

A PROSPECTIVE STUDY OF MANAGEMENT OF SIMPLE BONE CYSTS IN CHILDREN AND ADOLESCENTS WITH PERCUTANEOUS CURETTAGE, BONE GRAFTING AND TENS

Pradeep Natikar¹, Sachin Shah², Shivaraj Hadimani³, Avinash R⁴, Vishwanath Chikkanargund³, Sibi Rana³

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Corresponding Author:

Dr. Shivaraj Hadimani,

Email: drshivarajhadimani@gmail.com

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¹Associate Professor, Department of Orthopaedics, KBNU-FOMS, Kalaburagi, Karnataka, India.

²Professor and Head of the Department of Orthopaedics, KBNU-FOMS, Kalaburagi, Karnataka, India

³Resident, Department of Orthopaedics, KBNU-FOMS, Kalaburagi, Karnataka, India

⁴Senior Resident, Department of Orthopaedics, Sri Chamundeshwari Medical College and Hospital Ramanagara, Karnataka, India

Abstract

Background: Simple/solitary bone cysts are lesions filled with fluid in the cavities resulting in thinning of the cortices resulting in pathological fractures. These cysts more commonly occur at the metaphyseal areas of long bones with growing physes. It is more common in children and adolescents. The treatment options available are steroid injection, open curettage and bone grafting, decompression and percutaneous injection of marrow or graft substitutes. **Materials and Methods:** Our study is a prospective study conducted from July 2022 to July 2023, involving 10 patients. All patients diagnosed with SBC of proximal femur were primarily treated with percutaneous curettage and bone grafting, with an additional TENS inserted to treat the pathological fracture. The lesions healed within an average of 11 weeks (Range from 10 weeks to 12 weeks), and at the end of 6 months TENS was removed. **Result:** All cases were followed up every week for the first month, twice weekly till 4 months, and once every month for 6 months. All cases started showing signs of healing from three weeks onwards and the fracture united radiologically at the end of 2 months. **Conclusion:** Our study shows that using curettage and bone grafting along with a percutaneous method using TENS helps in the healing of the lesion and uniting the fracture. Minimally invasive percutaneous method using TENS gives benefit of curettage cyst decompression and stabilization of fracture. Allogenic bone graft fills the cavity and healing of lesions by osseointegration. This method should be considered.

INTRODUCTION

Virchow first described a benign osteolytic cystic lesion in 1876,^[1] seen in the skeletally immature long bones of children at the metadiaphyseal region called as Simple bone cyst or Unicameral bone cyst.^[2] The etiopathogenesis and its natural history still remains to be elucidated.^[3] Solely in children and adolescents, upto 85% simple bone cysts occur, between 3 to 14 years of age.^[4-6] The predilection in males is twice as common as in females.^[7] Sites most affected are femur [Figure 1] and humerus but it is also seen in lumbar spine, calcaneus, pelvis, tibia and cuboid.^[8] Usually these patients do not have any symptoms and present most commonly with a pathological fracture.^[9]

Many treatment methods have been used in the management of SBC such as intralesional steroids injection,^[10] autologous bone marrow fluid

injection,^[11] open curettage and bone grafting,^[12] percutaneous curettage and bone grafting, with varied success rate. Therefore, as such, there is no uniform protocol for the treatment. SBC has a propensity for recurrence which causes harm to the growth of the child as multiple surgeries would be required. Hence, the management should be more efficient, with less bone union time, less recurrence and less invasive.



Figure 1a: Simple bone cyst of left femur. b: Pre-operative X Ray showing expansile lytic lesion with cortical break in the left proximal femur.

In our study, we are using a minimally invasive technique, with an approach which preserves the blood supply, periosteum and muscles around the SBC.

