fractures for unclear reasons not related to hand dominance. Patient with this fracture are at risk for a second fracture, and 68% of second hip fracture are the same type as the first.

Various risk factors are –

**Non modifiable**

- Previous fracture
- Caucasian race
- Advanced age
Female sex
Dementia
Poor health
Geometric factors
  - Thickness of femoral shaft cortex
  - Thickness of femoral neck cortex
  - Reduction in the index of tensile trabeculae
  - Wider trochanteric region
  - Hip axis length.

Modifiable
  - Tobacco use
  - Low body weight
  - Estrogen deficiency
  - Low calcium intake
  - Inactive life style
  - Recurrent fall
  - Impaired eye site
  - Alcoholism

Ambroise Pare (1564) first described the treatment of these fractures. Potts (1716-1788) first tried to neutralize the muscles of flexion and extension to a point of balance of keeping leg semiflexed.
Sir Astley Cooper (1882) was the first to classify the fracture as intracapsular and extracapsular and accurately described the clinical features. All this was done before the discovery of X-rays. Furthermore, he propagated a pessimistic approach to the treatment of these fractures, he propagated the vogue to “treat the patient and let the fracture go”. This was the period of judicious neglect.

To assess the extent of injury, and to predict the prognosis. Pauwels (1935) and Gardens (1961) gave two different classifications. The anatomical classification where the femoral neck fractures have been divided into subcapital, transcervical and basal types, also gives a rough idea of prognosis, with the subcapital fracture having the worst prognosis.

Pauwels (1935) determined the prognosis of this fracture on the basis of the angle of inclination of the fracture line across the neck and described three grades, with Type I being more horizontal and type 3 more vertical. Type 3 fractures have a high incidence of non-union, attributed to the greater shearing force at the vertical fracture line, unlike the horizontal fracture where more impaction rather than shearing force is present and thus union is presumably better. However, Boyd and George (1948) and Boyd and Salvatore (1964) found that the rate of avascular necrosis and non-
union could not be correlated with increasing angle of fracture. They concluded that broader surface area of Pauwel's type III fracture tends to unite readily provided the shearing forces are sufficiently negated by rigid internal fixation. Also Kleenerman and Marcuson (1970) suggested that one can not be sure of the angle of the fracture of the femoral neck from the usual anteroposterior roentgenograms. Thus, the Pauwel type of fracture can be greatly altered by rotation of the distal fragment.

Garden (1961) classified the fractures based on the degrees of displacement. He believes that various types of femoral neck fractures represent different stages of the same displacing movement and classified these fractures into four groups:

**Stage I:** Incomplete fractures (impacted with the head titled in posterolateral direction).

**Stage II:** Complete fractures without displacement.

**Stage III:** Complete fractures with partial displacement, displacement judged by the direction of trabeculae in the head fragment but the two fragments remain in contact with each other.

**Stage IV:** Complete fracture with full displacement.
Garden's type III and IV fractures, as one might suspect, have a higher incidence of complications even with internal fixation, a fact which sometimes leads one to use an endo-prosthesis as the primary treatment. In Garden's type I fractures, Impaction imparts a significant amount of stability at fracture but this apparent stability may be lost if the fracture is not fixed. So, it is safer to fix even the Garden's type I fracture.

Degree of posterior comminution is also an important guide to prognosis since with severe comminution rigid fixation is not possible and anatomical reduction can not be maintained till healing occurs. This is due to the lack of buttressing effect of intact posterior neck and postoperatively the head rotates posteriorly (Garden, 1954). It is probably a major reason for delayed union, nonunion and malunion. Secondly, posterior comminution creates a large gap. According to Meyer (1974), closure of the gap in the posterior neck with muscle pedicle bone graft increases the stability of fixation of the fracture. Scheck (1959) observed in a series of 29 cases that in 21 cases there was a postoperative shift of the head fragment in-spite of adequate fixation peroperatively. Also, posterior comminution occurs more in osteoporotic bone, which further decreases the probability of a rigid internal fixation. Various
reports show that posterior comminution is up to 65% to 75% in cases of fracture neck of femur as seen in lateral preoperative X-ray.

