Outcomes of osteonecrosis of femur head by Core Decompression and tensor fascia Lata based muscle pedicle bone graft

ABSTRACT

Purpose: Osteonecrosis of femoral head (ONFH) is the major cause of musculoskeletal disability. Core decompression (CD) is the most widely used strategy for the management of ONFH but it lacks the ability to increase the vascularization around the necrotic femoral head. So the purpose of the study was to evaluate the outcome of CD with tensor fascia lata muscle pedicle bone graft in ONFH patients.

Methods: This prospective study was conducted on 26 ONFH patients. Core decompression with TFL muscle pedicle grafting methods was used in all the patients. The outcome of the technique was evaluated using Harris hip score.

Results: In this study, the major risk factor ONFH was alcohol intake followed by chronic steroid use. Majority of the patients (57.69%) were in stage III ONFH. The Harris Hip Score was excellent in 14 hips (53.846%), fair in 2 hips (7.692%) and poor in 1 hip (3.84%) respectively. There was a significant increase in post operative Harris hip score as compared to preoperative (86.6 ± 8.0 vs 63.7 ± 6.7).

Conclusion: Tensor fascia lata muscle pedicle grafting along with core decompression is a reliable technique for pain reduction and improved vascularization in necrotic femoral head.

Keywords: Osteonecrosis, femoral head, core decompression, muscle pedicle grafting, Harris hip score.

INTRODUCTION

"Osteonecrosis of the femoral head (ONFH) is a devastating, painful, and disabling clinical condition that generally affects middle and young individuals".[1] In most cases, ONFH is idiopathic and has a significant association with alcohol and steroid abuse and specific pathologies, liver and skin diseases, hemoglobinopathies and coagulopathies.[2] Early diagnosis based on the clinical and radiological perspectives is complicated and, if left untreated, may collapse the femur head and hip fractures. The management of ONFH depends on Ficat's grading system based on the plain X-ray, and it is routinely used in clinical practice.[3] During the early stage, the ONFH is managed by head preserving surgeries which reduce the intra-osseous pressure and thus enhance the formation of new blood vessels around the femoral head and thus form the new bone and delays the formation of ONFH.[4,5] "The core decompression (CD) is the widely used method in the case of ONFH Ficat stage I and IIA".[6] CD decreases the intra-osseous pressure and thus minimise the pain, but it cannot increase the necrotic femoral head vascularization, particularly during the advanced disease stage. So, to prevent this, CD is combined with various grafting methods such as bone grafting and muscle pedicle bone grafting to increase the vascularity of the femoral head and heal. Muscle-pedicle grafts have been described in the literature by many authors. Meyer et al.[7]described "quadratus femoris-based pedicle graft". Baksi et al.[8] reported "excellent clinical and radiological outcomes with tensor fascia lata muscle pedicle graft placed in the prepared window to the necrotic area, which also will serve to decompress the lesion". "A TFL-muscle pedicle graft onto the affected area of the head of the femur will increase the vascularity and prevent the further collapse of the head".[9] The procedure is technically less demanding but rewarding with a less steep learning curve for the average orthopaedic surgeon. Against this backdrop, the present study was aimed to evaluate

the clinical and radiological outcome of core decompression and fascia lata grafting in osteonecrosis of the femoral head in stages 2 and 3.

MATERIALS AND METHODS

This prospective study explored 26 patients with osteonecrosis femoral head diagnosed clinically, radiographically, and magnetic resonance imaging (MRI) presenting to a tertiary care institute.

Present study included patients with osteonecrosis hip unilaterally or bilaterally diagnosed between 18 and 65 years of age and they were followed up for 6 months after their surgery. Patients with Stage 4 osteonecrosis with marked collapse or deformed head or acetabular changes were excluded, as well as patients with neurological and mental disorders, or age less than 18 or over 65.