Objectives

1. To study the clinical features, occurrence, site involved.
2. To Identify the radiological features
3. To Describe functional outcomes and complications
4. To Describe when simple bone cyst requires treatment

MATERIALS AND METHODS

Our study is a prospective study conducted from July 2022 to July 2023, involving 10 patients with a mean age of 9.8 years, with 7 female patients and 3 male patients. Right side was involved in 6 patients and 4 patient had left side involved. All the patients with SBC involving proximal end of femur were treated in our hospital (KBNIMS, Kalaburagi), with percutaneous curettage and bone grafting. 2 patients presented with an associated pathological fracture [Figure 1b], so an additional percutaneous TENS was inserted for the stabilization of fracture. Patients were taken up for surgery because of restricted movements of hip, severe pain and impending fracture. All routine laboratory investigations were done and found to be normal. On plain X-rays, at the metaphyseal diaphyseal junction, expansile lytic lesions were seen. 2 patients had an additional pathological fracture. Same was seen on multislice CT, an expansile lytic lesion in 8 patients and with cortical break in 2 patients.

Allogenic bone grafts which were gamma irradiated and deep frozen were obtained from TATA Memorial Hospital, Mumbai [Figure 3] for packing the cavity of the cyst after curettage.

Under general anaesthesia and C-ARM guidance, a skin incision measuring 4-6 cm was made on the anterolateral aspect of the light and holes were drilled in the outer cortex of the proximal femur percutaneously with a drill bit of 3.2 mm. With a small scoope (resembling ice-cream scooper) curettage was done. Contents of the cyst were aspirated and thorough saline wash was given. The

aspirated materials were sent for histopathological analysis.

A 3 mm flexible TENS was inserted in 2 patients presented with pathological fracture for breaking the septae and decompressing the cyst. Bone marrow was aspirated from the (rt) iliac crest with a 5cm incision and mixed with the morselized allogenic bone marrow graft. This was used to fill the cyst cavity completely. Wound was closed by simple ethilon sutures.

Confirmation of simple bone cyst was given by the histopathological reports. Regular dressings were done and patients were followed up every week for the first month, twice weekly till 4 months, and once every month for 6 months [Figure 4a and 4b]. Broad spectrum antibiotics and anti-inflammatory coverage was provided. All the patients showed fracture union and resolution of the cyst with complete range of motion at hip joint by 12 weeks.

Ethical clearance for this research article has been obtained from Institutional Ethical clearance committee.

Inclusion Criteria

- Simple bone cyst of femur
- Age <14 years
- Diagnosis confirmed by X-Ray, CT/MRI
- No prior treatment before admission

Exclusion Criteria

- Simple bone cyst of othe bones like humerus, flat bones
- Associated with othe neoplasms,

Statistical Data Analysis

Statistical data was analyzed by IBM SPSS 20.0 version software. Collected data were spread on excel sheet and prepared master chart. Through the master chart tables and graphs were constructed. For quantitative data analysis mean and standard deviations were calculated and un-paired t-test was applied for statistical significant, for qualitative data analysis chi-square yates correction test was applied for statistical significance. If P-value was less than 0.05 considered as significant.

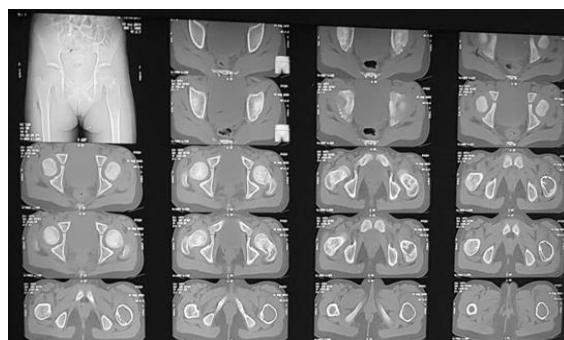


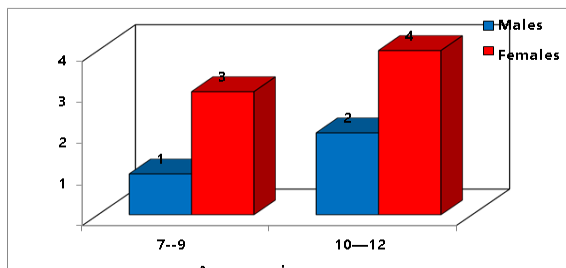
Figure 2: CT scan of left femur showing expansile cortical lesion with a cortical break.



