



OUTCOMES OF CORE DECOMPRESSION WITH PLATELET RICH PLASMA AND ORAL IBADRONATE SUPPLEMENTATION IN OSTEONECROSIS OF FEMORAL HEAD IN SICKLE CELL POSITIVE YOUNG ADULTS.

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Abstract:

BACKGROUND: Osteonecrosis of Femoral head (ONFH) is a common and serious complication of sickle cell disease (SCD). Without early treatment intervention, incidence of femoral head collapse and secondary osteoarthritis are very high and occur early in these patients. Aim of this study is to relieve the symptoms, improve the functional outcomes for better activity of daily life (ADL) and delay the progression of head collapse.

METHODS: In this retrospective study, 40 hips in 30 pts were selected by inclusion and exclusion criteria. Mean age was 25 years. All selected cases were belonging to **stage I, II and IIIa** according to **Modified Ficat and Arlet classification**. In all pts core decompression were done by making **two core tracks of 6 mm diameter with the help of Hollow-mill** and **PRP** was injected in both core track and packed with bone wax. Oral Ibandronate given in all pts for 6 months. Percutaneous adductor tenotomy was performed in stage **IIB** and **IIIa**. Functional outcome were assessed by Modified Harris Hip Score (MHHS) and radiological assessment done by serial X-rays and MRI. Follow up were done up to **96** weeks.

RESULTS: Average operative time was 30 minutes, average blood loss was 30 ml, average hospital stay was 7.5 days. Infection rate was only 5%. We observed **35% excellent, 45% good, 10% fair and 10% poor outcomes**.

CONCLUSION: We concluded that this technique is a relatively safe, cost effective, easy to perform, has very low complications rate and effective treatment option for the younger patients with **ONFH** in **SCD**.

Key words- ONFH, SCD, PRP, Ibandronate.

MANUSCRIPT

BACKGROUND

Osteonecrosis of femoral head (**ONFH**) have many aetiological factors. Sickle cell disease (**SCD**) is one of the common aetiological factors for osteonecrosis of femoral head. In **SCD patients**, **ONFH** is a cause of chronic severe pain and deterioration of activity of daily living (**ADLs**). **ONFH** in **SCD** was first reported as an incidental finding by **Huck in 1923**. Treatment of **ONFH** in young adults with **SCD** is a challenging subject. Without early treatment intervention, incidence of femoral head collapse and secondary osteoarthritis are very high and occur early in these patients (as compare to pts of **ONFH** due to other causes) which ultimately requires total hip replacement. Rate of femoral head collapse depends largely on site and extent of necrotic segment. Lesion which is lie outside the normal stress trajectories may remain structurally intact or collapse slowly while those involving the weight bearing area collapse faster. **SCD** is a genetic disorder in which red blood cell (**RBC**) contain abnormal haemoglobin (**HbS**). In deoxygenated blood, aggregation of the haemoglobin molecules increases leading to distortion of **RBC**. Initially this distortion is reversible and **RBC** regains their normal shape when blood is oxygenated. Eventually **RBC** membrane become damaged which leads to permanent distortion of **RBC**.

Etiopathogenesis of ONFH in SCD:-

SCD > Arteriolar occlusion > Marrow oedema > Sinusoidal compression > Vascular stasis> Osteonecrosis

The exact mechanism of osteonecrosis is a subject of debate. According to **Middlemiss and Raper** the bone tends to be the common site of ischemia because of diminished circulation and high oxygen utilization.^{1,2} According to **Murphy and Shapiro** and **Diggs** small vessel ischemia and arterial spasm may contribute to the destructive process. Rate and course of progression of the disease are unpredictable and radiological picture may not correlate with the clinical symptoms. In **SCD** patients clinical symptoms of **ONFH** appear at very early age compared to **ONFH** due to other causes. Bilateral involvement is very common approximately **40%-80%**. Sex incidence is almost **equal**. Various treatment options exist for **ONFH** like physical therapy, pharmacotherapy, osteotomies, resurfacing, core decompression and arthroplasty. So it is the needed to study a treatment modality which resolves the clinical symptoms, improves functional outcomes for better activity of daily life (**ADL**), delays the progression of femoral head collapse and have low complication rate.

With availability of **MRI**, now it is possible to diagnose the patients of **ONFH** in the early stage of disease.

