Core Decompression Combined with Intraosseous Ibandronate for Pre-collapse Osteonecrosis of the Femoral Head: Report of a Novel Technique, its Safety and Early Outcomes in Five Cases

Prasoon Kumar¹, Sameer Aggarwal¹, Karan Jindal¹, Sandeep Patel¹, Siddhartha Sharma¹, Monu Mahan¹

Learning Point of the Article:
The use of ibandronate as an adjuvant to core decompression in osteonecrosis femoral head is a cheaper alternative showing promise in short term results.

Abstract

Background: Core decompression (CD) is an effective method in the management of pre-collapse stage of osteonecrosis of the femoral head (ONFH). It has been combined with various adjuvants to increase the efficacy including bone marrow aspirate concentration and platelet rich plasma. We evaluated a cheaper alternative in the form of ibandronate as an adjuvant to CD and to highlight the technique, safety, and early outcomes.

Methods: The patients in the age group of 18–60 presenting with atraumatic ONFH in the pre-collapse stage were included in the study. The patients were followed up to a period of 1 year and evaluated in terms of radiologic progression and functional outcome (Modified Harris Hip Score [MHHS] and Visual Analog Scale [1]).

Results: The study included six hips in five patients (three females and two males) ranging from 18 to 57 years. There was no sign of stage progression or collapse on radiography. The average post-operative MHHS was 87.4 (73.7-96.7) while VAS score improved from 2.8 to 1.3 postoperatively (p=0.00395).

Conclusion: The use of ibandronate as an adjuvant with CD shows promise. It is safe and provides good clinical improvement and is a cheaper alternative. However, the interpretation is limited due to the small number of patients and short duration of follow-up.

Keywords: osteonecrosis, ibandronate, outcomes, safety, intraosseous.

Introduction

Osteonecrosis of femoral head (ONFH) is a progressive degenerative disease characterized by interruption of subchondral bone blood supply, which results in osseous necrosis, diminished support to the articular cartilage and its subsequent collapse. If not treated in time, it culminates in femoral head distortion and secondary osteoarthritis [1]. Disease progression in femoral head ONFH has been shown to correlate with progressively worsening functional outcomes and advanced ONFH is among the most common indications for total hip arthroplasty [2]. The treatment of ONFH varies by the stage of presentation. In pre-collapse stages where the articular cartilage is intact, the treatment modalities such as non-operative management in the form of symptomatic management and oral bisphosphonates or surgical interventions such as core decompression (CD), osteotomies, and bone grafting are used [3, 4, 5]. CD is perhaps the most common surgical intervention, which has been reported to be effective in up to 95% of Ficat Arlet Stage I cases. However, with increased area of necrosis and advanced stage, its...
Moreover, intraosseous ibandronate has been demonstrated to possess optimal bioavailability and promising results in animal models of ONFH [16, 17]. Hence, we conducted a feasibility study to determine the efficacy and safety of a novel treatment combination of CD and intraosseous ibandronate in pre-collapse stages of ONFH.

Materials and Methods

This pilot study was initiated after Institutional Ethic Committee clearance vide no. INT/IEC/2020/SPL-936. This present paper is a part of an ongoing trial registered in CTRI (CTRI/2020/09/028112). The patients between age group 18 and 60 years, presenting with atraumatic ONFH till the crescent stage, were recruited in the study after written informed consent. Traumatic and post-collapse stages with femoral head distortion or osteoarthritis were excluded from the study. Five consecutive patients were included in the study.

Surgical technique

All the patients were operated under spinal anesthesia. In Bilateral cases, where arthroplasty was planned on one side, combined spinal-epidural anesthesia was used. The patients were operated in the supine position on a radiolucent table, with a radiolucent bag placed under the sacral area. Standard aseptic preparation was followed. Bilateral cases were done sequentially in the same sitting. A guide wire was placed over the skin anteriorly and the neck shaft angle was confirmed under C arm. A 2 cm incision was made at the base of the greater trochanter. Under C arm guidance, a 3.5 mm Steinman pin was used to drill 4–5 holes extending from the vastus lateralis ridge into the neck and up to the subchondral part of femoral head; the target was the necrotic area inside the head. Increased resistance felt while drilling followed by a sudden give, signified the proper placement of the pin, which was confirmed by anteroposterior and lateral views in the C arm. The tract created up to the main necrotic area was chosen for instillation of ibandronate. A Jamshidi needle (11 G) was inserted in that tract through which the drug was instilled. The dosage was based on animal data which suggest that 0.6 mg of ibandronate is sufficient [16]. We doubled the dose to adjust for wastage and instilled 1.2–1.5 mg of the drug. The ipsilateral side was raised to avoid back flow and
bone wax was pushed into the tract after instillation followed by closure (Fig. 1).

**Post-operative protocol**

Postoperatively, the patients were not allowed to bear any weight on the operated side. In bilateral cases, mobilization was delayed till 6 weeks to allow the drill holes to heal. In unilateral cases, weight bearing on the non-operated side was allowed from post-operative day 2. If one side under-went arthroplasty, partial weight bearing was allowed on that side. The patient was encouraged to perform active ankle pumps, isometric quadriiceps strengthening, and hip abduction/adduction exercises. Frequent side turns and pelvic lifting exercises were initiated to avoid bed sores in non-mobilized cases. Sutures were removed on day 14.

