

The Effect of Steroid in the Treatment of Simple Bone Cysts

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Abstract

Objective: Although simple bone cysts are long-known lesions, an optimal treatment has not yet been found. There are quite different results reported in studies done with a steroid injection technique which is a popular treatment method today. The results of patients with pathological fractures who did not accept any treatment method were compared with the steroid injection technique.

Method: Twenty-four patients who had steroid injection technique (Group-I) and 19 patients who had had pathological fractures and who did not accept any treatment method (Group-II) between 1995 and 2011 were included the study. Plain radiographic evaluation criteria of Capanna were used in comparisons, and MRI was used with patients whose plain radiological findings were healed with residual phase. The results were rated according to both plain radiographs and MRI findings.

Results: The patients in Group-I were followed up for an average of 5.7 (2-9) years. Successful results were obtained in 18 patients (75%) according plain radiographs and in 13 patients (54%) according to MRI findings. The patients in Group-II were followed up 3 (2-7) years. Successful results were obtained in 15 patients (78.9%) according to plain radiographs and in 11 patients (57%) according to MRI findings.

Conclusion: No difference was observed in terms of the healing of cysts between the patients treated with a steroid injection technique and the patients that were only observed.

Keywords: Bone cyst; Observe; Steroid injection

Introduction

These lesions seen in growing children were defined about a hundred years ago. Although a century has passed since it was first defined, there has been no serious advance in the natural history, etiology and treatment of these lesions. It is seen in all bones of the skeleton and approximately 90% are localized in the humerus and femur. The lesion is generally diagnosed after a pathological fracture, and is slightly expanded containing serous fluid usually in metaphysis of long bones, making the cortex thin and remaining unicameral unless there is a pathological fracture.

Although its etiology has been attributed to many factors [1-9], none of them has progressed beyond theory. However in recent years there is consensus among the authors that a defect in venous drainage plays a role in its etiopathogenesis [3-6,8,9]. In this respect many modalities have been performed in the treatment of this lesion, but as yet without acceptable success. Among these treatment modalities there are mechanical treatments including curettage and grefonage [10-12], treatment methods with injection (steroids, bone marrow, demyelinated bone matrix) [11,13-17] decompression of cysts (multiple drilling, pin, nail and screw) [18-20], structural support and decompression (elastic intramedullary nail) [21-24]. The long-used and the most popular of these treatment modalities is the cortisone injection technique. The success rate was reported as 90-96% in studies which were done with steroid injection techniques in the 1970s and 1980s [13,14]. However in studies that were done in the 2000s, it

was reported that the success rate of this technique was between 20% and 40% [20,25].

Still there continues to be a lack of consensus about the natural course of the lesion. It is claimed that the bone cysts become clinically and radiologically stable and recover spontaneously after maturation of the skeleton [11]. On the other hand the spontaneous recovery rate of bone cysts is reported as 4-15% [10,12]. Yet, studies done with a limited number of cases in recent years suggested that the recovery rate is quite higher than the rate that is indicated above and that is generally accepted [26,27].

This study reports the results of patients who were treated by steroid injections, and the results of the patients who did not accept any treatment modality and with pathological fractures.

Material and Methods

Fifty-five patients diagnosed with solitary bone cyst between 1995 and 2011 were retrospectively studied. The study included patients with pathological fractures who did not accept any treatment and patients who steroid injection was performed. The diagnosis of simple cyst was confirmed with clinical and radiological findings and with the results of macroscopic and microscopic analysis of the aspirated fluid.

Group I: consisting of 30 patients in which steroid injection was performed. Six of these patients were excluded from the study for leaving the follow-up. Steroid injection was done under general anesthesia by using a bone marrow aspiration needle. It was determined under flouroscopy and then the bone marrow aspiration

needle was inserted inside the cyst and aspirated the cyst contents. A second bone marrow aspiration needle was inserted to wash the cyst cavity with normal saline. After finishing the washing process the second needle was removed and methylprednisolone acetate 120 mg was injected into the cyst from the first needle. Injection therapy was performed to each patient 3 times at 2 month intervals.

Group-II: In this group 25 patients were admitted with pathological fractures diagnosed as bone cysts. This group consisted of patients who did not accept any treatment method used in bone cysts. Six of these patients were excluded from the study for leaving the follow-up.