METHODS

This was the retrospective study of **40 hips in 30 patients** conducted in Department of orthopaedics, PIMSR, Parul University, Vadodara, Gujarat (India) during the year **2019 to 2021**. All cases were selected by inclusion and exclusion criteria. Age of the patients in this study was ranged from 20 years to 40 years with mean age was 30 years. Modified Ficat and Arlet classification were used in this study. All selected patients were belonging to stage **I, II** and **IIIa**. **18(60%)** patients were male and **12 (40%)** patients were female. In this study, **18 (60%)** patients had bilateral involvement and **12 (40%)** patients had unilateral involvement. Among 40 hips, **20 hips were belongs to stage I, 16 hips in stage II** and **4 hips in stage III**. **Functional outcome was assessed by Modified Harris Hip Score (<70 = Poor, 70 – 79 = Fair, 80 – 89 = Good, 90 – 100 = Excellent) and radiological outcome by serial X-ray and MRI on regular follow up interval.**

OPERATIVE PROCEDURE:

Under spinal or general anaesthesia patient was placed on standard operating table in supine posture. We make lateral longitudinal incision starting from greater trochanter to 3 cm distally. Two guide wires were placed targeting the most necrosed and depressed part of femoral head under c-arm control. Each guide wire was over reamed with hollo-mill. Necrosed bone was removed out. Depressed articular margin of femoral head were elevated with help of small impactor. After that PRP was injected in both tract and packed with bone-wax. Percutaneous adductor tenotomy was performed in all hips with stage **IIb** and **IIIa ONFH**. Wound was closed and antiseptic dressing applied. Sutures were removed on **13th** postoperative day.

PRP supplementation: -15ml blood was taken from patient and sent to laboratory. They provide 4ml fresh PRP on urgent basis. PRP injected in both the tracts and packed with bone wax.

PHARMACOLOGICAL AUGMENTATION:- Oral ibadronate 150mg monthly started prior to surgery and continued for 24 weeks in all patients. Bisphosphonate inhibits the osteoclastic activity in the osteonecrotic lesion site and thus promote bone healing. It prevents the onset of subchondral fracture or collapse in early ONFH. Many studies had proved the beneficial effects of bisphosphonate in ONFH. ^{3,4,5,6,7}

POSTOPERATIVE PROTOCOL:

On 1st postoperative day static quadriceps and ankle pump exercise were started. From 2nd postoperative day, all movements of hip, knee and ankle were started. Partial weight bearing was started by 6th postoperative week and full weight bearing by 12th postoperative week. Follow up were done at regular interval of 6th week, 12th week, 18th week, 24th week, 48th week and 96th week.

RESULTS:

This was the retrospective study of 40 **hips in 30 patients** conducted in Department of orthopaedics, PIMSR, Parul University, Vadodara, Gujarat (India) during the year **2019 to 2021**. Average operative time was 30 **minutes (25-35 minutes)**, average blood loss was 30 ml (**20ml - 40ml**), average hospital stay was **7.5 days (5-10 days)**. Pain was relieved in all patients immediately after surgery. Two (**5%**) patients had superficial infection which resolved within a week. All patients with stage **I(20 pts)** showed excellent to good outcomes till final follow-up. Among **16 hips of stage II**, **12 (75 %)** hips had excellent to good outcomes and **2 (12.5 %)** hips had fair and **2(12.5%)** hips had poor outcome. All hips with stage **IIIa** had fair to poor outcome. Out of 4 hips of grade **III**, **2 (50%)** hips showed initial improvement in clinical findings up to **36th** week and **2 (50%)** hips up to **48th** week and there after progressive deterioration was started. In all 4 hips of stage **IIIa** total hip replacement were done after 48th postoperative week. Out of 30 patients on oral ibadronate, 2 patients (one with stage **IIb** and one with stage **IIIa**) were not taking regular ibadronate. All patients were instructed for partial weight bearing after 6th postoperative week but 2 patient (with stage **IIIa**) started full weight bearing after 6th postoperative week. Over all postoperative clinical outcomes according to MHHS – 14 hips (35%) had excellent outcome, 18 hips (45%) had good outcome, 4 hips (10%) had fair outcome and 4 hips (10%) had poor outcome. Highest postoperative MHHS score was **96** and lowest was 70. The mean score was **83**. Result was shown in table 3.