Garden (1971) followed a series of 323 healed subcapital fracture of femur and stated that “with few exception, capital fragment maintains its integrity when fragments are aligned within the narrow limits of good reduction but undergoes late segmental collapse if reduction is poor.

Garden's alignment index” is helpful in determining the quality of reduction along with other determinants of mal-reduction, such as wedging of hip joint space, extreme tilting of capital fragment, disturbance in Shenton’s line, undue prominence of fovea capitis, loss of near circular outline of the articular margin and lowell’s curve.

Garden's angle in the antero-posterior view is formed by the central axis of medial primary compressive trabecular system in the head fragment and the medial cortex of the femoral shaft and should measure from 160-180°. An angle smaller than 160° denotes an unacceptable varus reduction and one greater than 180° denotes severe valgus, which has shown to increase the risk of avascular
and degenerative changes within the joint caused by hip joint incongruity (Bunata et al, 1958). On the lateral view, Garden's alignment index should be within 20° of the normal 180° straight trabecular alignment from the head fragment to the neck fragment. Any variation from this indicates anteversion or retroversion of the femoral head. Garden accepts a reduction within the range of 160-180° on both anteroposterior and lateral projections. In spite of the above fact, anatomic reduction is rarely achieved and seldom possible. Because of the posterior comminution associated with these fractures, even an open reduction does not allow stable anatomic reduction. Also, most current day image intensifies do not permit sufficient detail and clarity to permit determination of Garden's alignment index.

Patients with subcapital fractures with a core of bone attached to the femoral head have been found to have a high incidence of avascular necrosis, the core being a part of calcar. It has been shown that heads in such cases are essentially avascular and follow up studies after internal fixation of these fractures reveal that head remain avascular and little, if any, of the head is revascularized.

All femoral neck fractures are at risk of avascular necrosis. It is important to differentiate this complication from late segmental
collapse, incidence of which is less and it occurs late in course of healing. Anderson (1980) concluded that vascular damage produced by the initial trauma and displacement necrosis in the 20-40 years age group may be due to the fact that more severe trauma produces a greater degree of vascular damage. Posterolateral retinacular vessels, which are the most important vessels, are damaged, as they cross the fracture line of femoral neck. The lateral epiphyseal vessels are crushed at the fracture site. Three factors, namely, displacement, posterior comminution and posterior rotation of the head play important role in producing vascular injury. In displaced fracture, additional damage to retinacular vessels occurs and thus incidence of avascular necrosis is greater in displaced fracture as compared to undisplaced or impacted fracture. Sevitt (1964) studied the vascularity of 79 heads after angiographic injection. His conclusions were that, complete and almost complete avascular necrosis occurs in 45% of the heads, partial avascularity in 35% heads and normal vascularity in 20%. In approximately 15% of the fractures, which occurs at transcervical and cervicotruncantheric level, avascular necrosis is less frequent.

Many other factors contribute to the reduction in blood supply of the head later in the course of treatment. Mal-handling of
patients during transport, tamponade effect of intracapsular haematoma, delay in reduction, internal fixation, vigorous manipulation during reduction, mal-reduction, placement of implant in posterosuperior quadrant, large size of implant and hammering a nail inside the neck, all seem to affect the precarious circulation of head and neck of femur.

Also prompt reduction of displacement may possibly open some of the retinacular vessels that may be temporarily closed from kinking and stretching and rigid fixation may permit re-establishment of some vascular continuity that might otherwise not be preserved if reduction and fixation is delayed beyond a few hours. But reports of early treatment (on day of fracture) of femoral neck fractures by McCarron (1953) have not indicated a decreased incidence of avascular necrosis compared with that seen in patients who were operated 2-3 days after the fracture. In experimental studies of Henard and Calandruccio (1970) in which arterial supply of femoral epiphysis was occluded by simply maintaining the hip in abduction, extension and internal rotation indicate that if there is no arterial perfusion in femoral head of a dog for more than 6 hours, there is a histological evidence of irreversible cellular damage, occlusion for more than 8 hours produced a greater amount
of dead bone in femoral head, in 4 weeks there was radiological evidence of avascular necrosis.