The same treatment was performed on the patients who had applied with pathological fractures in both groups. If the pathological fracture was localized in the proximal metaphysial area of the humerus, velpeau bandage was applied to these patients. Long arm splint was applied to the patients if the fracture was localized in the diaphysial area. The follow-up of patients was done with anteroposterior and lateral plain radiographs. MRI was also used with patients in both groups whose radiological findings were healed with residual phase following their last control with plain radiographs

Results were evaluated according to the criteria of Capanna [14]: (1) complete healing: when the cyst was completely filled with a new bone formation and the cortical margins had thickened; (2) healing with residual radiolucency: when most of the cyst was filled with bone and had healed, it was well consolidated with bone, and the cortical margins had thickened but there were still small, residual areas of radiolucency; (3) recurrence: when the cyst had healed initially and had become filled with bone but large areas of radiolucency and cortical thinning subsequently developed; and (4) no response to the treatment; when there was no evidence of any effect of treatment. Both local recurrences and no response represented a failure of treatment.

MRI findings: MRI findings and grading were based on Capanna X-Ray measurement criteria.

Results

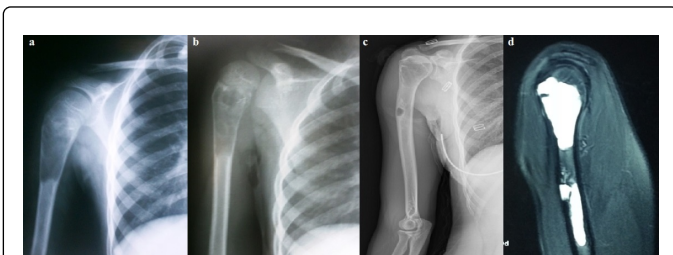


Figure 1: An 8-year-old female patient. Active bone cyst in proximal humerus, a. Steroid therapy was applied; b. Control image from 3rd month; pathological fracture developed; c. Control image in the 3rd year; and it was accepted as being at residual recovery phase; d. The inside of the cyst is filled with fluid as found in MRI imaging is seen.

GROUP-I: Sixteen of 24 patients who were included the study were male, eight of them were female and 19 of the lesions were at proximal humerus metaphysis. Twelve of the lesions were active. The cyst area measured in plain radiographs was an average of 67.9 (27-115) cm³. Seventeen of these patients were admitted with pathological fractures (Table 1). The patients were followed up for an average of 5.7 (2-9) years. Upon evaluation according to Capanna criteria in plain

radiographs, successful results were obtained in 18 patients (75%) (Table 2). An additional MRI was performed on 13 patients who were accepted as incomplete healing (healed with residual). Although the area of the cyst was consolidated and partial cortical thickening was seen in plain radiographs of these patients during the follow-up, clinical complaints developed in some patients (Figure1). According to MRI results, successful results were obtained in only 13 patients (54%) (Table 3). In this group, as a complication humeral shortening of 2 and 3 cm developed in two lesions localized in meta-epiphysis.

GROUP II: Thirteen of 19 patients who were included the study were male, six of them were female and the mean age of the patients was 10.2 (8.5-18.2) years. Thirteen of these lesions were active and all of them were localized in the humerus. Seventeen of the lesions that were localized in the humerus were in metaphysis. The mean cyst volume was 72.5 (67.7-123.8) cm³. The patients were followed up for an average of 3 (2-7) years. Upon evaluation with plain radiographs, successful results were obtained in 15 of the lesions (78.9%) (Table 2). All of the patients who had incomplete healing in plain radiographs were checked again with MRI (Figure 2). It was seen that successful results were obtained in 11 (57.9%) of these lesions (Table 3). As a complication, malunion developed in one patient and shortening of the humerus by 3 cm developed in one patient.