Table 1- showing age, sex and side affected incidence

Age range	No. of patients	Involvement		Sex incidence	
		U	B/L	M	F
20 – 26 years	6	4	2	4	2
27 – 33 years	16	6	10	8	8
34 – 40 years	8	2	6	6	2
Total	30	12 (40 %)	18 (60 %)	18 (60%)	12 (40%)

U= unilateral, B/L= bilateral, M = male, F= female

Table 2. Comparative results of different studies

Studies	Treatment Methods	Results
Gangii et al ⁸	CD with Bone Grafting CD alone	10% pts had head collapse 62.5%pts had head collapse
Stulberg et al	CD alone	70% success rate
Kang P et al ⁶	CD with Alandronate	Better result compare to CD alone
Kim and Assoc ⁹	CD(MD)	Lower rate of head collapse
Mukisi-Mukaza ¹⁰	CD	Delayed need for THR
Al -Jafar HA etal ⁷		Observed potential benefits
Our study	CD+PRP+Ibadronate	80% excellent to good result 20% fair to poor result

CD = core decompression, PRP= platelet rich plasma

Table 3 – Showing stage by final outcomes (used HHS)

STAGES	NO. OF HIPS	OUTCOMES			
		E (90 -98)	G (80 – 89)	F (70 – 79)	P (<70)
STAGE I	20	10	10	0	0
STAGE II	16	04	08	02	02
STAGE III	04	0	0	02	02
Total	40	14 (35%)	18 (45%)	04 (10%)	04 (10%)

E = Excellent, G = Good, F= Fair, P = Poor.

Radiological observation (on serial MRI & X ray):

In majority of hips with stage I and II ONFH, postoperative follow up MRI showed marked improvement in bone marrow changes with subtle abnormal high signal intensity changes, reduced irregularities with smoothening of articular surface, disappearance of cystic area, and evidence of revascularization as compared to preoperative MRI. Out of 4 hip of stage IIIa, 2 (50%) hip showed neither improvement nor deterioration up to 48th week but there after progressive deterioration were observed while in rest 2 (50%) hips progressive deterioration were observed after 12th postoperative weeks. Out of 16 hips of stage II, in 1 (6.25%) hip deterioration start after 48th week and in 1 (6.25%) hips after 72 week.

DISCUSSION:-

In our study, among 20 hips of stage I, 10 (50%) hips had excellent and 10 (50%) hips had good outcomes. Among 16 hips of stage II, 4 (25%) hips had excellent, 08 (50%) hips had good, 2(12.5%) hips had fair and 2 (12.5%) hip had poor outcome. Among 4 hips of stage III, 2 (50%) hips had fair and 2(50%) hips had poor outcomes.

Kim and associate demonstrated that the multiple drill hole technique for core decompression had a lower rate of collapse.⁹Mukisi-Mukaza et al. demonstrated delayed need for arthroplasty with early core decompression.¹⁰ Stulberg et al. reported approximately 70% success in patients with fical stage I, II and III who were operated with core decompression.¹¹ Studies suggested that core decompression with bone grafting yield better result compare to core decompression alone. Cancellous bone grafts become incorporated more quickly and completely than cortical bone grafts. Gangii et al. reported 62.5% femoral head collapse who had core decompression alone while 10% femoral head collapse who had core decompression with bone grafting during two years follow up.⁸ Some studies have shown complete resolution of the cystic changes and full functional recovery with no pain thereafter.

Beneficial result of bisphosphonate in ONFH has been proved by many studies. Agrawala et al first reported the efficacy of alandronate in the treatment of ONFH and showed that it not only improve

the symptoms but also retarded progression of disease and reduced the rate of collapse of femoral head.⁵ **Lai et al** reported efficacy of alandronate in the treatment of non traumatic ONFH in early stage.³ **Nishii Tet al** also found beneficial effect of bisphosphonate in treatment of ONFH.⁴ **Kang P. et al** found better result with multiple drilling and alandronate compare to multiple drilling alone.⁶ **Al-Jafar H.A et al** observed potential benefits of bisphosphonate in ONFH in SCD.¹² In our study with CD+PRP+oral ibadronate, 80% patients showed excellent to good result while 10% patients showed fair and 10% poor result.

