

## **Neglected Fracture Neck of Femur : Its Staging/ Classification and its Role in Predicting the Outcome of Treatment by Osteosynthesis**

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### **Abstract**

In a retrospective study of 500 patients of femoral neck fracture of more than 3 weeks duration treated by various operative procedures aimed at preserving the hip joint, it was observed that the results of these procedures were influenced by changes which had occurred at the fracture site with passage of time. These changes were a) The fracture surface became smooth and cortical. b) The femoral neck got absorbed resulting in increase in the fracture gap and decrease in size of the proximal fragment. c) The femoral head in some cases started showing radiological signs of avascular necrosis. Based on these changes the fracture was staged/classified into stage I, II, III. When this staging was applied to the 500 patients operated by different procedures in the retrospective study it appeared to be appropriate and of predictive value. In a prospective study, 202 patients of femoral neck fracture of more than 3 weeks duration. 53 in Stage I, 140 in stage II, and 9 in stage III were treated by closed reduction and internal fixation with cancellous screw and the free fibular graft. The fracture united in all the 53 patients in stage I, in 125 out of 140 in stage II and 3 out of 9 in stage III. On an average follow up of 7.25 years (range 2-16 years) it was observed that the hip joint achieved highly satisfactory function and the joint remained free of symptoms in 171 (95%) patients.

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## Introduction

In spite of advances in the management of skeletal trauma fracture of femoral neck continues to be a problem for the Orthopaedic Surgeon. The characteristics which make it a problem fracture are (a) fracture surfaces are exposed to the synovial fluid and its enzymes, (2) disruption of blood supply to femoral head and (3) high shearing strain to which it is subjected. As a result of these a displaced femoral neck fracture does not unite unless it is accurately reduced and internally fixed. The problem becomes further complicated if the treatment is delayed. From practical point of view, if this fracture remains untreated for 3 weeks or more, it is designated as neglected fracture because internal fixation alone has a very high failure rate. In order to achieve union in such cases internal fixation has to be combined with some type of bone graft or osteotomy.

In the developing countries including India it is not uncommon to see patients reporting late for treatment and quite a few of them are young below the age of 55. In Western countries such cases are treated by replacement arthroplasty. Majority of population in India have to squat or sit in cross legged position for activities of daily living and religious customs. The movements required to adopt these postures are neither possible nor permissible in artificial joints available. It is therefore desirable to

preserve the hip joint particularly in young patients. Many operative procedures (1,3,4,7-10,12-16,18-21,23-25,28,29,32) have been tried in this respect with varying degree of success and quite often unpredictable outcome. It was hypothesized that the changes which occur in the region of fracture with the passage of time have influence on the outcome of these procedure. A study was planned to work on this hypothesis.

## Material And Methods

The present study has been carried out in two parts 1) A retrospective study of patients of neglected fracture neck of the femur already operated by different methods, and the results achieved; 2) A prospective study of patients treated by closed reduction internal fixation and free fibular graft.

Retrospective study: Five hundred consecutive patients operated during 1962-1985 (including those operated by other surgeons, but reported to the author for the opinion) by different methods were studied and results analysed (Table 1).

Study of preoperative and postoperative skiagrams of these patients revealed that the results of these operative procedures depended largely upon the changes which had occurred at the fracture site with the passage of time (Fig. 1a-d). These changes were:-

- a) The fracture surfaces became smooth and cortical.



**Table 1**

Results of various operative procedures performed for neglected fracture of femoral neck (retrospective study)

Operative procedure	No. of cases	Union of fracture
McMurray's osteotomy	327	112
ORIF with screws and bone muscle pedicle graft	78	66
Abduction osteotomy with internal fixation	43	33
Internal fixation alone	52	6

- b) Femoral neck got absorbed resulting in decrease in the size of proximal fragment and increase in the gap between the fragments.
- c) Femoral head in some cases started showing signs of avascular necrosis (AVN).

Based on these changes neglected fracture was classified/ staged as follows (Fig. 1a-d):

**Stage I:**

- a) The fracture surfaces were still irregular (fresh)
- b) The size of the proximal fragment was atleast 2.5 cm or more (as measured from upper part of fovea centralis to the middle of the fracture surface).
- c) Fracture gap was 1 cm or less.
- d) The femoral head did not show any radiological sign of AVN.

