

Case Series

Evaluation of transtrochanteric rotational osteotomy for avascular necrosis of hip: a case series

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ABSTRACT

Osteonecrosis, also referred to as avascular necrosis (AVN), aseptic necrosis and ischemic necrosis, is not a specific disease but rather a condition in which a circumscribed area of bone becomes necrotic as a result of a loss of its blood supply. The femoral head is the site most often affected and its frequent cause is a displaced fracture through the femoral neck. This is a case-series study that has been done on 9 patients (10 hips) with clinical and radiological evidence of osteonecrosis of head of femur. After treatment patients were followed clinically and radiographically at 1 to 3 months intervals during first year after the operation and at 3 to 6 months intervals thereafter. Out of 9 study subjects, 7 (77.7%) were male and 2 (22.2%) were female. Mean age was 40 ± 7.5 . Among 7 (70%) hips, cannulated cancellous screws were used and dynamic hip screw were used in 3 (30%) hips. Majority of the cases, 4 (40%) had more than 2 mm of progressive collapse of transported intact area in their latest follow up. Transtrochanteric rotational osteotomy procedure is valuable and needs to be tried by new genre of orthopedician as it helps in clinical improvement of patient and might also delay the necessity for total hip arthroplasty.

Keywords: Avascular necrosis, Femoral head, Transtrochanteric rotational osteotomy, Hip

INTRODUCTION

Osteonecrosis, also referred to as avascular necrosis (AVN), aseptic necrosis and ischemic necrosis, is not a specific disease but rather a condition in which a circumscribed area of bone becomes necrotic as a result of a loss of its blood supply. The femoral head is the site most often affected and its frequent cause is a displaced fracture through the femoral neck.¹ Non traumatic AVN of femoral head is a devastating disease and still an unsolved orthopaedic problem. Its most commonly identified etiologic factors are high doses of corticosteroids and chronic, excessive alcohol intake.

In approximately 70% of idiopathic cases, subtle coagulopathies are present.² Chemotherapy, alcoholism, post trauma, caisson disease (decompression sickness), vascular compression, hypertension, vasculitis, arterial embolism and thrombosis, damage from radiation, bisphosphonates, sickle cell anaemia and Gaucher's Disease etc are also attributed to cause AVN. A number of procedures have been described to preserve and not replace the femoral head. Although an accurate comparison of their relative effectiveness is not yet available, surgical treatment of osteonecrosis in general yields better results than protected weight bearing and symptomatic management.

Osteonecrosis of the femoral head (ONFH) presents a clinical challenge because of its inconsistent and suboptimal results with head-preserving procedures. Although head-preserving surgeries such as core decompression and vascularized and non-vascularized grafting appear to delay the progression of collapse and subsequent arthritic changes, in these studies the indications vary in terms of etiologic factors, radiographic staging or indications for surgery and the survival rate of the femoral head decreases with increase in size and stage of the lesion. Whichever procedure is selected, a better outcome will be achieved if the condition is diagnosed and treated early before femoral head collapse.

The primary goal of osteotomy in the treatment of osteonecrosis is to shift the necrotic segment of bone out of the region of major weight bearing and to replace it with normal bone and cartilage. The effectiveness of conventional angulation osteotomies is necessarily quite limited by the amount one can alter the normal neck shaft angle without impairing motion and function of the hip. However, this is not encountered when performing rotational osteotomies. The head can be rotated 90° or more around the head neck axis without interfering with hip function. Thus, these osteotomies should be more effective in shifting normal bone and cartilage into the major weight-bearing region.

In 1967, a study described a double intertrochanteric osteotomy to accomplish this. However, by 1977, the clinical results with this procedure were no better than with conventional angulation osteotomies and abandoned it.³ In 1973, a study reported a different type of transtrochanteric anterior rotation osteotomy. Many studies on these procedure results in hips treated before significant femoral head collapse, were quite gratifying. In some instances, this might be explained by deviation from the specific indications for the procedure, the complicated operative technique, or the postoperative regimen outlined.^{4,5}