**Deyerle** (1980) not only aspirated hip of the patient on admission but also did capsulotomy at the time of surgery to drain the haemorrhage. But **Drake and Meyers** (1984) could aspirate only 3cc of blood from the hip with neck fracture and the average pressure recorded was 31 mmHg, well below the normal pressure. Considering the above findings the concept of tamponade is not accepted, because; (a) capacity of the hip is 40cc and small haemorrhage will not cause any tamponade, (b) if the capsule gets torn, as it usually does, intracapsular pressure can not increase, (c) in impacted fracture, there is not much of intracapsular bleeding, still there is 10-15% incidence of avascular necrosis. The intracapsular pressure increased in extension and internal rotation and thus it is possible that keeping the hip in this position during internal fixation for 1-2 hours produces some additional vascular damage. **Darke and Meyers** also concluded that traction should be applied in external rotation and flexion until surgical treatment can be undertaken.
Until recently, it was impossible to know whether the head is vascular or not following injury. Various methods are now known that detect the vascularity of head:

1) Radioisotope scanning using technique 99 MDP and technetium 99 S.C.
2) Tetracycline labeling
3) CT scan
4) Nuclear magnetic resonance
5) Laser Doppler flowmetry
6) Other methods like venography and oxygen tension methods.

After the fracture unites, the diagnosis of avascular necrosis is usually made if collapse of part of femoral head occurs. This collapse is a definite indicator of avascular necrosis but there are also other indications as shown by Hulth (1956) shows different indication of collapse:

1) Absorption of the head (Mushroom)
2) Secondary varus positioning (ploughing)
3) Relative increase in density
4) Mottled appearance
5) Infarction (late segmental collapse)

6) Resorption of neck

7) Slow union

8) Slipping of the nail (Late)

9) Late onset of arthritis deformans.

Stevans et al (1962) reported that 71% of patients with femoral neck fractures had osteoporosis. Osteoporotic bone has a lower energy absorbing capacity. With trivial injury the bone fractures. Osteoporosis also causes posterior comminution, fracture gap and instability of the fracture. The quality of fixation and stresses, which can be tolerated postoperatively, are related to the severity of osteoporosis. Singh, Nagrath and Mani (1970) gave an index called the "Singh Index" based on trabecular pattern of proximal femur to assess the quality of bone. In this method, antero-posterior roentgenogram of pelvis with hip joints is made in full internal rotation and findings are the graded as follows:

Grade 6: Normal trabecular pattern composed of primary and secondary compression and tension trabeculae, was well as trochanteric trabeculae readily seen.
5) Infarction (late segmental collapse)

6) Resorption of neck

7) Slow union

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Grade 6: Normal trabecular pattern composed of primary and secondary compression and tension trabeculae, was well as trochanteric trabeculae readily seen.
Grade 5: Decrease in the secondary trabecular pattern and Ward's triangle becomes prominent.

Grade 4: No secondary trabecular and tensile and trochanteric trabecular reduced.

Grade 3: Break in continuity of primary tension trabeculae near the greater trochanter.

Grade 2: Reduction in primary compressive trabecular with loss of principal tensile group of trabeculae.

Grade 1: Marked reduction in primary compressive trabeculae.

Although this index is accepted to grade osteoporosis, Kranendonk and associated (1972) have disputed the accuracy of the method. The advantages of Singh's grading are that no special investigation is required to evaluate osteoporosis.

Severe osteoporosis influences the choice of treatment. Higher grades permit better fixation and in these early weight-bearing will also be well tolerated.