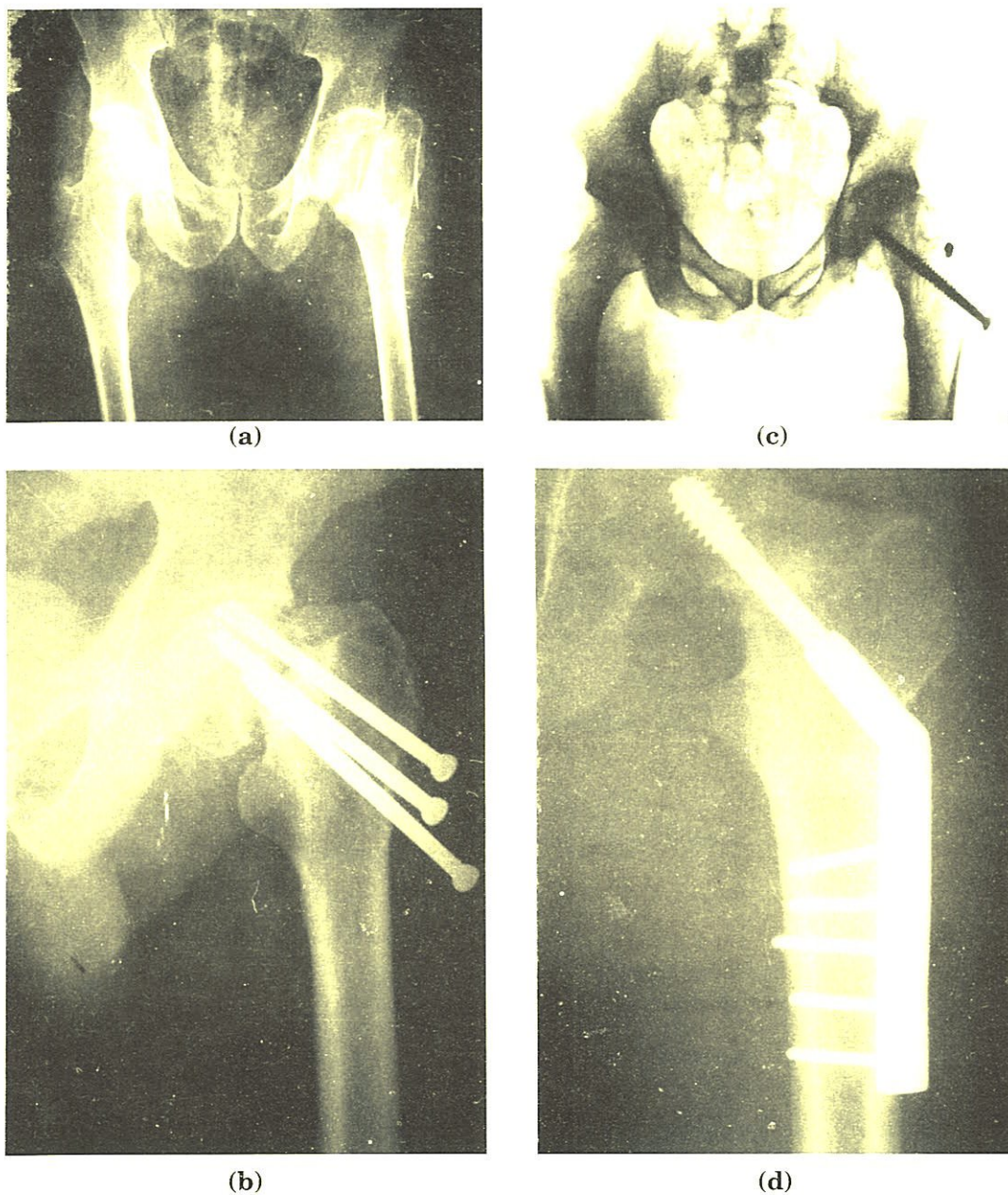
**Stage II:**

- a) Fracture surface had become smooth (cortical)
- b) Size of the proximal fragment was 2.5 cm or more.
- c) Fracture gap was more than 1 cm but less than 2.5 cm.
- d) Femoral head did not show any radiological sign of AVN)

If either of feature a or c was present the fracture was placed in stage II.

**Stage III:**

- a) Fracture surfaces had become smooth (cortical).
- b) The size of the proximal fragment was less than 2.5 cm
- c) The fracture gap was more than 2.5 cm
- d) The femoral head showed radiological signs of AVN.