In most instances, osteonecrosis involves the anterosuperior aspect of the femoral head, leaving the posteroinferior portion relatively intact. By rotating the femoral head anteriorly, the necrotic segment is removed from the region of major weight bearing and replaced with relatively normal bone and cartilage. Occasionally, rotation posteriorly rather than anteriorly will more effectively accomplish this goal. Varus or valgus can be added to the rotation. The exact plane and alignment of the osteotomy can be determined from a careful measurement of preoperative radiographs. A critical point is the absolute necessity of maintaining the blood supply to the femoral head by preserving the vascular pedicle of the medial circumflex femoral vessels, which is located beneath the quadratus femoris.^{1,6}

Rotational osteotomy is indicated for the treatment of early to intermediate stages of osteonecrosis of the femoral head in which the acetabular cartilage is relatively unaffected. There must be sufficient normal bone and cartilage in the femoral head so that after rotation the intact segment

occupies at least 36% of the weight-bearing surface of the acetabulum. Contraindications include whole-head necrosis, significant degenerative changes in the femoral head or acetabulum, and poor general health.^{1,7}

With the above background, the present study was conducted to evaluate transtrochanteric rotational osteotomy for Osteonecrosis of the femoral head in terms of functional outcome of this surgery and prevention of progression of disease and to determined complication rate for TRO.

CASE SERIES

Study population, setting and data collection

The present case series study reviewed 9 patients (10 hips) with clinical and radiological evidence of osteonecrosis of head of femur attending the department Of Orthopedics, Government Medical College and Hospital, Ambikapur, Sarguja (C.G) India from October 2020 to March 2021.⁷ men and 2 women with the average patient age of 40 years Grade II and Grade III osteonecrosis of femur, combined necrotic angle (AP and lateral x-ray) of less than 2000 and patient not received any sort of previous surgical intervention for AVN of hip were included in the study. Diagnosis was done on the basis of clinical features, imaging for osteonecrosis (x-rays, MRI) and laboratory tests. Ethical consideration was made through Institutional ethical committee and informed consent was taken from the subjects prior to study.

Preoperative planning

The amount of posterior or anterior intact area was evaluated and rotation was planned accordingly. The ratio of the intact to the total area was calculated.⁴ Anterior TRO was performed in 6 hips and posterior TRO was performed in four.

Surgical technique

Patient lying in lateral position in a radiolucent fracture table, lateral skin incision of 7 to 10 cm was given and the capsule of the hip joint was exposed through a lateral approach. The greater trochanter was osteotomized and reflected proximally with the attached tendons of gluteus medius and minimus and piriformis muscles. (Figure 1) The short external rotator muscle tendon units attached to the intertrochanteric area were transacted and the joint capsule was widely exposed anteriorly and posteriorly. Posterior branch of middle femoral circumflex artery at the anterior edge of quadratus femoris was carefully protected. Joint capsule was incised circumferentially near the acetabular rim. Two large pins were inserted in the greater trochanter from lateral to medial in a plane perpendicular to the femoral neck and roentograms were made to confirm the sites of the pins and that of planned osteotomy. Power saw was used to make a transtrochanteric osteotomy 10 mm distal to intertrochanteric line at 90 degree to the long axis of femoral neck. A second osteotomy at right angle to

the first at the superior edge of lesser trochanter was made leaving the lesser trochanter with the distal fragment. This helped in supporting the proximal fragment after rotation. (Figure 2) In patients who had extensive lesions intentional varus positioning in addition to rotation was achieved by inclination of osteotomy plane. After completing the second osteotomy, femoral head and neck down to intertrochanteric line were freed of any bony attachments to the remaining femur. With the help of proximal pin the femoral head was rotated anteriorly between 45 to 90 degrees or posteriorly between 95° to 135° depending upon the size of necrotic area that was required to be rotated away from the weight bearing position.

Fixation device

The osteotomy was internally fixed either by Canulated cancellous screw and washers or with Dynamic Hip screw. Greater trochanter was reattached by large screw or wire. A set of roentogram was made before wound closure to confirm that the necrotic area of femoral head was loaded off from the weight bearing area.

After treatment

Patients were kept in skin traction of 2 kg for first weeks and then for additional 2 weeks at night only. Intermittent quadriceps and active range of motion exercises were started as soon as pain tolerance allowed. Non weight bearing crutch walking was encouraged after 2 weeks for a minimum of 3 months followed by partial weight bearing for another 3 months. Crutch walking was continued until 4 to 6 months after surgery.