Variables	Steroid Group	Observation Group	P Value
	Group-I= 24	Group-II=19	
Mean age (years)	9.3 ± 3.2	10.2 ± 3.8	0.678
No of M/F	16/8	13/6	0.428
Cyst area (cm ³)	67.9 ± 14.2	72.5 ± 15.8	0.544
Activity			
Active	12	13	0.642
Inactive	12	6	0.745
Involved bone			
Humerus	19(%79)	19(%100)	0.002
Radius	2	0	
Fibula	2	0	
Ulna	1	0	
Anatomical loc.			
Metaphysis	19	17	0.662
Meta-epiphysis	2	1	
Diaphysis	3	1	
Pathological frac.	17	19	0.002

Table 1: Details of the steroid injection technique and observation groups

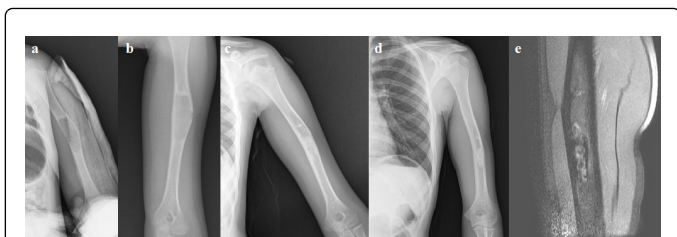


Figure 2: An 11-year-old male patient with bone cyst first admitted with pathological fracture, a. Long arm splint was applied to stabilize the fracture; b. Control image (2nd month); c. Control image (1st year); d. Control image (3rd year); e. MRI (3rd year).

Variable	Steroid Group (Group-I)		Observation Group (Group-II)	
	Success: N=18	Failure: N=6	Success: N=15	Failure: N=4
Mean Age	11.5 ± 3.4	8.3 ± 2.8	10.2 ± 3.6	9.8 ± 3.9
Male/Female	5-Sep	3-Jul	2-Sep	4-Apr
Add Fractures	13	4	11	7
Activity				
Active	7	5	5	6
Latent	8	4	6	2
X-ray				
Healed	5	0	7	0
With residual	13	0	8	0
Recurrent	0	3	0	2
Persistent	0	3	0	2
Complication	2	0	2	0

Table 2: Details of the results of both groups according to X-Ray findings

Grades	STEROID GROUP		OBSERVATION GROUP		P Value
	Number	Percent	Number	Percent	
Healed	5	13(54)	7	11(57)	0.766
With residual	8		4		
Recurrence	8	11(46)	6	8(43)	0.822
Persistence	3		2		

Table 3: Success rates of the groups based on MRI findings

Statistical analysis: in this study no statistically significant difference was found between healing lesions in both groups in terms of cyst area (P=0.773), cyst activity (p=574), distance from physis, and healing (p=0762).

Authors and Year	No of cysts	Resolved	Not resolved	Resolution rate Percent (%)
Garceau (1954)	19	3	16	15.7
Garceau (before1954)	lit. 55	8	47	14.5
Neer (1966)	41	3	38	8
Neer (1973)	48	1	47	2.08
Total	163	15	148	9.2
Kaelin (1989)	11	5	6	46
Mylle 1992	12	4	8	33
Chuo(2003)	7	6	1	85
Tey (2009)	13	5	8	38.46
Author	19	11	8	57
Total	62	31	31	50

Table 4: Literature data of observation of pathologic fracture cysts

Discussion

The etiopathogenesis of simple bone cysts remaining theoretical, causes not forming a consensus on treatment of these lesions. Although many factors are blamed in its etiology, the theory of venous drainage defect defined by Cohen et al [4,5] is among the generally accepted theories. In this theory there is an obstruction in venous return with unknown etiology along with a fluid secretion especially transudate in nature. This fluid contains proteolytic enzymes and substances increasing the osteoclastic activity such as interleukin-1 β , prostoglandin-E2 and gelatinase [5]. There are two important factors in pathogenesis. The first is bone-resorptive factors that are found in cyst contents, the second is the intracystic pressure increase secondary to continuous fluid secretion. On the other hand, different from Komiya et al we think that when the intracystic pressure reaches a certain level, “intraosseous compartment syndrome” will develop and therefore endosteal and periosteal arterial circulations will also be affected.

