



LOCAL ADMINISTRATION OF ZOLEDRONIC ACID FOR PREVENTING COLLAPSE OF THE FEMORAL HEAD IN EARLY STAGE OF OSTEONECROSIS: A PROSPECTIVE STUDY

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ABSTRACT **Introduction:** The treatment of osteonecrosis of hip depends upon the stage. Once collapse of the femoral head occurs; hip replacement is the only option. Therefore, it is important to reduce osteonecrotic weakening of the femoral head in early stages itself. **Materials And Methods:** A prospective study was conducted in 20 patients to analyze the functional outcome of local administration of zoledronic acid in early stage of osteonecrosis of hip by clinical and radiological methods. Under IITV guidance, guidewire was inserted and drilling was done through same tract. 600 mcg zoledronic acid mixed with normal saline in 10 ml syringe was pushed slowly over 10 minutes through Jamshedi needle into femoral head followed by injection of another 10ml of normal saline to prevent back flow, and the holes were sealed with a small amount of bone wax. All the patients were followed up and functional outcome was assessed using Harris Hip Score. **Results:** Mean preoperative HHS was 80.63 and postoperative final followup HHS mean was 90.5. Mean difference was 9.87 and was found to be statistically significant. Evaluation with x-rays at follow up showed gradual restoration of femoral head morphology, increase in bone density and prevention of collapse progression. **Conclusion:** In young adults, with early detection and infusion of zoledronic acid into the femoral head , encouraging results were obtained. This treatment modality should go a long way towards becoming the most desirable hip preservation surgery in early osteonecrosis of femoral head in near future.

KEYWORDS : osteonecrosis, femoral head, zoledronic acid

INTRODUCTION

Osteonecrosis of the femoral head (ONFH) is a debilitating condition affecting the hip joint especially in the younger population and is one of the most common causes of total hip replacement in this age group^{1,2}. Clinically early stages of osteonecrosis is painless which on progression will result in severe groin pain associated with limitation of hip movement and collapse of femoral head ultimately leading to end-stage degeneration^{3,4,5}.

The treatment of AVN hip are mainly based on categorization into pre-collapse or early collapse and advance collapse or osteoarthritis stage^{6,7}. Once collapse of the femoral head occurs; hip replacement is the only option for patients^{8,9}. Therefore, it is important to reduce osteonecrotic weakening of the femoral head in early stage of osteonecrosis to prevent subsequent head collapse.

Studies have shown that bisphosphonates inhibit osteoclast activity, reduce bone absorption, retain bone trabeculae¹⁰, reduce apoptosis of osteoblast and osteocytes and promotes new bone formation¹¹. Systemic administration of zoledronic acid is associated with many complications, including osteonecrosis of mandible and atypical femur fractures¹².

The purpose of this study was to evaluate the efficacy of local administration of zoledronic acid for preventing collapse of femoral head in early stage.

MATERIAL AND METHODS

A prospective study was conducted in 20 patients to analyze the functional outcome of local administration of zoledronic acid in early stage of osteonecrosis of hip by clinical and radiological methods in department of Orthopedics, at Jorhat medical college and hospital, Assam between September 2021- August 2022. Patients aged between 18-55 years with FICAT I-II ONFH (confirmed by x-ray and MRI) were included in the study and patients with previous ONFH related surgery , hematological or metabolic diseases and lactating and pregnant women were excluded.

Initial Workup:

After admission detailed history was taken and thorough examination of patient was performed. The diagnosis was established by clinical and radiological examination (AP and lateral view of pelvis including

both hip and MRI were done). In the study, osteonecrosis of femoral head were classified on basis of Ficat and Arlet classification.

In our study, all cases were done under spinal anesthesia.

Guide Wire Placement

After positioning the patient supine in a fracture table, a guide wire was inserted laterally and percutaneously under fluoroscopic guidance. Guide wire was advanced by handpushing until it reached the lateral cortex in the metaphyseal region opposite the superior portion of the lesser trochanter. Then femur was penetrated and wire was advanced through the femoral neck into the site of the lesion in femoral head (as determined on preoperative radiographs or MRI) with help of electric drill. Position of guide wire was confirmed in both AP and lateral views (Fig 1). Care was taken to avoid penetration of the femoral head cartilage while advancing the wire.