**Figure 1** (a) Skiagram 6 years after McMurray's osteotomy in a patient of femoral neck of 6 months duration. Fracture not united. (b) Skiagram 8 months after closed reduction and internal reduction with multiple screws in a patient with fracture of femoral neck of 5 months duration. Fracture not united. (c) Skiagram 7 years after open reduction and internal fixation and bone muscle pedicle graft in femoral neck fracture of 7 weeks duration. Fracture united. (d) Skiagram 2 years after open abduction osteotomy and internal fixation in a patient of femoral neck fracture of 12 weeks duration. Fracture united



If any of the b, c or d feature was present the fracture was placed in stage III.

operative procedures, it appeared to be appropriate as would be clear from Table 2.

When this classification was applied to these 500 cases treated with different

**Table 2**

The results of 500 patients of neglected fracture neck of the femur treated by different methods in stage I, II and III

Method treatment	Stage I	Sage II	Stage III
McMurray's osteotomy	112/102 (91.7%)	123/0 (0%)	92/0 (0%)
ORIF with screws and bone muscle pedicle graft	23/22 (95.6%)	55/42 (76%)	—
Abduction osteotomy with internal fixation	30/28 (93.3%)	9/5 (55%)	4/0 (0%)
Internal fixation alone	18/6 (33.3%)	34/0 (0%)	—

**Note :** Number of patients/number of fractures united

A prospective study was carried out

- To test the validity of this classification/staging.
- Level of function achieved by osteosynthesis.
- Durability of the pain free hip joint after union of fracture.

### Prospective study:

This study is based on 236 patients of neglected femoral neck fracture examined at Dr. KSM Orthopaedic Hospital and HS Othopaedic Hospital and Superspecialty Research Centre, Amritsar from January, 1990 to December, 2004. The duration of fracture varied from 3 weeks to 22 years with an

average of 29 weeks. Average age of these patients was 36.5 years (range 22-70 years). Fifty two (22.03%) were restricted to bed, 142 (60.1%) were walking with support and 42 (17.8%) without any support. There was shortening of 1.5-4.5 cms (measured in lying down position) with an average of 2.8 cms. Movements were painful and resented in 52 patients

while in rest flexion of 70-130 degree. Abduction, adduction and rotation varied from 10-80% of the normal side. Forty two patients who were walking without support could squatt and sit in cross legged position.

X-ray pelvis with both the hip joint in as identical position as possible was taken and studied for:

1. Fracture margin for any smoothening.
2. Absorption of neck of femur resulting in the gap between the two fragments.
3. Size and density of the proximal fragment.

In addition to plain X-ray MRI or spiral CT was taken in 96 patients and the following observation were made:

1. Exact measurement of gap between the fragments.
2. Size of the proximal fragment as measured from the upper part of fovea centralis to the middle of fracture margin.
3. Any sign of AVN i.e. increased marrow signal on T2W1 of the proximal fragment; double line sign, fragmentation and collapse of the head of the femur.

On MRI in some patients absorption of femoral neck was more marked in the centre of the proximal fragment than towards periphery giving it the shape of

a cup or moon hence all measurements were taken from the centre of fracture margin.

Based on these changes it was possible to allocate the fracture to one of the three above mentioned stages (Fig. 2a-d) :