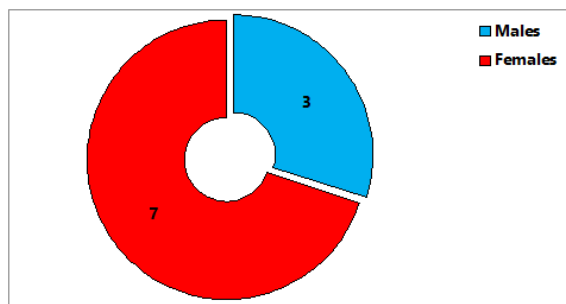
Figure 3: Freeze dried, gamma radiated, allogenic bone graft

RESULTS

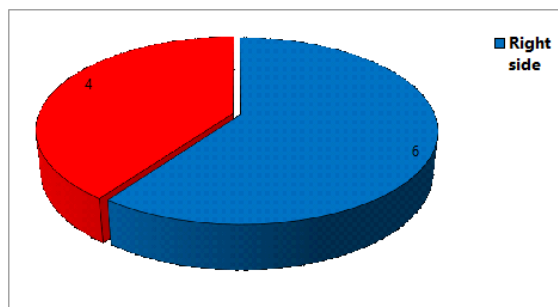
Study observes that, Number of patients 4 (40.0%) were belongs to the age group of 7—9 years and 6 (60.0%) of patients were belong to the age group of 10—12 years. Minimum age of the patient was 7 years and maximum age of the patient was 12 years. The mean age of male patients was 10.67 years and the mean age of female patients was 9.57 years. The mean age of all patients was 9.80. There was statistically no significant difference of age among gender ($P > 0.05$).



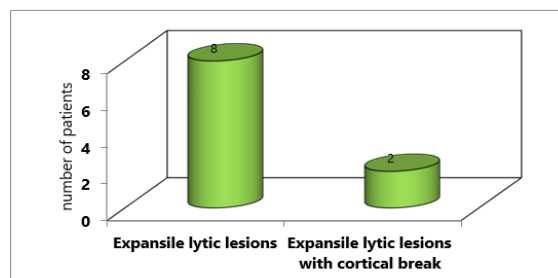
Multiple bar diagram represents age and gender wise distribution of patients



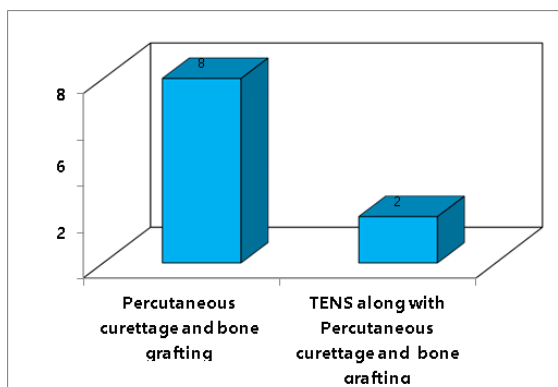
Pie diagram represent gender wise distribution of patients



Pie diagram representside involve of proximal femur wise distribution of patients



Bar diagram present type of fracture wise distribution of patients



Bar diagram present procedure of treatment wise distribution of patients

Of the 10 patients, in the age group ranging from 7-12 years, 3 were males and 7 females. Percutaneous curettage and bone grafting was done in 8 patients. TENS along with percutaneous curettage and bone grafting was done in 2 patients who had presented with pathological fracture. All cases were followed up every week for the first month, twice weekly till 4 months, and once every month for 6 months. All cases started showing signs of healing from three weeks onwards and the fracture united radiologically at the end of 2 months. Patients had a complete range of motion by the end of 3 months. TENS was removed at the end of 6 months in 2 patients presented with pathological fractures. No recurrence was noted and none of the patients had any complications.



Figure 4a: Post-operative Xray at 3 months.



Figure 4b: Post-operative Xrays at 5 months.

Table 1: age and gender wise distribution of patients

Age in years	Males		Females		Total	
7—9	1	33.3	3	42.8	4	40.0
10—12	2	66.7	4	57.2	6	60.0
Total	3	100.0	7	100.0	10	100.0
Mean ± SD	10.67 ± 3.05		9.57 ± 2.63		9.80 ± 2.83	
P-value	t = 0.578 P = 0.579, NS					

NS= Not significant, S=Significant, HS=Highly significant

Table 2: distribution of patients according side involve of proximal femur

Side involvement	Number of patients	Percentage
Right side	6	60.0
Left side	4	40.0
Total	10	100.0

Right side involved in 6 (60.0%) patients and 4 (40.0%) of patients had left side involved.