Patients were followed clinically and radiographically at 1 to 3 month intervals during first year after the operation and at 3 to 6 month intervals thereafter. All the patients were assessed with the Harris hip score (HHS) preoperatively and at the last follow up. Follow up radiographs were evaluated to determine progression of collapse. We defined collapse as progressive when the maximum collapse of the transposed intact area beneath the acetabular weight bearing portion on the final follow up AP radiograph was greater than 2 mm compared with the immediate postoperative film. On the preoperative, immediate postoperative and latest follow up radiographs, neck-shaft angle was calculated. The change in varus angulation between the immediate postoperative and the latest follow up radiographs also was calculated to evaluate progression of varus angulation.

RESULTS

Out of 9 study subjects, 7(77.7%) were male and 2(22.2%) were female. Mean age was 40±7.5 (Table 1). Out of 6 patients with grade II, 1 (16.7%) patient had mild, 4 (66.7%) had moderate, and 1 (16.7%) had marked pain. And out of 4 patients with grade III stage, 1 patient (25%) had mild, 2 (50%) had moderate, and 1 (25%) had marked pain (Table 2).

R.O.M. did not correlated well with the grade of A.V.N. Adduction/abduction/Flexion/external/internal rotation were measured in each diseased hip and recorded. However, there was more restriction of movements in higher grade of A.V.N. (Table 3).

Most common cause of A.V.N. was found to be idiopathic with 67.7%. Alcohol abuse was attributed to 22.2% cases and steroid intake caused the disease in 11.1% males. 5 (55.55%), 3 (33.3%) and 1 (11.15) cases had A.V.N. of right hip, left hip and bilateral involvement respectively. 7 (70%) cases were operated within 2-3 years of onset of symptoms, 2 (20%) cases after 3 years and only 1 (10%) case within 1-2 yrs. There were 3 cases with combined necrotic angle of less than 1000 degree in AP and lateral view x-rays, 5 cases of A.V.N, with combined necrotic angle between 1000-1500 and 2 cases with combined necrotic angle between 1500-2000. Anterior rotation of neck was done in 7 (70%) cases and posterior rotation was done in 3 (30%) cases. Among 7 (70%) hips, canulated cancellous screws were used and dynamic hip screw were used in 3 (30%) hips. Intra operative blood loss varies from 250 -550 ml. In 4 cases (40%) blood loss was around 450-550 ml. In other 4 (40%) cases blood loss was around 250-350 ml while in 2 cases (20%) blood loss was around 350-450 ml. Majority of the cases, 4 (40%) had more than 2mm of progressive collapse of transported intact area in their latest follow up (Table 4).

Table 1: Age and gender-wise distribution of study subjects.

| Features | Variant |
|--------------|---------|
| Age, Mean±SD | 40±7.5 |
| Gender M/F | 7/2 |

Table 2: Ficat and arlet stage of disease at the time of presentation.

| Grade of AVN and pain experienced by patient. | Total hip joints (%) | Pain |
|---|----------------------|----------|
| II | 1 (16.7) | Marked |
| | 4 (66.7) | Moderate |
| | 1 (16.7) | Mild |
| III | 1 (25) | Marked |
| | 2 (50) | Moderate |
| | 1 (25) | Mild |

All the cases of grade II and Grade III disease patients had Preoperative harris hip score between 60-69, which is regarded as poor score. Post-operative results of patients were graded into excellent, good, poor and fair. In our study 4 cases were graded as poor, 3 cases were graded as fair, 2 cases as good and 1 case had excellent Harris Hip score. Patients with Harris Hip Score more than 70, were considered to be successful. Out of 10 operated cases, 6 (60%) had successful results (HHS > 70) while 4 (40%) cases had unsatisfactory results (Table 5).