In 1961, Garden pointed out that the medial lamellae in the internal weight-bearing system are directed upwards at an angle of only 3-8° with a perpendicular and their endosteal lining forms the
principal source of bone repair after femoral neck fractures. Thus, the purpose of fixation should be to maintain the fragments in an arrangement than maintains lamellae in close approximation. He advocated a low angle nail which pierces and the strong lateral cortex of femur well below the greater trochanter so that the nail lies almost vertical against the buttress of calcar femorale and obtains two points rigid fixation in the distal fragment as advocated by Eaton earlier in 1956.

Kocher (1896) acting on the assumption that fractures of femoral neck will fail to unite, recommended excision of head and neck femur as a form of treatment.

Royal Whitman (1904) voiced a sustained objection to the pessimistic attitude in the treatment of these fractures, and after the introduction of X-rays, suggested careful closed reduction followed by hip spica immobilization. He obtained healing in 89.2% percent of cases, but others using this method have been unable to duplicate these results. Furthermore, this method produced extremely high morbidity and mortality because of prolonged recumbency and immobilization, which aggravated the cardiac, pulmonary and renal complications, often associated with the elderly.
Lorentz in 1919, described bifurcation osteotomy. In 1936, McMurray described an osteotomy with medial displacement of femoral shaft for treatment of femoral neck fractures. Kessels (1955) introduced the osteotomy plate. Since then many types of osteotomies and various designs of implants for fixing them have come up, but they are mainly indicated in cases of femoral neck fractures with established non-union.

Result after this injury apparently depends on

a. Extent of injury, such as

   i. The amount of displacement
   ii. Amount of comminution
   iii. Whether the circulation has been disturbed

b. Adequacy of reduction

c. Adequacy of fixation

Barnes (1976) said that multiple factors affects the outcome of patient with fractured femoral neck i.e., the type of fracture, quality of bone, quality of reduction, quality of fixation and the patients ability to comply with the postoperative regime must be assessed before an appropriate treatment plan can be formulated.
To be considered effective, any treatment must give sufficient fixation of hip to allow immediate weight bearing for rapid physiological and psychological return of normal activity (Cedor, 1980).

Upper end of femur is anatomically and biomechanically a structural marvel. It is most heavily loaded and stressed during function and is only second to lumbar disc in this respect. Restoring the head and neck to the original biomechanically sound structure is challenge forced by the treating surgeons.

The pattern of loading of upper end of femur during physiological activity is cyclical and can never be reproduced in an experimental setup. Variation in local morphological, muscle mass, limb position and other momentary influences continually alter the resultant stress at femoral neck.

During routine one-legged stance with femur underneath the body, there are only compressive stresses, very high along the medial cortex and calcar, and minimal along the superior cortex. In this stance the superincumbent body weight “W” act at an angle of 15° to the vertical in coronal flexion. The resultant force can be resolved in to two components.
Frankel (1984) has shown that the final resultant force would change the fracture into various morphological groups. The high ratio of $F_{\text{axial}}$ to $F_{\text{shear}}$ would cause subcapital fracture, and lesser ratio, would cause high cervical, vertical fractures. Backman’s experience has ruled out any role of rotational stress responsible to femoral neck fracture. Due to very low friction between the acetabulum and head, it was impossible, to cause fracture by torsional stesses.

In Vivo, the total quantum of energy would depend upon gravitational force, muscular force and also force of impact against ground. Muscles may absorb the energy of fall, by elastic and plastic strain in the skeleton system, and the elastic strain in the soft tissues.

In the elderly, poor balance, lack of co-ordination, which itself responsible for fall, result in delaying or even absence of energy absorbing process, especially the stress resisting musculo-skeletal system on the lateral side. In addition osteoporosis reduces energy absorbing capacity of the femoral neck. Thus a large quantum of energy not absorbed by muscles, is expanded on proximal femur which itself is osteoporosed and, therefore, a fracture results.
In the young patient impact is directly over the hip area (e.g. fall from height, RTA, dashboard injury) so the energy dissipation mechanism do not have a chance to act and a fracture results, even when the bones are so strong.