**Follow-up**

The patients included in this study were followed up after 2 weeks, 6 weeks, 6 months, and 1 year. The patients were evaluated clinically with the modified Harris hip score (MHHS) and visual ana-log scale (VAS); radiological evaluation was done with X-rays for assessing improvement or worsening of ONFH by one stage or subchondral collapse. DEXA scan was done for the hips to assess for any cortical signs of stress reactions/fractures due to ibandronate.

**Statistical analysis**

Due to the small sample size, we performed only two sets of comparisons. The pre-operative VAS score was compared to the score at last follow-up by means of a paired t-test. P<0.05 were considered as significant. SPSS version 20 was used.

**Results**

The present study included six hips in five patients (three females and 2 males) of ONFH, with mean of 39.2±17.28 (range from 18 to 57 years). Three patients had a history of steroid intake and one had consumed alcohol for 10 years; one patient was categorized as idiopathic. One hip be-longed to Stage I, three to Stage IIa, and two in the crescent phase (Stage II b) according to the modified Ficat and Arlet staging (Table 1). All the cases were bilateral ONFH, with total hip re-placements done for the contralateral hips in four cases. One case underwent bilateral CD + iband-ronate instillation.

The radiographs of all the hips showed healing of the drill tracts, well-contoured femoral heads, and no signs of stage progression or collapse at last follow-up at 1 year (Fig. 2,3,4).

The mean pre-operative VAS score of the six hips which underwent CD was 2.8, which reduced to 1.3 postoperatively (p=0.00395). The average MHHS of the patients postoperatively was 87.4 (73.7–96.7).

The DEXA scan showed osteopenia in only one patient who underwent bilateral CD; however, the femoral neck Z scores were normal (−0.3 and −0.2 on the two sides, respectively). Probable reason could have been complete immobilization for 5 weeks in that particular patient. There were no indications of stress/typical fractures such as cortical beaking/focal cortical changes laterally at the lesser trochanteric region in any patient. There were no complications observed in any of the patients.

**Discussion**

Avascular necrosis of the femoral head strikes an imbalance between bone formation and resorp-tion, which causes progression to collapse, distortion, and osteoarthritis [1]. The early stages tend to heal well with modern day adjuvants to CD such as BMAC and PRP; rates of worsening of AVN stage and conversion to arthroplasties tend to improve with these modalities [7, 8]. However, the high-associated costs continue to stress on the need for alternatives. The financial burden of arthroplasties itself is high and poorer patients specially in developing countries with lack of robust insurance mechanisms cannot afford THRs; this leads to further loss of work force due to associated functional limitations with negative impact on the economy [18].

Bisphosphonates have been shown to increase the trabecular bone volume by inhibiting bone re-sorption; there is improvement in the sphericity of the femoral head protecting its morphology [14]. Studies have shown that their usage may limit the proportion of patients who progress to femoral head collapse/distortion and need of THR [13, 14]. However, rare but severe complications include osteonecrosis of jaw and unusual atypical femoral fractures stress on the need for localized action of the drug to enable better bioavailability and lesser systemic toxicity. Ashraf et al. performed micro-CD of the necrotic area after safe surgical dislocation of affected hips and added intraleisional zoledronic acid as treatment of AVN in 19 hips of 15 patients. They showed improved MHHS postoperatively with minimum follow-up of 2 years [19]. In Perthes disease which is ONFH of the femoral capital epiphysis, Sivakumar et al. explored local delivery of zoledronic acid in the epiphysis in two cases and found it effective in prevention of disease progression at 4 years of follow-up [20].

In the present series, we used ibandronate as it has been shown to maintain femoral head sphericity and adequate bioavailability in animal models of AVN hip. In addition, it has been shown by Fan et al that zoledronic acid can inhibit...
The use of ibandronate as an adjuvant with CD has shown promising results. Although limited due to the small number of patients and short duration of follow-up, it appears to be safe and provides good clinical improvement and is a cheaper alternative. Further, large scale studies with higher number of patients are needed.

In systemic application these fractures occur on prolonged usage (>3 years); however, with targeted delivery, the incidence is unknown and no study has described the same. In our initial six hips, the DEXA scan did not show any pre-fracture hip lesions or focal lateral cortical changes in the form of periosteal changes or internal medullary changes. There were no prodromal symptoms such as ipsilateral thigh pain and serum calcium profiles were within normal limits.

Overall, our novel technique of combining intraosseous ibandronate with CD in pre-collapse stages of AVN has shown initial efficacy and safety. However, prolonged follow-up and increased number of included cases are needed to substantiate the method for recommending wider usage. Comparative trial with isolated CD is being done by the authors who will shed better light on additional benefit of this prospective adjuvant to CD.

### Clinical Message
The use of ibandronate as an adjuvant with CD has shown promise as cheap alternative with safety and good clinical improvement.