Another controversial topic is the natural history of the bone cysts. Much of the data on this subject are only assertions. One thing that is known is that during the natural course of this lesion at least one pathological fracture develops in almost all cases. The rare incidence of this lesion after maturation has generated the idea that the cysts regress and recover spontaneously [11]. 80% of cases admit with complaints of pathological fracture. The debates about the healing rates of cysts after pathological fractures are ongoing but there is no definitive data about the natural course of the fracture. Information about the natural course of the fracture relies on data from Neer et al. and Garceau et al. According to a study done by Garceau et al. [10] in 1954, 27 cases were observed without any treatment. They reported that only 3 (15.7%) of 27 cases healed. In the same study they cited literature stating that 8 (14.54%) of 55 patients who were presented had healed. The ratio of 15% reported by the author was based only on cysts which healed during the healing process of the pathological fracture. In 1966 Neer et al. [12] followed up 45 patients admitted with pathological fractures over 1-10 years. The fracture was in the

proximal part of the humerus in 41 of 45 patients. They reported that in only 3 (8%) of these patients, healing of the cyst was seen together with the healing of the fracture. In another study done by the same authors in 1973, they reported that only one cyst of 48 patients with pathological fracture was obliterated [28]. According to the data that we acquired in the literature review, a total of 163 lesions were observed before 1980 [10,12,28]. In all, successful results were reported in only 15 (9.2%) of these lesions (Table 4).

According to our knowledge no serious clinical study investigating the natural course of the patients with pathological fracture has been done after 1980. However some authors followed up a small number of cases and reported the results in order to follow up the natural course of the patients who were admitted with pathological fracture [26,27,29-31]. Sixty-two cases were followed up for this purpose. It was reported that 31 of 62 cases (50%) healed spontaneously and 31 cases did not heal (Table 4). The patients admitted to our clinic with pathological fractures were followed up approximately for 3 years without any treatment. The fractures healed in an average of 3.7 weeks. During follow-up, a total of 18 fractures developed in 13 patients. The natural course of the spontaneous healing of the cyst was that trabecular bony structures form in unicompartamental lesion after each fracture and then it takes on a multicompartamental appearance. After each fracture the number of compartments increased and the volume of each compartment decreased. In time, the lines of the fractures decreased and the duration of healing of the fracture shortened and the cortex thickened.

To the best of our knowledge, 28 different treatment modalities have been performed since the bone cysts were first defined and the desired success has not yet been achieved, so the search for new treatments continues. However today the steroid injection technique is one of the treatments which remain popular and about which serious studies have been done in recent years. This technique was first performed by Scaglietti et al. [13], treated 82 cases with bone cysts with the cortisone injection technique between 1974 and 1975. They reported the results of 72 patients whose controls were done. Thirty-four of these patients had been admitted incidentally with pain and the rest were admitted with pathological fractures. They reported that after follow-up of these patients for 1-3 years, successful results of 90% were achieved. In 1982 Capanna et al. [14], 90 patients were treated with the same technique and they achieved 80% good results. In a study done by Oppenheim et al [11] in 1984, they reported a success rate of 95% and a complication rate of 0%. In 1986 Campanacci et al. [32] treated 141 patients with cortisone injection technique. They achieved successful results in 128 (90%) of 141 patients.

On the other hand after the 1990s successful results with the steroid injection technique were not as high as those achieved in previous years. Success rates critically decreased in the 2000s. In a study done by Wright et al. [26] in 2008, 38 patients were treated with the steroid injection technique. They achieved successful results in 16 (42%) of these patients. In a study done by Brecej et al. [21] in 2007, they treated 69 patients diagnosed with bone cyst with conventional surgery, cannulated screw and steroid injection technique. They reported that successful results were achieved in only 19% with steroid injection technique. On the other hand, Chuo et al. [27] treated patients who were diagnosed with bone cyst, with observation, cannulated screw and conventional surgical techniques. They reported that there was no difference between the three techniques in terms of results. We reported successful results in 18 (75%) of 24 patients based on direct radiographical evaluations. On the other hand, MRI was

performed in 21 cases (in both groups) who were accepted as being in residual healing phase radiologically. Only in 12 of these 21 cases the healing criteria were observed.

Many factors that can affect the healing of cysts were attributed. Many factors such as the patient's age, volume of the cyst, localization of the cyst, the distance of the cyst from the epiphysial line and gender of the patient and even the treatment modality were attributed and serious studies were performed about these factors. However a consensus could not be reached on any factor or factors that can affect the results. In our study no statistically significant difference was found in either group between the healed and unhealed groups in terms of age, gender, volume, distance to the physical line or treatment modality.