*Effects of fracture reduction on biomechanics –*

Valgus reduction increases the axial force and decreases the shear force acting on the upper end of femur. Axial force tends to impact the fracture and also push the nail out of the neck, hence also known as “Pin extrusion force”.

Varus reduction increases the shearing force, which acting at right angle to the implant induces a bounding force on the implant.

Bending movement ‘V’ = \(N \times \text{force}\)

\(N\) is the distance from tip of implant to head (which acts as fulcrum).

With the increasing values of ‘\(N\)’ varies bounding is magnified, resulting in varus collapse of head neck fragment, on the implant or the cutting out of implant through the superior cortex of the proximal fragment. The strong cortical portion of calcar affords a good buttress to resist the force ‘\(V\)’ (Bending force).
In addition, nail do not provide any compression. Fixed angle nail plate is notorious for penetrating the joint in the event of collapse.

Multiple pin-fixation have an advantage that they are easy to introduce and causes little operative morbidity, blood loss and less time consuming also. Inspite of these facts, multiple pins are not popular because they fail to provide rigid fixation and interfragmentary compression. So implant failure is greater.

It has been stated that the best hip obtainable following a femoral neck fracture is one that has been anatomically reduced, thoroughly impacted and rigidly fixed, but it must heal and escape avascular necrosis or later segmental collapse. Following improved internal fixation devices early weight-bearing can be allowed following secure internal fixation, thus patient can walk without support within few weeks of their injury instead of the previous three months period after injury (Rydell, 1966 and Frankel, 1960). But imperfect technique has no place for this method of treatment. Internal fixation is intended to maintain reduction and when this has not been obtained, the fixation appliances, even if the best, do no more than maintain deformity.
Over the years, many fixation devices have been used to treat femoral neck fractures. Tronzo (19740 illustrated some 77 devices that can be used for fixation of the fractures around hip.

In the search for ideal fixation of femoral neck fractures, a major breakthrough took place when a number of Swiss surgeons joined force in 1958 to establish “The Association for study of Internal Fixation (ASIF)”. Their goal was to investigate the reasons for poor final.

The first report of attempts at internal fixation of femoral neck fractures was by Von Langenbeck in 1950, using silver plate screws. Koning in 1875, used metal nails, Hey Grooves in 1916, used bone pegs. Nicolaysen in 1897 and Lembotte in 1913 made attempts by using various fixation devices, but because of metal incompatibility of material failures, these were less than optimal. As a result, internal fixation fell in some disrepute.

Smith Peterson et al (1931) reviewed the procedures of internal fixation using a triflanged nail made of non-electrolytic metal by open method. Johanson (1932) simplified this technique by introducing the cannulated triflanged nail inserted without open reduction. By this method, Smith Peterson reported a decrease in
mortality from 75% to 25% and an increase in rate of union from 30% to 70%. This gave a new impetus to surgical treatment of femoral neck fractures. Since then, many improvements were made in the internal fixation devices. The revival of internal fixation was made practical by (a) development of relatively non-electrolytic metals after experimental work of Venable, Stuck Beach (1937) and (c) perfection of more efficient roentgenographic control.

In 1964, Garden came out with cross screw method of internal fixation of the fracture. He pointed out that, a single, low angle screw or nail, exerts a forward and upward pressure, within the capital fragment, but when combined with a horizontally placed screw after crossing it anteriorly, the direction of pressure is exerted in a backward and downward direction. This is because the force is being balanced by an upward thrust by the horizontal screw.

Early breakdown of reduction occurred frequently with cross Garden screw fixation. Finally, this fixation did not allow proper setting of the fragments. This, with absorption of the neck, which occurs after fixation, a persistent gap is likely. Also Howard and Davies (1982) reported that this method has resulted in 2.4%
incidence of fracture of femoral shaft at the point of entry of the screw.