Table 3: Grade of AVN / range of movement.

| Grade | Total no of hips | range of movement | | | | |
|-------|------------------|-------------------|-----------|---------|----------|-------------------|
| | | Adduction | Abduction | Flexion | External | Internal rotation |
| II | 6 | 20 | 35 | 110 | 30 | 10 |
| | | 20 | 40 | 100 | 20 | 20 |
| | | 20 | 25 | 110 | 20 | 20 |
| | | 25 | 35 | 110 | 20 | 20 |
| | | 20 | 35 | 115 | 30 | 15 |
| | | 15 | 25 | 100 | 20 | 15 |
| III | 4 | 15 | 25 | 110 | 30 | 20 |
| | | 15 | 25 | 100 | 25 | 15 |
| | | 15 | 25 | 100 | 20 | 15 |
| | | 20 | 25 | 100 | 30 | 15 |

Table 4: Clinical data of patients.

| Features | Total no of cases (No. of hip involved) (%) | |
|---------------------------------|--|----------|
| Cause | Idiopathic | 6 (66.7) |
| | Alcohol | 2 (22.2) |
| | Steroids | 1 (11.1) |
| Side affected | Right | 5 (55.6) |
| | Left | 3 (33.3) |
| | Bilateral | 1 (11.1) |
| Duration of symptoms (in years) | 1 – 2 | 1 (10.0) |
| | 2 – 3 | 7 (70.0) |
| | >3 | 2 (20.0) |
| Necrotic angle (lat+AP veiw) | <100° | 3 (30) |
| | 100°-150° | 5 (50) |
| | 150°-200° | 2 (20) |
| Operative Time(hrs) | 1.5-2.5 | 6 (60) |
| | 2.5-3.5 | 4 (40) |
| Type of rotational osteotomy | Anterior | 7 (70) |
| | Posterior | 3 (30) |
| Fixation device | Canulated cancellous screw | 7 (70) |
| | Dynamic hip screw(DHS) | 3 (30) |
| Blood loss (ml) | 250-350 | 2 (20) |
| | 350-450 | 4 (40) |
| | 450-550 | 4 (40) |
| Complication | Superficial infection | 1 (10) |
| | Delayed wound healing | 1 (10) |
| | Non union of greater trochanter | 2 (20) |
| | Increased varus angulation | 2 (20) |
| | Progressive collapse (2 mm) | 4 (40) |

All the cases of grade II and Grade III disease patients had Preoperative harris hip score between 60-69, which is regarded as poor score. Post-operative results of patients were graded into excellent, good, poor and fair. In our study 4 cases were graded as poor, 3 cases were graded as fair, 2 cases as good and 1 case had excellent Harris Hip score. Patients with Harris Hip Score more than 70, were considered to be successful. Out of 10 operated cases, 6 (60%) had successful results (HHS > 70) while 4 (40%) cases had unsatisfactory results. (Table 5)

Table 5: Postoperative Harris hip score.

| Harris Hip score | No of hips (%) | |
|------------------|----------------|-----------|
| | Grade II | Grade III |
| 59 or less | 0 (0.0) | 0 (0.0) |
| 60-69 (poor) | 2 (33.33) | 2 (50) |
| 70-79 (fair) | 2 (33.33) | 1 (25) |
| 80-89(good) | 1 (11.11) | 1 (25) |
| >90(excellent) | 1 (11.11) | 0 (0.0) |



Figure 1: Osteotomy of greater trochanter.



Figure 2: K wire insertion in proximal and distal fragment.

DISCUSSION

Osteonecrosis of Femoral Head (ONFH) is a potentially disabling condition which may cause rapid femoral head collapse in young patients. The failure rates of various femoral head-preserving surgical procedures for an extensive lesion are high. The reported success rate of TRO (Transtrochanteric Rotational Osteotomy) also is inconsistent and controversial even though some authors including Sugioka et al reported TRO is an effective head-preserving procedure in younger patients. We therefore questioned whether TRO would prevent progression of collapse in extensive ONFH (Osteo Necrosis of Femoral Head) lesions and thus increase the survivorship clinically and radiographically.

In the present study, out of total 9 study subjects, 77.8% were males and 22.2% were females. The mean age of patients was 40 years ranged from 25-50 years. Iwasada reviewed 48 hips in 43 patients out of which 34 patients were males and 9 were females and nearly similar to our study, the average age at operation was 41 years.⁸ Most common cause of osteonecrosis was idiopathic constituting 6 (66.7%) cases followed by alcohol use in 2 (22%) and steroid intake in one (11%) case. Whereas a study done by Yoon on reviewed 39 patients (43 hips),

cause of osteonecrosis were excessive alcohol consumption in 15, steroid use in 11, idiopathic in 12, and posttraumatic in five patients.⁹