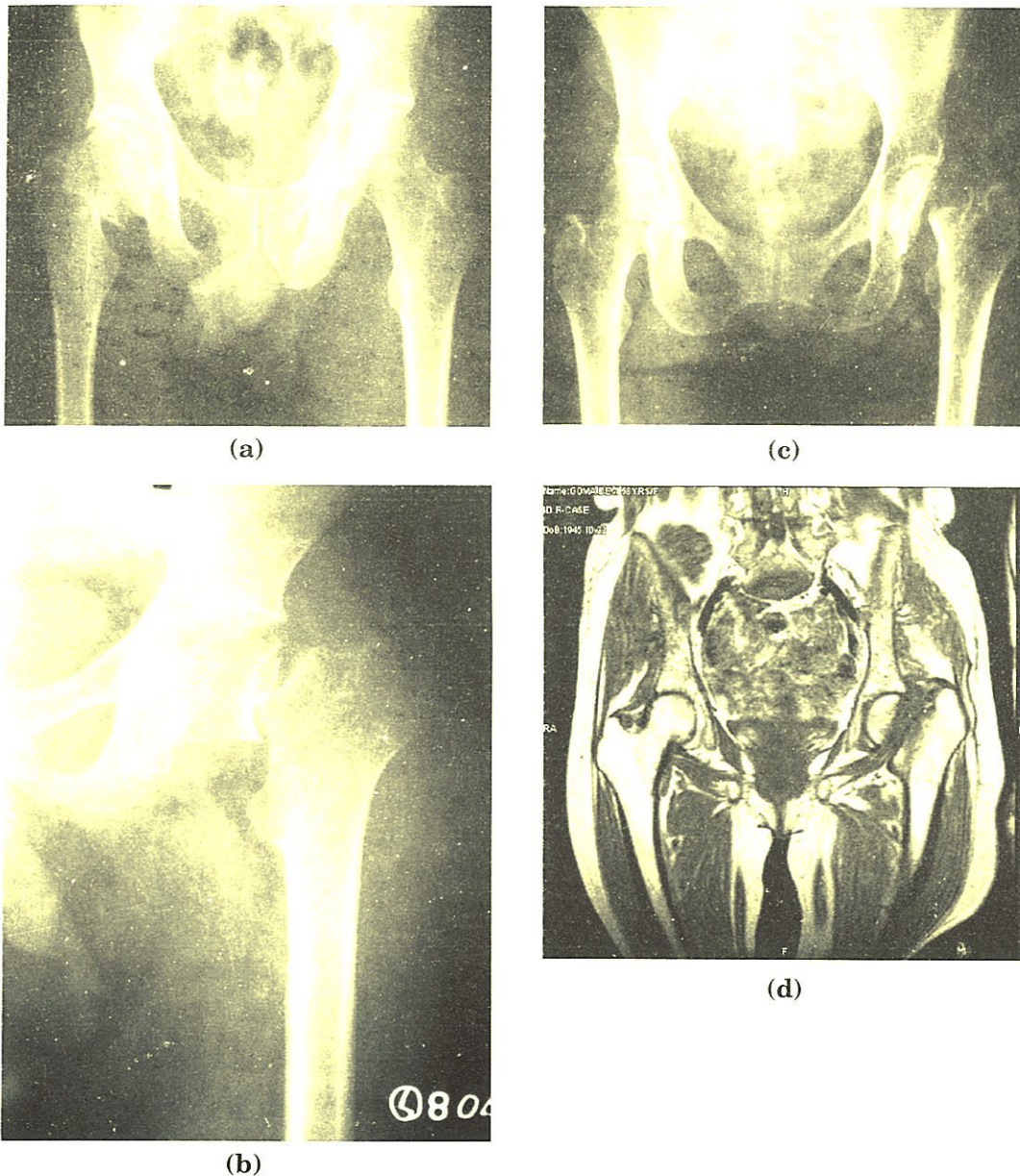
Out of 236 patients 53 (22.4%) were allocated to stage I 140 (58.2%) to stage II and 43 (18.4%) to stage III. It was also observed that while stage I lasted upto 12-16 weeks duration stage II continued for many weeks or months (upto 2 years) in some cases.

#### **Treatment:**

The operative procedure undertaken to test the validity of this staging/ classification and level of hip function achieved and duration of pain free hip closed reduction of the fracture and osteosynthesis with cancellous screws and free fibular graft.

Out of 236 patients, 202 (72.9%) patients were treated by closed reduction and internal fixation with cancellous screw and free fibular graft. Fifty three patients were placed in stage I, 140 in stage II and 9 in stage III. In 163 (80.76%) patients one cancellous screw and double fibular graft and in rest 39 (19.3%), two cancellous screw and one free fibular graft was given. Excluded from this treatment were 34 patients who were either treated by different operative procedure or did not receive any treatment. Duration of fracture in





**Figure 2** (a) Skiagram of fracture femoral neck of 3 weeks duration fracture surfaces are still fresh. – Stage I (b) Fracture of 20 weeks duration. Fracture margin have become smooth and sclerosed.- Stage II (c) Fracture of 2 years duration. Fracture margins are sclerosed. Femoral neck is absorbed. Size of approximal fragment is less than 2 cms and femoral head showing signs of AVN – Stage III. (d) MRI of the same patient, fracture gap is 2.5 cms. Size of approximal fragment is 2.2 cms and head shows signs of AVN.

these 202 patients was 3 to 118 weeks (average 19.8 weeks). There were 138 (68.3%) male and 64 (31.7%) female patients. Their average age was 32.5 years (range 22-55 years). Fifty two (25.7%) were restricted to bed while 150 (74.3%) had started walking and 142 with support and 8 without support. Average shortening of the limb was 2.4 cm (range 1.5 to 3.5 cm). Movements of hip were painful and resented in 52 while in rest of 150 flexion of 70-90 degree was possible.