Hargadon and Pearson (1963) 100 cases of femoral neck fractures with Charnley compression screw reported by Charnley, Blockey and Purser in 1957. Charnley had developed the concept of Putti, who was among the early investigators to propose fixation of a device with a side plate attached to femoral shaft. His belief that lateral rotation force at the fracture site can be neutralized by a rigid device which, enter the firm subchondral bone of the femoral head and fixes to the strong cortical bone of the femoral head and shaft. This spring loaded compression screw produces compression at the fracture site and allows for bone resorption by extruding. Moreover, is also secures fixation to the shaft of femur. It was observed that the extrusion was small and ceased after 3 months if the fracture was uniting, otherwise the extrusion continued. All cases of nonunion led to extrusion through head as the collapsing head becomes unable to withstand the compression force. The results with this treatment were reported as 65.5% satisfactory. The sliding nail plate of Pugh and Fulloch-Brown proved to be more successful (Brown and Abrami, 1964 Feilding Wilson and Ratzan, 1974).
According to literature available, Von Langenbeck (1878) was the first to treat these fractures by internal fixation. His attempt failed due to sepsis, as antibiotics and concept of sterilization were not known in that era. The method was not accepted by surgeons of that era.

Senn in 1888 obtained a higher rate of union of femoral neck fracture in days by internal fixation.

In (1907) Dacosta reported the use of ordinary wood screws for fixation of femoral neck.

Smith Peterson (1931) is credited for reviving and popularizing the procedure of internal fixation for femoral neck fractures by introducing triflanged nail and reported lower rate of mortality and morbidity and increasing the rate of union from 30% to 70%.

In (1932) Smith Peterson to using technique was simplified by introduction of the cannulated nail by Johnsson. This advancement allowed the surgeons to reduce the fracture blindly using the cannulated nail over a guide pin.

Moore in (1934) and Gaensien, Telson Ransohoff and Knowles in 1936 independently advocated the use of multiple pins
for internal stabilization of fracture neck femur. This is simplest method of internal fixation and can be performed percutaneously under local anaesthesia.

In (1959) King advised fibular bone graft with Smith Peterson nail in patients whose fracture was less than three months old, head was vascular and without much absorption of neck.

In (1945) Virgin and MacAusland introduced a Screw that provided dynamic compression at fracture site.

Inclan (1946) and Patrick (1944) also published their results of Smith – Peterson nailing and fibular grafting, reporting 10% to 15% of Non – union and avascular necrosis.

In (1559) Degete described his Multipin method and stressed vigorous impaction and early ambulation after surgery. The reported 100% rate of union in femoral neck fracture.

In 1950 King compared the results of osteotomy and osteosynthesis by S. P. Nail conclude that:

1. The success rate 69% with nailing alone, 71% and bone grafting and 72% with primary osteotomy.
2. Incidence of avascular necrosis in less after primary osteotomy i.e. 4% as compared to 28% after nailing and bone grafting.


In 1961 Garden R. S. observed that Medial weight bearing trabeculae are directed at Angle of 3-8 degree to the perpendicular axis of femur.

William D. Arnold (1974) treated intracapsular fracture neck femur by close reduction and percutaneous multiple pin fixation. He stated that this technique is simple safe and reasonable effective method of treatment of non-pathological fractures neck femur.

Martens et al (1979) showed that internal fixation with multiple Knowles pin has a high rate of failure unless the most distal screw rests on the cortical bone of the medial aspect of the femoral neck.

Mark F. Swientkowski (1975) studied the results of osteosynthesis in femoral neck fracture by closed reduction and internal fixation by 6.5mm cancellous screws.

Schwartz, N. (1981) reported that lag screw osteosynthesis using more than 2 screws in a parallel position has proved, both theoretically and practically, to be a useful method of treatment. The caudal screws increase the stability due to their position on the caudal rim of femoral neck, while the cranial screws ensure against rotation and exertion of tensile force.