Most commonly, right hip was affected in 5 (55.6%) cases and bilateral was found only in 1 case. 6 (60%) hips had grade II and 4 (40%) hips had grade III osteonecrosis according to ficat and arlet staging criteria. Nearly Similar finding were observed in the study done by Biswal, in which out of 63 hips, 40 (63.5%) had Stage II and 23 (36.5%) had Stage III involvement.¹⁰

In our study, 3 (30%) hips had a combined necrotic area of less than 100 degree. 5 (50 %) of the cases had a 100 to 150 degree and only two cases (20%) had more than 150 degree of combined necrotic area. Some surgeons evaluated pre and postoperative intact and necrotic area ratio, for determining the better predictors of outcome of this surgery. In Sugioka's et al study on 88 of 93 hips the intact surface was greater than one-third of the total on lateral roentgenograms and Ninety-eight of the 102 hips had ratio of the intact area of the femoral head to the acetabular weight-bearing area on postoperative anteroposterior roentgenograms greater than 36%.^{4,5} In Sakano in 20 hips the ratio of intact area on the weight-bearing portion increased from 19% to 61% postoperatively.¹¹

Nontraumatic osteonecrosis of hip usually affects the anterior, superior, and lateral aspects, with the presence of some intact bone posteriorly. Therefore, anterior TRO was performed in most of our patients. In our study anterior rotational osteotomy was done in 6 (60%) hips and posterior rotational osteotomy in 4 (40%) hips. Range of anterior rotation was around 400 -500 and posterior rotation was around 600- 700. Sugioka reported successful outcomes with rotation angles of 550–700 in anterior rotated TRO and Atsumi et al reported successful outcomes with rotation angles of up to 1800 when performing a TRO with posterior rotation.^{5,12} Initially we fixed the osteotomy with two to three cancellous screws with washers (in seven hips). In later three hips DHS (dynamic hip screw-1250) were used. Chen et al did transtrochanteric rotational osteotomy in 20 osteonecrotic hips.^{13,14} Fixation with large cancellous was used in the first five hips. Unfortunately, fixation failures were encountered in all of the five cases. The fixation mode was then shifted by them to a combination of plate and screws. Biswal et al used three or four cannulated 6.5-mm screws in 44 hips, and 125° dynamic hip screws in 16 hips.¹⁰

Collapse of transported intact area more than 2 mm was considered to be significant in 4(40%) cases. Increased in varus angulation was seen in 2 (20%) cases in their latest follow up. Non union of greater trochanter was found in 2 (20%) patients, superficial infection and delayed wound healing in one patient (10%) each. Non union of greater trochanter was most probably due to inadequate fixation and subsequent loss of reduction. This two patients initially had trendelenburg gait, but with due course of

time they showed improvement in gait and in range of movement as well. In few cases with anterior rotational osteotomy, external rotation was found to be increased and internal rotation was decreased. Eyb et al revealed a high incidence of complications (46%) including pseudarthrosis in five hips and increasing varus angulation in four of 39 hips at a mean follow up of 49 months.¹⁵ Progressive varus deformity developed in 16% of our 44 hips and three hips were converted to THA. Progressive varus deformity was attributable to not only 6.5 mm cannulated screw fixation but also to the additional varus position of the proximal part of the femur despite prolonged partial or non weight bearing after TRO. Iwasada reviewed 48 hips in 43 patients with transtrochanteric rotation osteotomy, complications, such as varus deformity, subtrochanteric fracture, and ectopic bone formation, occurred in eight hips.⁸

CONCLUSION

Our clinical observation suggested that fixation of osteotomy can be effectively done by both cannulated cancellous screws and Dynamic Hip Screw. The major limitation of our study is the small number of patients, and short term follow up. The large number of confounding variables (example- stages, etiologies) and relatively small numbers of patients preclude more complete analysis of predictive variables and thus more clear indications. Rotational osteotomies can be recommended in a few selected patients with shallow necrosis involving less than one third of the femoral head diameter and without osteoarthritis or head flattening. Under these conditions, good outcomes may be achieved. TRO procedure is valuable and needs to be tried by new genre of orthopedician as it helps in clinical improvement of patient and might also delay the necessity for total hip arthroplasty. The procedure is technically difficult to perform with steep learning curve, but if performed meticulously by strictly adhering to the recommended protocols and in carefully selected patients, it can yield satisfactory results.

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