---

**Table 1: Outcome analysis of five patients**

| Age | Sex | Risk Factor | Modified Ficat Arlet Stage | Follow up (months) | Surgery | Pre-operative VAS on CD Side | Post-operative VAS | Post-operative MHHS | DEXA | X-rays |
|-----|-----|-------------|---------------------------|-------------------|---------|-----------------------------|-------------------|-------------------|------|--------|
| 25  | M   | Steroids for skin allergy | R: Stage IIb | 12 | R: CD+Iban | 2 | 1 | R: 94.6 | Normal | No progression or collapse |
|     |     |             | L: Stage III |                   |         |                             |                   |                   |      |        |
|     |     |             | L: Stage IV |                   |         |                             |                   |                   |      |        |
| 57  | F   | Steroids    | R: Stage IIa | 12 | R: CD+Iban | 3 | 1 | R: 79.2 | Normal | No progression or collapse |
|     |     |             | L: Stage IV |                   |         |                             |                   |                   |      |        |
| 54  | M   | -           | R: Stage IIa | 12 | R: CD + iban | 3 | 1 | 95.7 | Normal | No progression or collapse |
|     |     |             | L: Stage IV |                   |         |                             |                   |                   |      |        |
| 42  | M   | Alcoholic for 10 years | R: Stage I | 12 | R: CD+Iban | 2 | 1 | 96.7 | Normal | No progression or collapse |
|     |     |             | L: Stage III |                   |         |                             |                   |                   |      |        |
|     |     |             | L: Stage IV |                   |         |                             |                   |                   |      |        |
| 18  | F   | Steroids for dermatomyositis | R: Stage IIa | 12 | B/L Cd + Ibandronate | 4 | 1 | R: 84.7 | B/L osteopenia (-1.2 and -1.4 Z score) | No progression or collapse |
|     |     |             | L: Stage Iib |                   |         |                             |                   |                   |      |        |
|     |     |             | L: 3 |                   |         |                             |                   |                   |      |        |

**CD**: Core decompression; **THR**: Total hip replacement; **DEXA**: Dual energy X-ray absorptiometry; **R**: Right; **L**: Left; **Iban**: Ibandronate; **M**: Male; **F**: Female. **MHHS**: Modified Harris Hip Score, **VAS**: Visual Analog Scale
References

1. Kumar P, Shetty VD, Dhillon MS. Efficacy of orthobiologic adjuvants to core decompression for hip preservation in avascular necrosis hip. J Hip Preserv Surg 2020;7:423-38.

2. Kumar P, Sen RK, Aggarwal S, Jindal K. Common hip conditions requiring primary to-tal hip arthroplasty and comparison of their post-operative functional outcomes. J Clin Orthop Trauma 2020;11:S192-5.

3. Fairbank AC, Bhatia D, Jinnah RH, Hungerford DS. Long-term results of core decompression for ischaemic necrosis of the femoral head. J Bone Joint Surg Br 1995;77:42-9.

4. Hernigou P, Beaujean F. Treatment of osteonecrosis with autologous bone marrow grafting. Clin Orthop Relat Res 2002;405:14-23.

5. Sugiyama Y, Hotokebuchi T, Tsutsui H. Transtrochanteric anterior rotational osteotomy for idiopathic and steroid-induced necrosis of the femoral head. Indications and long-term results. Clin Orthop Relat Res 1992;277:111-20.

6. Yoon TR, Song EK, Rowe SM, Park CH. Failure after core decompression in osteonecrosis of the femoral head. Int Orthop 2001;24:316-8.

7. Aggarwal AK, Poornalingam K, Jain A, Prakash M. Combining platelet-rich plasma in-stillation with core decompression improves functional outcome and delays progression in early-stage avascular necrosis of the femoral head: A 4.5-to 6-year prospective random-ized comparative study. J Arthroplasty 2021;36:54-61.

8. Jindal K, Aggarwal S, Kumar P, Rathod P. Core decompression with bone marrow aspi-rate concentrate in post collapse avascular necrosis of hip: A systematic review and meta-analysis. J Clin Orthopa Trauma 2021;17:87-89.

9. Papavasiloiou AV, Triantafyllopoulos I, Paxinos O, Tsoukas D, Kostantoulakis C. The role of cell therapies and hip arthroscopy in the management of osteonecrosis: An up-date. J Hip Preserv Surg 2018;5:202-8.

10. Smith SW, Meyer RA, Connor PM, Smith SE, Hanley EN Jr. Interobserver reliability and intraobserver reproducibility of the modified Ficat classification system of osteonecrosis of the femoral head. JBJS 1996;78:1702-6.

11. Epstein S, Zaidi M. Biological properties and mechanism of action of ibandronate: Application to the treatment of osteoporosis.

Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this case report

How to Cite this Article
Kumar P, Aggarwal S, Jindal K, Patel S, Sharma S, Mahan M. Core Decompression Combined With Intraosseous Ibandronate for Pre-collapse Osteonecrosis of the Femoral Head: Report of a Novel Technique, its Safety, and Early Outcomes in Five Cases. Journal of Orthopaedic Case Reports 2021 December;11(12):96-100.