D.J. Wood; D.W. Gate and J. Stevens (1991) fixed subcapital femoral fractures by Asnis guided system. A total of 84 patients with 86 fractures underwent closed reduction and internal fixation with the Asnis guided screw system of the 84 patients, 81 were followed up for at least 1 year after surgery or until death. There were 12 failures based on clinical and radiological features, all of which were in displaced fracture, nine patients underwent revision surgery.

In 1989 Lars Rehnbergand and C. Olerud designed the new method of internal fixation with self tapping cannulated screw which could be used over guide pin. It provides compression and rigid fixation at fracture site. It reduced the mechanical complication of internal fixation of femoral neck fractures.

Lindequist, S.; Wredmark, T.; Eriksson, S.A.; Samncgard, E. (1993) evaluated the influence of different screw positions on the stability of fixation in femoral neck fractures and suggested that a posterior position with cortical support for the proximal screw, compared to a central screw position with only cancellous bone support increases the stability of femoral neck fractures.

Peter, R.E.; Fritschy, D. (1993) reviewed that internal fixation with three cancellous screw provides good mechanical stability without compromising head vitality when compared to other implants.
Raulcau, J.P.; Slasier, R.S.; Taai, E.; Coldstein, S.A. (1994) reported that one major advancement is the treatment of femoral neck fractures has been the development of cannulated screws.

Poulsen, T.D.; Overses, O.; Anderson, I. (1995) reported that percutaneously introduced double screw osteosynthesis is at least as effective as sliding screw plate osteosynthesis.


Both K.C. Donaldson; T.K. Dai (1998) did experimental work and compared the results of conventional central fixation with calcar screw placement and reported more stability with calcar fixation.

Gautam, V.K.; Anand, S.; Dhavan, B.K. (1998) documented that in young adult primary open reduction by Watson Jones approach and internal fixation with 3 cancellous screw of displaced femoral neck fracture can be recommended as the treatment of choice.
Nagi, Dhillon, Goni (1998) recommended open reduction internal fixation an fibular autografting for the treatment of neglected fractures of the neck of femur in young adults to reduce resorption of neck, AVN and nonunion.

Jukkala- Paotio, K.; Partio, E.K.; Hele Virta, P.; Pohjonen, T.; Tormala, P.; Rokkaness, P. (2000) reported that cancellous bone fractures of femoral neck have been treated successfully with bio-absorbable polyglycoside and poly-L-Lactide implants. In this study bio-absorbable poly-L-Lactide lag screw and metallic screws were compared in the fixation of subcapital femoral neck fractures. The ability to walk and the range of movement were better after bioabsorbable fixation self reinforced poly L-Lactide lag screw can be used safely to fix subcapital femoral neck fractures in Garden stage I and II fractures and in younger patients in Garden III fractures.

Parker, M.J. (2000) said that intracapsular fracture should not be thought of as the unsolved fracture.

Complications like non-union, avascular necrosis and failure of fixation resulted in significant patient morbidity. Scared with these complications, surgeons like Austin Moore in 1940, started
the replacement of head of femur even in fresh fractures by using his vitallium prosthesis.

Nicoll (1963) in his editorial criticized the routine use of prosthesis in all fresh femoral neck fractures as replacement had many complications like protrusion of head into acetabulum, loosening and ectopic bone formation. In 1964, Boyed and Salvatore after a comparative study of internal fixation of femoral neck fractures and replacement by endoprosthesis observed that no prosthesis is as good as patient’s own head and that replacement has very limited indications in a small group of elderly patients.

The history of arthroplasty of the hip may be considered in five major historical phases; osteotomy arthroplasty, interpositional arthroplasty, reconstructive arthroplasty, replacement arthroplasty and total arthroplasty.

The history of arthroplasty begins with John Rhea Barton of Lancaster, Pennsylvania, who performed an osteotomy on an ankylosed hip in 1826 and maintained motion at the site by manipulation following osteotomy.