Fig 1- AP View To Confirm Guide Wire Position

Insertion Of Drill Bit And Jamshedi Needle

After insertion of the guide wire drilling was done with 3.5 mm cannulated drill bit through the same tract. Then Jamshedi needle was inserted in the same tract for delivery of zoledronic acid after removal of drill bit and guide wire (Fig 2).

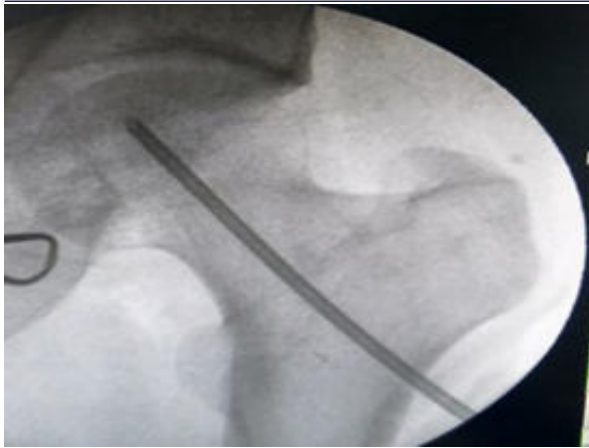


Fig 2- Jamshedi Needle Inserted Through Same Tract

Delivery Of Zoledronic Acid Intraoperatively

600 mcg zoledronic acid mixed with normal saline in 10 ml syringe, pushed through Jamshedi needle to the head of the femur(Fig 3). It was injected slowly over a period 10 minutes to prevent the drug from going in to the veins. Followed by injection of another 10ml of normal saline pushed through needle to prevent back flow, finally the holes will be sealed with a small amount of bone wax. Sterile dressing was applied over the wound.



Fig 3- Delivery Of Zoledronic Acid

Post Op Protocol

Non-weight bearing for 6 weeks was advised. Partial weight bearing was initiated after 6 weeks and full weight bearing after radiological evidence of improvement. Hip and knee mobilization exercises were started from 2nd postoperative day. X-ray taken after 6 weeks then after 3rd and 6th month. Functional outcome was assessed using Harris Hip Score.

RESULTS AND OBSERVATIONS

All 20 patients included in the study were followed up as per established protocol and none of them were lost to follow up. All the patients were followed up at 2 weeks, 6 weeks, 3 months and 6 months till the improvements were achieved. Full assessment of all patients were done after that.

The youngest patient of the study was 19 years of age and oldest being 55 years old. The mean age was 33.6 years. The maximum number of cases were observed between 31-40 years of age group. There were 15 male patients and 5 female patients. Left side was involved in 11 patients, right hip in 7 and 2 patients had bilateral involvement. 5 patients(5 hips) were classified into ficat stage-I and 15 patients(17 hips) were ficat stage-II. We found mean operative time to be 34.22 minutes, range 30- 60 minutes. Average time of initiation of partial weight bearing was found to be 6.1 weeks (range 6-8 weeks). In terms of functional outcome, 13 hips (59.09%) achieved excellent result with average score being 93.9 . 7 hips had Good results and 2 hips had fair results as per Harris Hip Score (HHS). Mean preoperative HHS was 80.63 and postoperative final followup HHS mean was 90.5. Mean difference in HHS was 9.87 and was found to be statistically significant (p< 0.0001). In our study, 19 patients had uneventful recovery postoperatively. One patient with bilateral AVN had superficial

infection on the left side which was treated with oral antibiotics. It did not affect the ultimate outcome of the procedure. The patient had Harris hip score of 78 on the affected side.

CLINICAL EVALUATION:

Clinical evaluation was done pre-operatively and post-operatively at a regular interval using Harris Hip Score, which takes into account pain, function, deformity and range of motion.

The location of pain was recorded as in the groin, the buttocks, the lateral or trochanteric area, the anterior aspect of the thigh or diffuse. Pre-operatively 7 hips had a score of 30 points, 11 hips had 20 points, 4 hips had 10 points. Post-operatively 2 hips had 30 points, 17 hips had 40 points and 3 hips had 44 points. At the final follow up, 10 hips had 44 points, 8 hips had 40 points, 2 hips had 30 points and no hip had 0 points.