All the 140 patients in stage II and 9 patients in stage III were treated by closed reduction, internal fixation with one cancellous screw and double fibular graft, while out of 53 patients in stage I, 39 were treated by 2 cancellous screw and one fibular graft and 14 were treated by one screw and double fibular graft.

#### **Preoperative Treatment**

Skin or skeletal traction was given for 3-7 days to bring down the greater trochanter (distal fragment).

#### **Operative technique:**

Operative procedure was carried on fracture table under C-ARM control. Fracture was reduced by traction and internal rotation. Through a lateral longitudinal incision femur was exposed subperiosteally in subtrochanteric region. After drilling a cancellous screw was passed from subtrochanteric area to the subchondral region of the head of femur. Two guide wires were passed into the neck in the same way in relation to the

screw and suitable tunnels were created over these guide wires using triple reamer. Two fibular grafts taken from the same side were threaded over these guide wires reaching subchondral region of the head. When osteosynthesis was carried out with 2 screws and one free fibular graft, the graft was threaded on one guide wire and other was replaced by cancellous screw. Wounds were closed over suction drains.

#### **Postoperative:**

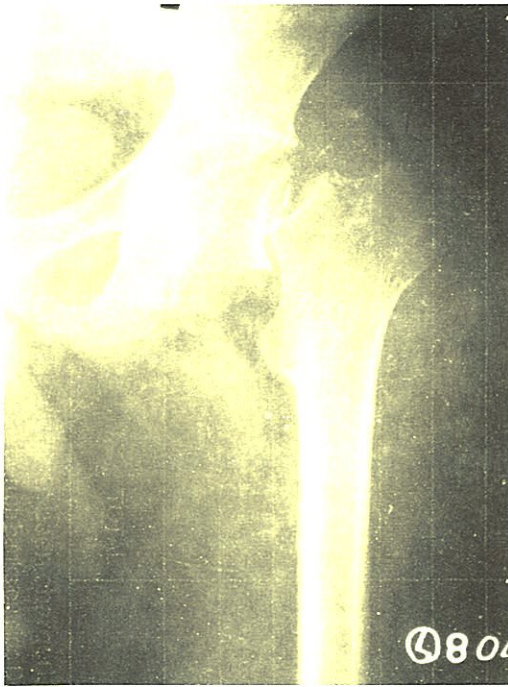
Skin traction was given for 2-4 weeks, antibiotics were given for 3-7 days. Drains were removed after 48 hours and stitches on the 12th day. Walking with support without weight bearing was permitted after 3-4 weeks. Gradual weight bearing was started after radiological union of fracture.

#### **Follow up and results:**

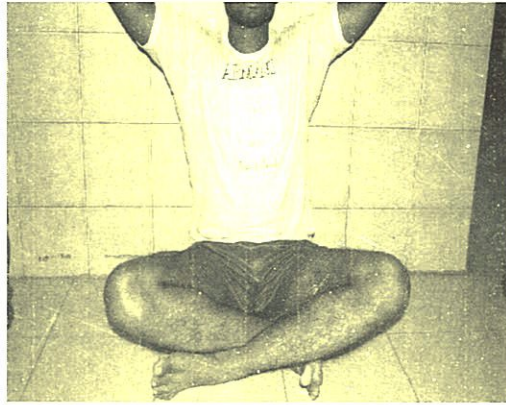
Average follow up of these patients was 7.25 years (range 2-16 years). The fracture united in all the 53 patients operated in stage I in 18-24 weeks. Out of 140 patients belonging to stage II, 125 (89%) united and among 9 patients treated in stage III, 3 (33.3%) united in 20-28 weeks time.

The range of movements regained in 181 successful patients were flexion 90-100% of the normal side. Abduction and adduction 60-100% and rotation 40-100%. There was shortening of 0.5-1.5 cm in 21 patients. All 181 patients could squat and 154 sit in cross legged position (Fig. 3a-d).





(a)



(c)



(d)



(b)

Figure 3 (a) Femoral neck fracture - Stage II of 6 months duration. (b) Skiagram 4 years after osteosynthesis with cancellous screw and double fibular graft. (c&d) Patients sitting in cross legged position and squatting.

Causes of failure were avascular necrosis in 6, inadequate length and improper placement of graft in 7. Fracture of graft due to early weight bearing (before fracture united) in 7, deep seated infection in 1.

#### **Late complications:**

Two patients had late collapse of the head of the femur, 5 showed radiological signs of osteoarthritis. Three of these became symptomatic after 7, 10, 11 years and have undergone total hip replacement. Remaining 178 patients are having same life style as before the fracture. One hundred and seventy one patients (94%) have remained clinically free of symptoms and radiologically normal for a period of 2-16 years (average 7.25 years) after operation.