CONCLUSION

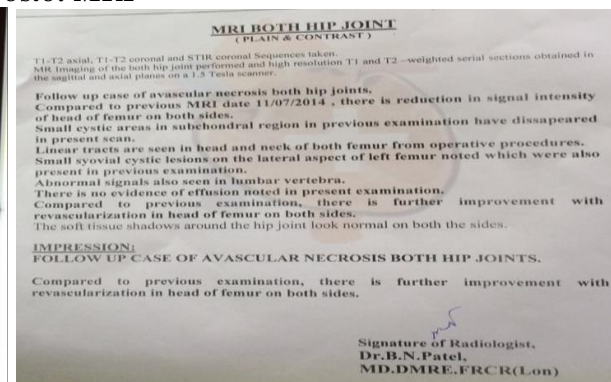
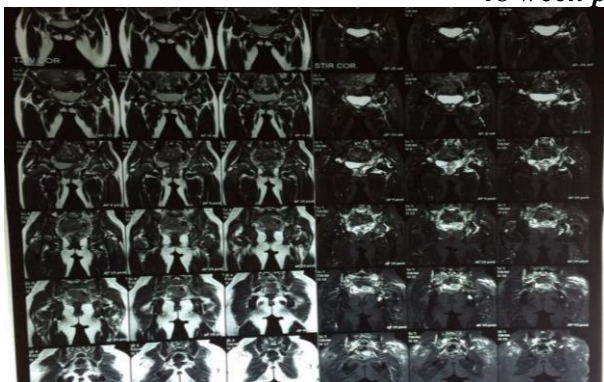
In this study, it is noticed that patients with stage **I** had excellent to good outcome, stage **IIa** had excellent to good outcome, stage **IIb** had good to poor outcome, stage **IIIa** had fair to poor outcome. So it is concluded that in early stage (stage **I** and **IIa**) this method of treatment is a good alternative to relieve symptoms, increase range of movement for better **ADL** and delay the collapse of femoral head in young patients with osteonecrosis femoral head in sickle cell disease. It was concluded that core decompression with PRP and oral ibadronate supplementation in ONFH in SCD if done in early stage (stage **I** and **IIa**), outcomes are very impressive. Beneficial result of bisphosphonate in ONFH have been proved in **many studies**.^{3,4,5,6,7} We recommend use of bisphosphonate (**oral ibadronate 150 mg/month**) along with core decompression and PRP in patient with osteonecrosis of femoral head in sickle cell disease. This technique is a relatively safe, easy to perform, has very low complications rate and effective treatment option for the younger patients with osteonecrosis femoral head in sickle cell disease. The only limitation of our study is that our observation was only up to 2 years; so long term observations are still awaited.

PHOTOGRAPHS

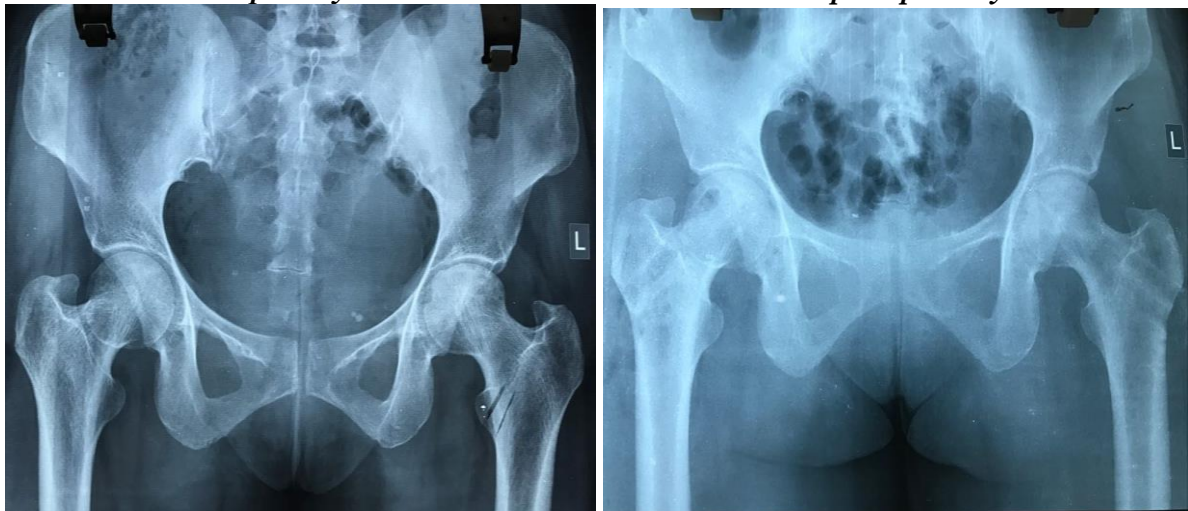
Case 1 - 22 years old SCD patient with Stage II ONFH (B/L).
6th postop. week