We collected a detailed history from the patient and relatives regarding any high-risk history, such as the history of sickness lung, alcohol consumption, and steroid use. For all patients with osteonecrosis hip unilateral or bilateral, stage 1, 2, and 3, we carefully collect a complete medical history. A clinical evaluation was conducted in order to evaluate the patient's general health and local signs at the hip, focusing on common signs such as tenderness in the Scarpa's triangle, decreased range of motion, sectoral signs, and axis deviations.

Radiological Examination

For early diagnosis and accurate staging of bilateral osteonecrosis of hip joints, all patients underwent x-rays, magnetic resonance imaging (MRI) and bone scans.

Operative Technique

Depending on the anaesthetist's discretion, patients were operated under spinal, epidural or occasionally general anaesthesia. The patient was supine with the sandbag under the gluteal region during the operation.

The iliac crest was incised about 5 cm posterior to the anterior superior iliac spine, extending to 2 cm below the greater trochanter on the lateral side of the hip.

In order to expose the iliac crest, three abdominal muscles were raised until one reached approximately two centimeters deep. Similarly, the iliac crest with attached tensor fascia lata is exposed on the outer side. A cleavage between the sartorius and TFL was identified. An incision was made between anterior and middle TFL fibers, and 2 cm of middle TFL fibers were separated up to the iliac crest.

An osteotomy of the iliac crest was performed superiorly and approximately 2 to 3 cm distally and medially with isolation of the TFL graft externally using a pneumatic saw. An iliac crest graft with TFL pedicle is best separated from the surrounding muscles by subperiosteal separation without disturbing their vascular supply. In order to create the desired size of TFL, the entire width of the iliac crest is elevated and retracted downwards with attached fibers of TFL. The superior gluteal artery and ascending branch of the lateral femoral circumflex artery supply blood to this TFL muscle pedicle iliac crest graft.

The reflected pedicle of the TFL with fibres of gluteus minimus was removed from the outer surface of the ilium, retracted downwards, and brought to the anterior capsule of the involved hip joint. An incision in the shape of a T was made to open the hip capsule. The anterior capsule and thickened synovium were removed. It was exposed and examined for deformation and contour changes in the ischaemic, necrotic segment. An anterior window was drilled at the junction of

the neck of the femur and the articular surface. Through this window, serial reaming was performed in all directions in the ischaemic segment of the femoral head up to the subchondral region under image intensifier guidance. Perforations were avoided by taking care not to damage the articular surface. As a result, the entire necrotic tissue was removed with the curette, leaving a large void in the head of the femur, usually in the upper quadrant, and the inferior quadrant was untouched. By using a punch/impactor, the deformed femoral head and articular surface were raised to match their original shapes under an image intensifier in all directions. As a result of the osteotomy, the resulting hole was partially filled with a small amount of cancellous bone removed from the iliac crest.

Afterwards, the raised pedicle of the TFL and iliac crest at the junction of the head and neck was prepared to rest through the window defect. The femoral neck is drilled two times, superiorly and inferiorly, with drill bits of 2 mm. The TFL graft is also inserted into two holes in the pedicles of the iliac bones. After that, the TFL pedicle was impacted into the head under image control up to the subchondral region of the femoral head, and the graft was tied by no.1 vicryl to the femoral head and neck. Additionally, the muscle belly was stitched inferiorly and superiorly to the capsule. Suction drains were located at the hip, iliac crest, and wounds were closed layer by layer. A similar procedure was performed in the same setting on the opposite side in bilateral cases.

Postoperative protocol

To avoid tension on the TFL pedicle after surgery, the limb was held in 20 degrees of abduction, 30 degrees of flexion, and 10 degrees of internal rotation.

The patient was mobilized after 15 days in bed and after 4 to 6 weeks the patient can be mobilized out of bed in a non-weight-bearing position if only 1 hip was operated. In bilateral

cases, weight bearing was started after only 10 weeks. Partial weight bearing was permitted after 14 to 16 weeks. In order to prevent crisis, oral medications were immediately administered to Sickle cell patients.