RADIOLOGICAL EVALUATION

During follow up period MRI was not done. Radiological evaluation with x ray (AP and lateral view) at follow up showed gradual restoration of femoral head morphology, increase in bone density and prevention of collapse progression.

Evaluation of one of our patients with osteonecrosis of Left femoral head is illustrated in Fig 4.



Fig 4a- Preoperative Xray of a patient with ONFH left side



Figure 4b- Immediate postop Xray



Fig 4c- Xray after 6 months postop



Fig 4d- Patient sitting crosslegged (after 6 months postop)



Fig 4e- Patient squatting (after 6 months postop)

DISCUSSION

The efficacy of oral bisphosphonates in AVN hip has been documented by multiple studies in the literature. Their property of inhibiting osteoclastic activity in the avascular lesion promotes bone healing as well as prevention of progression to subchondral fracture in early cases and delays collapse in advanced cases^{13,14}. In our study we opted for local infiltration of bisphosphonates and the rationale behind was the property of bisphosphonate to be able to get rapidly absorbed into the bone surface and higher concentration achieved locally compared to other forms of administration. In oral as well intravenous administration around 50% absorbed drug is excreted unchanged through the kidney and the equal distribution of the remaining drug in the circulation results in failure to achieve maximum concentration at the desired site.¹⁵

In our study the average age group was 33.6 years (range 19-55 years) which was comparable to the studies conducted by Harsha V et al.¹⁶ (mean age= 34.71 years) and KA Lai et al¹⁷ (mean age= 42.6 years). Male to female ratio was 3:1 which was comparable to the studies conducted by KA Lai et al¹⁷ (3:1), Ashraf M et al¹⁸ (2.15:1) and Harsha V et al¹⁶ (5:1). We had 5 cases (5 hips) of ficat-I stage and 15 cases (17 hips) of ficat-II stage of osteonecrosis. Ashraf M et al¹⁸ reported 4 cases of ficat-I stage, 13 cases of ficat-II stage and 4 cases of ficat-III stage in their study.

In our study the mean pre-operative modified HHS in stage I (n=5), stage II (n=17) were 84.59 and 79.47 respectively. The mean post-operative modified HHS for stage I at 6 month was 94.9. The mean post-operative modified HHS for stage-II at 6 month was 89.17. 59.09% patients achieved excellent result with average score being 93.9. All the patients including those who had fair outcome had good pain relief after 6 months post operatively in their hips. None of our patients suffered from limp postoperatively and all patients could walk

without any support except patients with fair outcome, who used cane for long walks. Post-operatively patients with excellent and good results were able to walk for unlimited distance, patients with fair results could walk for 6 blocks only. Post-operatively patients with excellent and good results were able to climb stairs without rails while patients with fair results used rails to climb stairs. All patients had good range of hip movements except those who had fair outcome and no patients had fixed flexion and abduction deformity of hip. Follow up x-rays of all patients showed gradual restoration of femoral head morphology and increase in bone density except patients with fair outcome.

Limitations of our study include small sample size and shorter duration of study. Also finding out treatment responses according to different aetiology of osteonecrosis would have added to the relevance of the study.

CONCLUSION

If not detected early and appropriate treatment initiated to arrest its progression, osteonecrosis of femoral head is not only a very devastating condition for the patient but is also a challenge for the orthopaedic surgeons to manage. Without treatment, 70% of femoral head with osteonecrosis collapses and will require prosthetic replacement. Due to socio-religious customs, in our country squatting and sitting cross legged are very much part of our daily activities, which can be only achieved with head preservation procedures. In early stages of osteonecrosis (ficat stage I-II) every attempt should be made to halt the progression of the process and preserve the functional femoral head to avoid replacement surgery, and thereby allowing happy unrestricted activities.

From our study, we would like to conclude that in young adults, with early detection and infusion of zoledronic acid into the affected femoral head, encouraging results were obtained and should go a long way towards becoming the most desirable hip preservation surgery in early osteonecrosis of femoral head in near future.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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