Table 3: type of fracture wise distribution of patients

Type of fracture	Number of patients	Percentage
Expansile lytic lesions	8	80.0
Expansile lytic lesions with cortical break	2	20.0
Total	10	100.0

Study observed; out of 10 patients; 8 (80.0%) patients were seen expansile lytic lesions and 2 (20.0%) of patients were seen expansile lytic lesions with cortical break

Table 4: procedure of treatment wise distribution of patients

Procedure of treatment	Number of patients	Percentage
Percutaneous curettage and bone grafting	8	80.0
TENS along with Percutaneous curettage and bone grafting	2	20.0
Total	10	100.0

Out of 10 patients; 8 (80.0%) patient's treatment procedure was percutaneous curettage and bone grafting and 2 (20.0%) patient's procedure was percutaneous TENS and bone grafting.

DISCUSSION

Simple bone cyst is also called a Unicameral bone cyst or traumatic bone cyst. It is a benign cyst which occurs more commonly in the first two decades.^[13,14]

On imaging, it is seen as an expansile lytic lesion, sometimes with a pathological fracture due to thinned out cortices.^[15] Typically, it occurs at the metaphysis near the physis of the long bones. It is seen most commonly in proximal femur and humerus but also has been noted in vertebrae, pelvis, ribs and tarsal bones.^[15]

The differential diagnosis for Simple bone cysts are aneurysmal bone cyst, monostotic fibrous dysplasia, eosinophilic granuloma and enchondroma.^[16] Two most important differential diagnosis of cystic lesions

in children include unicameral bone cyst and aneurysmal bone cyst.

As the etiopathogenesis of Simple Bone Cyst is yet unknown, several theories have been hypothesized.^[17-19]

In the study by Harnet et al,^[20] they proposed the theory of "trauma-hemorrhage", which is the most commonly accepted theory but was disregarded by some, as most of the cases did not have a previous trauma history. So, it was concluded that SBC must have a multifactorial etiology.^[21]

In the study conducted by Aarvold et al., they found a that the kappa-B ligand which is a receptor activator of nuclear factor signaling mechanism,^[22] helps in the osteoclastogenesis which supports the study which shows interaction between osteoblastic cells and osteoclast progenitors to recruit osteoclasts when

induced by IL-1.^[23] As the fluid analyses of Simple bone cysts reveals high levels of IL-1,^[24] PGE-2,^[25] acid phosphatase,^[26] and proteolytic enzymes,^[27] this shows that inflammation induced by trauma can be related to increased activity of osteoclasts resulting in Simple bone cyst.

In a similar study by Komiya et al,^[27] etiopathogenesis of simple bone cyst was related with high inflammatory markers like PGE-2, IL-1, bone resorption induced by gelatinase and venous obstruction leading to high intraosseous pressure. Here the treatments used were local steroid injections and curettage of the cyst. For cyst decompression K-wires, IM nails,^[28] and cannulated screws were used.^[29]

In the study by Spence et al,^[30] they packed the cystic cavity by cancellous bone graft which was freeze dried. This is a relatively new method.

Wright et al,^[31] did a comparative study of healing rates of SBCs when treated with intralesional injections of methylprednisolone acetate which was found to be 42% and with bone marrow which was just 23%. Similar study by Canavese et al,^[32] did a comparative study of healing rates which was highest after being treated with percutaneous curettage which was 70%, bone marrow injection which was 21% and with methylprednisolone acetate injection which was 41%.

In our study we used TENS in patients presented with pathological fractures to decompress the cyst and stabilize the fracture. Allogenic bone graft mixed with autologous bone graft from iliac crest was used to pack the cyst cavity. This was a minimally invasive method. Titanium elastic nails have been used to reduce the medullary canal and cyst pressure and to clear the septae in the cyst.^[33] The lesions healed within 3 months and no complications or recurrences have been observed till date.

CONCLUSION

Minimally invasive technique using bone curettage and aspiration along with Titanium Elastic Nailing system along with allogenic bone graft is an excellent method in the treatment of Simple bone cysts in children and adolescents.

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