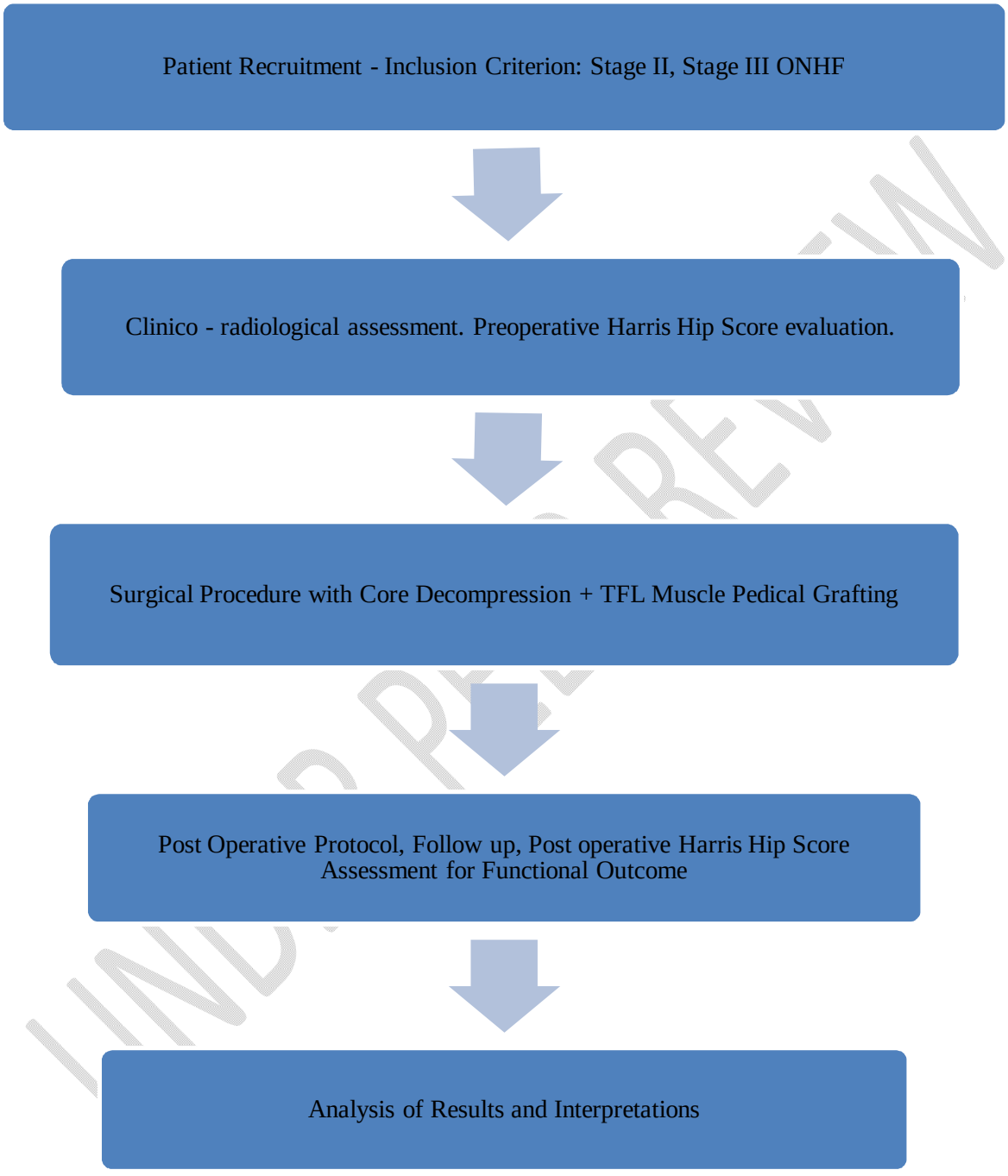
Follow up

Follow-up was done every six weeks for six months after stitch removal and every three months for 2-3 years afterward