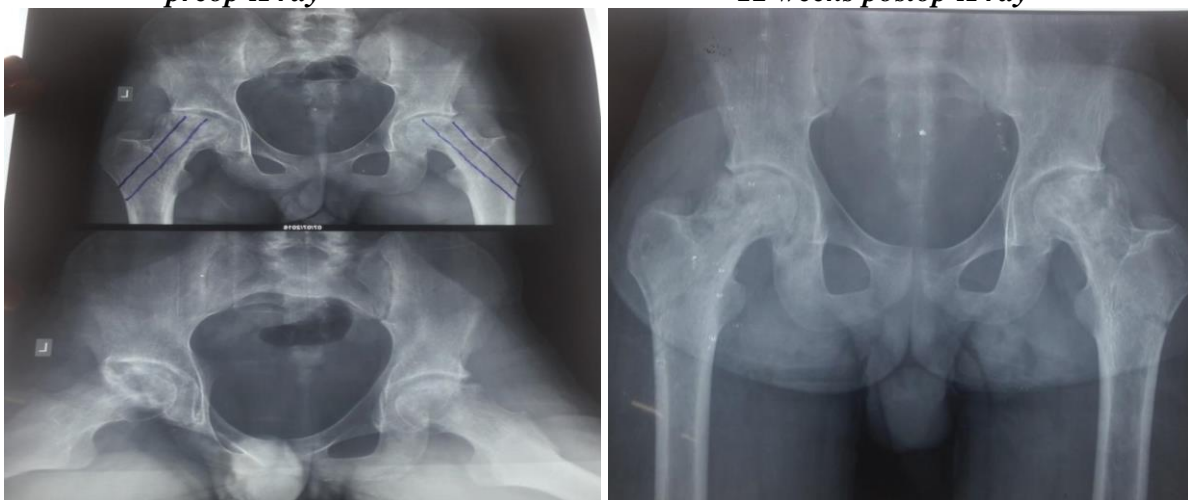
2 years postop
48 week postop. MRI



Case - 2 30 years old SCD pt with B/L ONFH
Preop X ray **Immediate postop X ray**



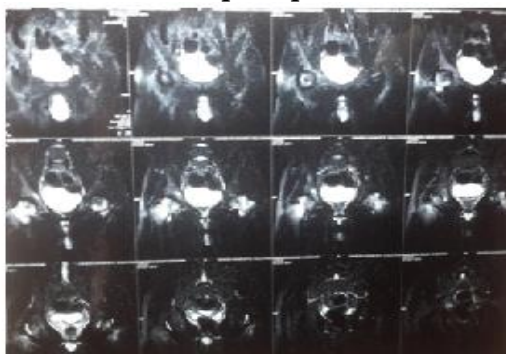
Case 3- 20 years old SCD pt with B/L stage III ONFH
preop X ray **12 weeks postop X ray**



Case 3 - 25 years old SCD pt with B/L ONFH
Preop. X ray **12 weeks postop.** **24 week postop.**



24 week postop. MRI



Case 4- 26 years male SCD pt with U/L ONFH

Preop. X ray



12 weeks postop. X ray



REFERENCE

1. Murphy R.C, Shaprio S (1945); The pathology of sickle cell disease. Ann. Intern. Med.23;376
2. Diggs L.W (1965); sickle cell crisis. Amer. J. Clin. Path. 44; 1.
3. Gangji V, Hauzeur JP. (2005); Treatment of Osteonecrosis of the femoral head with implantation of autologous bone marrow cells. JBJS 87,106-112
4. Lai K A, Shen WJ, Yang CY et al (2005); use of alandronate to prevent early collapse of femoral head in patients with nontraumatic Osteonecrosis. JBJS Am;87;2155-9.
5. Mukisi-Mukaza M, Manicom O, Alexis C, et al. (2009); Treatment of sickle cell disease's hip necrosis by core decompression: a prospective case control study. Orthop. Traumatol. Surg. Res. 95,498-504.
6. Sen RK, Tripathy SK, Agrawal S, et al. (2012); Early results of core decompression and autologous bone marrow mononuclear cell instillation in femoral head Osteonecrosis. J. Arthroplasty 27,679-686.
7. Kang P, Pei F, Shen B, Zhou Z, Yang J (2012); Are the result of multiple drilling and Alandronate for Osteonecrosis of the femoral head better than those of multiple drilling? A pilot study. JBS, 79(1); 67-72
8. Kim SY, Kim DH, Park IH et al. (2004); Multiple drilling compared with standard core decompression for the treatment of Osteonecrosis of femoral head. JBJS(Br),86-B,149.
9. Hernigou P, Beaujean F (2002); Treatment of Osteonecrosis with autologous bone marrow grafting, Clin. Ortho. Relat Res (405);14-23.
10. Nishii T, Sugano N, Miki H, Hashimoto J, Yoshikawa H (2006); does alandronate prevent collapse in Osteonecrosis of femoral head? Clin Orthop Relat Res, 443; 273-9.
11. Stulberg BN, et al (1991)osteonecrosis of femoral head. A prospective randomized treatment protocol.Clin Orthop Relat Res,July1991;(268):140-51

12. Al-Jafar HA, Al-Ali NS, Ali A, Alobaid A (2016); medical and surgical treatment options for early Osteonecrosis in sickle cell disease. *Ann. Hematol. Oncol.* 2016; 3(5):1092.