Complication at donor site: There was temporary weakness of extensor hallucis longus in 9 and permanent in 2.

#### **Discussion**

Neglected fracture neck of the femur is a problem faced by orthopaedic surgeons in the developing countries where patients report late for proper treatment. Occasionally it may be seen even in developed countries where the diagnosis is missed in a case of polytrauma or unconscious patient. Internal fixation alone having high incidence of non-union has to be combined with some type of bone graft or osteotomy. A retrospective study of 500 patients of femoral neck fracture treated by different methods of osteosynthesis

aimed preserving the hip showed unpredictable results. Union of femoral neck fracture was achieved in 112 patients of 327 treated by McMurray Osteotomy, in 66 out of 78 patients treated with open reduction and internal fixation and bone muscle pedicle graft and in 33 out of 43 with abduction osteotomy and internal fixation. Internal fixation alone achieved union in only 8 patients out of 52. Study of pre-operative and follow up skiagrams of these patients revealed that the changes which occurred in the region of fracture with passage of time played an important role in the final outcome of the methods of treatment mentioned above.

The changes which were observed to influence the end results of these methods of treatment were (a) the fracture surface become smooth and cortical (b) femoral neck got absorbed leading to increase in fracture gap and decrease in the size of proximal fragment (c) the femoral head in some cases showed radiological signs of AVN. It was possible to stage/classify the fracture on the basis of these changes, into 3 stages. Although some classifications (5,6,11,17,21) for fresh femoral neck fractures are available yet there has been none for the neglected one. These are not applicable to neglected fractures as Stage I of neglected fractures starts where stage IV of Garden's Classification ends. When this staging was applied to the group of patients in retrospective study it is appeared to be quite valid as would be clear from the fact that



McMurray's osteotomy achieved union of fracture in 102 out of 112 (91.7%) patients placed in stage I and none of 123 placed in stage II and 92 placed in stage III. Open reduction and internal fixation with bone muscle pedicle graft resulted in union in 22 out of 23 patients (95.6%) in stage I and 42 out of 55 (76.4%) in stage II. Abduction strotomy with internal fixation succeeded in achieving union of fracture in 28 out of 30 patients (93.3%) in stage I and 5 out of 9 patients (55%) in stage II and non out of 4 in stage III. Internal fixation alone achieved union of fracture in 6 out of 18 patients (33.3%) in stage I and none out of 34 patients in stage II.

Prospective study carried out in 202 patients treated by closed reduction and internal fixation with cancellous screw and free fibular graft, double or single confirmed the validity of staging as would be clear from the fact that fracture union was achieved in all the 53 (100%) patients operated in stage I, in 125 out of 140 (89.2%) in stage II and only in 3 out of 9 (33.3%) in stage III.

In India where people are required to squat and sit in cross legged position, it is important to preserve the hip particularly in young patients below the age of 55. There are many operative procedures being practiced to achieve this. Meyer *et al* (15), Bakshi *et al* (1,3) used open reduction internal fixation and bone muscle pedicle graft. Nagi *et al* (18-20), Gautam *et al* (7) used open reduction and internal fixation and free fibular graft. Lecroy *et al* (10) used open

reduction vascularised fibular graft. Sandhu *et al* (24-26) used closed reduction, internal fixation and free double fibular graft, Maghu *et al* (12) carried out abduction strotomy and internal fixation. All these procedure can achieve union of fracture in very high percentage of patients in stage I. In stage II open reduction freshing of fracture surfaces, internal fixation and bone muscle pedicle or fibular graft or closed reduction and internal fixation with cancellous screw and double fibular graft can achieve union of fracture in quite high percentage of patients. In stage III where either the femoral head has become necrotic or the size of the proximal fragment is less than 2.5 cm i.e. it cannot give grip to the implant as well as graft, any operative procedure aimed at union of fracture is likely to have high percentage of failure.

In the present study, restoration of function after osteosynthesis has been quite satisfactory as all the 181 patients in whom union fracture was achieved were able to squat and 154 could sit in crossed legged position and continue to have same occupation. The hip joint remained free of signs and symptoms of degenerative changes in fairly high percentage of patients (171 out of 181 patients) over an average of 7.25 years (range 2-16 years). Any osteoartheritic changes which occur over a long period can be treated by various lines of treatment available including total hip arthroplasty.

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