Statistical analysis

Descriptive analysis was done to display the data as frequency, %. The pre and post operative Harris hip score was compared using paired students T test. The data was analysed using SPSS v 24. A p value <0.05 was considered as statistically significant

Fig 1: Flow Chart of the Study



RESULTS

Among the 26 patients in this prospective study, 20 were males and six were female. Most of the patients (52.38%) were between the ages of 31-40. The mean age of the patients was 30 years. The most common cause of ONFH in this study was alcohol consumption in 42.85% of patients, followed by steroid consumption in 28.57 % of patients, and sickle cell disease in 14.28% of patients. Based on ARCO classification, 57.69% of patients were in Stage III, followed by 42.305% in Stage II. The average duration of partial weight bearing was 8.615 weeks, and the average duration of full weight bearing was 12.077 weeks.

The result was assessed using the Harris Hip Score. The Harris Hip Score was excellent in 14 hips (53.846%). In 9 hips (34.61%), excellent results were obtained, while fair results were obtained in 2 hips (7.692%) and poor results in 1 hip (3.84%). Out of 11 hips in stage II, 10 (90.91%) had excellent results, and 1 (9.09%) had a good outcome. The results of 15 hips in stage III were excellent in 4 hips (26.66%), good in 8 hips (53.33%), fair in 2 hips (13.33%) and poor in 1 hip (6.66%). Table 1 summarizes the results.

On average, preoperative hip scores were 63.7±6.7 (median 65.5), while postoperative hip scores were 86.6±8.0 (median 90). The paired "t" test was used to analyze changes in hip scores pre and post-op. According to the results, there was significant improvement in Harris hip score pre and post-operatively ($t = 11.2$, $P<0.0001$ and $z = 5.8$, $P<0.0001$).

DISCUSSION

Among the various musculoskeletal pathologies, ONFH is the major etiology with significant morbidity and mortality. [1] "In the absence of treatment, it may progress to secondary osteoarthritis of the hip. This is the natural progression of the disease. As a result, ONFH may be treated and managed earlier when diagnosed and treated early. Although some studies have shown that bisphosphonates are effective in the early stages of ONFH with small necrotic lesions, medical management of ONFH is not always satisfactory. During the advanced stages of ONFH, the only satisfactory option is total hip replacement. ONFH appears to be multifactorial in etiology and may be associated with a variety of risk factors. A femoral head ONFH with no obvious risk factor is referred to as idiopathic. Among major risk factors for ONFH of the femoral head, alcohol consumption (up to 400ml per week) has been identified. The causes of ONFH have been linked to alcohol consumption and corticosteroid use".[10] "In order to plan treatment for ONFH of the femoral head, it is important to classify it or stage it. Clinical practice most commonly uses Ficat's classification system. An early goal of treating ONFH of the femoral head is to reduce the intraosseous pressure and enhance the vascular supply to the femoral head. Only a core-decompression of the femoral head was reported initially by Hungerford, with promising results. Decompression of the core has always been a subject of controversy in the literature. The core decompression results in only temporary relief of pain, without preventing the collapse of the femoral head in the long run". [11] In Ficat' stage I & IIA of ONFH of the femoral head, Buckley et al. have reported positive outcomes with core decompression and cortico-cancellous bone grafts.[12] Permeation of granulation tissue into the drilled area from the adjacent MPBG results in the revascularization of the necrotic area, thus

providing long-lasting pain relief. On the subject of free vascularised grafts for treatment of ONFH, Urbaniak et al.[13] have used "the fibula (with peroneal vascular pedicle) to achieve adequate vascularization. In stages IIB and III of Ficat, they have shown good clinical and radiological outcomes with free vascularized bone graft. Nevertheless, these procedures are technical, tedious and time-consuming and cannot be performed bilaterally in a single session. Numerous types of muscle pedicle bone grafting procedures (after core decompression) have been described to overcome the shortfalls of vascularized grafts".