Many surgeons in Europe and the United States attempted interpositioning arthroplasty at the turn of the century by placing a
variety of materials between the articulating surfaces of the hip joint. An arthroplasty of this type performed by Smith Petersen in 1923 led to the clinical success of cup-arthroplasty, and he must be credited with proving that the acetabulum could tolerate a foreign body performing a weight bearing function as a method for arthroplasty.

Around the turn of the century, many surgeons used reconstructive procedures involving, the acetabulum and the upper femur with the hope of formation of pseudarthrosis. Brakett, Whittman, Magnusen, Colonna, Jones, Girdlestone and others are responsible for the development of arthroplasty of the hip without any formal interpositioning material.

The Judget brothers contribution was significant because it proved that mechanical replacement of the hip can be tolerated, a concept subsequently refined by Frederick Thompson of New York and Austin Moore of South Carolina.

The concept of total hip arthroplasty is credited to many surgeons, with Wiles, Haboush, Mckee, and Charnley among the early pioneers in the field. It must be recognized, however, that Charnley’s major contribution to the understating of total hip
replacement, a milestone in the history of orthopaedic surgery, includes the introduction and popularization of acrylic cement for fixation an high density polyethylene plastic as bearing material of the socket. Charnley’s work has had a worldwide influence on many surgeons and engineers who are today working to identify the inherent problems in total joint replacement and to improve existing methods and materials.

Different types of Osteotomies with or without fixation have been done from time to time. It was in 1826 that John Rea Bolton of Philadelphia performed an osteotomy between the greater and lesser trochanter, in a sailor with ankylosed hip joint due to an old fracture and infection.

Anthony White (1882) of London performed a similar intertrochanteric osteotomy. Afterwards many workers like Borvier (1835) Langenback (1854), Brodhurst (1865), and Adam (1869) performed osteotomies.

In 1963, Lewis, A. Sayere did an osteotomy for ankylosis for hip by removing a block of bone. He called his procedure a modification of Barton’s osteotomy.
In 1979, Gant performed an abduction subtrochanteric osteotomy which still has its name. In 1991, Lorenz reported an unusual bifurcation operation, which was a modification of the Kirmisson’s operation (1894). This was done mainly to secure instability in case of old unreduced congenital dislocation and old hip fracture.

Schanz (1922) reported a low subtrochanteric abduction osteotomy to secure better stabilization in an old hip fracture and for unreduced congenital dislocation.

One of Schanz’s pupil- Pauwels (1270) recognised that a non-union of femoral neck fracture would consolidate within few months if shearing force acting on the non-union were transformed into a compression. Even today Pauwels principle for re-orienting the non-union at right angle to resultant force by resecting a laterally based wedged of bone, retains its validity. Pauwels used an abduction cast to stabilize his osteotomies.

Among another techniques developed for treatment of femoral neck fracture, McMurray’s intertrochanteric displacement osteotomy (1937) used for old ununited fracture as a salvage
procedure. However, later many surgeons including McMurray (1938) used it as a primary treatment for fresh fractures.

Ettor (1936) McMurray (1938) Dawkins (1941) and Blount (1943) proposed primary osteotomy as a big improvement on simple nailing.

In 1941, Henry Milch described a pelvic support abduction osteotomy.

Blount (1943) advised internal fixation of fracture and osteotomy for established nonunion of femoral neck fracture.

In 1944 Lead Better described an axial displacement osteotomy for osteoarthritis of hip and ununited fracture of neck of femur.

Dickson (1947) suggested a high geometric osteotomy and bone graft for femoral neck fracture.

De Plama (1950) recommended a wedge osteotomy.

Mcnour (1953) advised wedge osteotomy with nail plate fixation.

Kessels (1955) introduced osteotomy plate.
Retliff (1962) considered the primary osteotomy in cases of displaced femoral neck fracture in children less than 10 years of age and in older children where a good reduction of fracture can not be achieved.

Muller and Thomas (1979) described repositioning osteotomy with double angled A/O blade plate fixation.


Mani described repositioning osteotomy with dynamic hip screw, double angled barrel plate in non-united fracture neck femur.