The procedure has shown favourable results in the early stages of the disease with revascularization of the femoral head and prevention of collapse. Meyer described quadrates femoris muscle as a pedicle graft[7], Baksi described iliac crest as a pedicle graft, as well as tensor fascia lata and the iliac crest graft for the Baksi procedure.[8]

Conclusion

According to our experience, TFL muscle pedicle grafting produces excellent results if the ischemia necrosis of the femoral head is detected early in stage II core decompression. In stage III, the depressed section can be lifted and the deformity can be fixed with elevation and bone grafting, even if there is a small collapse and deformation. The long standing effect of surgery was excellent with significant improvement in the post operative Harris hip score.

Consent

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

REFERENCES

1. Petek D, Hannouche D, Suva D. Osteonecrosis of the femoral head: pathophysiology and current concepts of treatment. EFORT Open Rev 2019 ;4:85–97.

2. Takao M, Nishii T, Sakai T, Yoshikawa H, Sugano N. Repair in osteonecrosis of the femoral head: MR imaging features at long-term follow-up. Clin Rheumatol 2010; 298 :841–8.

3. Jawad MU, Haleem AA, Scully SP. In Brief: Ficat Classification: Avascular Necrosis of the Femoral Head. Clin Orthop Relat Res 2012;470 :2636–9.

4. Mont MA, Ragland PS, Etienne G. Core Decompression of the Femoral Head for Osteonecrosis Using Percutaneous Multiple Small-Diameter Drilling. Clin Orthop Relat Res 2004;429:131–8.

5. Zhang H-J, Liu Y-W, Du Z-Q, Guo H, Fan K-J, Liang G-H, et al. Therapeutic effect of minimally invasive decompression combined with impaction bone grafting on osteonecrosis of the femoral head. Eur J Orthop Surg Traumatol 2013;23:913–9.

6. Agarwal T, Patel P, Sooknundun M, Mohapatra A, Joshi H, Salgia A. Management of stage i and II A/B avascular necrosis of femoral head with core decompression autologous

cancellous bone grafting and platelet rich plasma factors. Med J Dr DY Patil Univ 2015; 8:713-8

7. Meyers MH. The treatment of osteonecrosis of the hip with fresh osteochondral allografts and with the muscle pedicle graft technique. Clin Orthop Relat Res 1978:202–9.

8. Baksi DP. Treatment of osteonecrosis of the femoral head by drilling and muscle-pedicle bone grafting. J Bone Jt Surg - Ser B 1991;73:241-5.

9. Ashraf M, Subramanian V, Narayanan SK, Mohan M. Tensor fascia lata muscle pedicle grafting for avascular necrosis femoral head. Int J Res Orthop 2016;2: 333-9.

10. Shah KN, Racine J, Jones LC, Aaron RK. Pathophysiology and risk factors for osteonecrosis. Curr Rev Musculoskelet Med 2015 ;8:201-9.

11. Wang L, Tian X, Li K, Liu C. Combination use of core decompression for osteonecrosis of the femoral head: A systematic review and meta-analysis using Forest and Funnel Plots. Comput Math Methods Med 2021 ;2021:1284149.

12. Buckley PD, Gearen PF, Petty RW. Structural bone-grafting for early atraumatic avascular necrosis of the femoral head. J Bone Joint Surg Am 1991; 73: 1357–64

13. Urbaniak JR, Coogan PG, Gunneson EB. et al. Treatment of osteonecrosis of the femoral head with free vascularized fibular grafting. A long-term follow-up study of one hundred and three hips. J Bone Joint Surg Am 1995; 77: 681–94.

Table 1: Stage wise outcomes based on Harris hip score

	HHS Excellent outcome	HHS Good outcome	HHS Fair outcome	HHS Poor outcome
AVN Stage II	11 [90.91%]	01 [9.09%]	None	None
AVN Stage III	04 [26.66%]	08 [53.33%]	02 [13.33%]	01 [6.66%]