The presence of fluid secretion and the pressure increase secondary to the increased fluid and the cytokines that the fluid contains are important factors that play role in pathogenesis of this lesion. We believe that when the fluid that is continuously secreted reaches a certain volume, in addition to venous obstruction, the arterial circulation is also affected and both play an important role in the pathogenesis of this lesion. Ultimately "intraosseous compartment syndrome" develops. The lesion together with the pathological fracture carries out a spontaneous "faciotomy" operation. It will carry out the first step in treatment process by decreasing the intracystic process. In the steroid injection technique, the cortical hole that is opened and the fluid removed during steroid injection cause a decrease in intracystic pressure. We think that this process plays the primary role in the healing of the cyst. However it is not yet known whether it has a direct effect or a neutralization function on these substances present inside the cyst or not.

Conclusions

In conclusion, the present situation in the treatment of cysts is still at the initial point that was defined by Morton in 1982. Morton [33] reported that in his series of 76 bone cysts most ran their own course and were not greatly affected by treatment. The techniques which are performed as of 2013 are not the primary means of treatment of cysts, but rather depend on decreasing the intracystic pressure. We have to await the spontaneous repair of the basic pathology by the bone tissue. At the present time, the only point at which we can help in repair seems to be in decreasing the intracystic pressure. We believe that steroid has no primary curative role in the treatment of bone cysts, but that other factors occurring during steroid injection or natural course of the cyst itself (pathological macro and/or micro fractures developing during the treatment process, procedures causing a decrease in intracystic pressure during injection) may play a supportive role in the healing process.

References

1. Mirra JM, Bernard GW, Bullough PG, Johnston W, Mink G (1978) Cementum-like bone production in solitary bone cysts (so-called .cementoma. of long bones): Report of three cases. Electron microscopic observations supporting a synovial origin to the simple bone cyst. Clin Orthop 135: 295-307.
2. Jaffe HL, Lichtenstein L (1942) Solitary unicameral bone cyst: With emphasis on the roentgen picture, the pathologic appearance and the pathogenesis. Arch Surg 44:1004-1025.
3. COHEN J (1960) Simple bone cysts. Studies of cyst fluid in six cases with a theory of pathogenesis. J Bone Joint Surg Am 42-42A: 609-16.

4. Cohen J (1970) Etiology of simple bone cyst. *J Bone Joint Surg Am* 52: 1493-1497.
5. Komiya S, Minamitani K, Sasaguri Y, Hashimoto S, Morimatsu M, et al. (1993) Simple bone cyst. Treatment by trepanation and studies on bone resorptive factors in cyst fluid with a theory of its pathogenesis. *Clin Orthop Relat Res* : 204-211.
6. Markovic B, Cvijetic A, Karakasevic J (1988) Acid and alkaline phosphatase activity in bone-cyst fluid. *J Bone Joint Surg Br* 70: 27-28.
7. Gerasimov AM, Toporova SM, Furtseva LN, Berezhnoy AP, Vilensky EV, et al. (1991) The role of lysosomes in the pathogenesis of unicameral bone cysts. *Clin Orthop Relat Res* : 53-63.
8. Gebhart M, Blaimont P (1996) Contribution to the vascular origin of the unicameral bone cyst. *Acta Orthop Belg* 62: 137-143.
9. Chigira M, Maehara S, Arita S, Udagawa E (1983) The aetiology and treatment of simple bone cysts. *J Bone Joint Surg Br* 65: 633-637.
10. Garceau GJ, Gregory CF (1954) Solitary unicameral bone cyst. *J Bone Joint Surg Am* 36: 267-280.
11. Oppenheim WL, Galleno H (1984) Operative treatment versus steroid injection in the management of unicameral bone cysts. *J Pediatr Orthop* 4: 1-7.
12. Neer CS 2nd, Francis KC, Marcove RC, Terz J, Carbonara PN (1966) Treatment of unicameral bone cyst. A follow-up study of one hundred seventy-five cases. *J Bone Joint Surg Am* 48: 731-745.
13. Scaglietti O, Marchetti PG, Bartolozzi P (1982) Final results obtained in the treatment of bone cysts with methylprednisolone acetate (depomedrol) and a discussion of results achieved in other bone lesions. *Clin Orthop Relat Res* : 33-42.
14. Capanna R, Dal Monte A, Gitelis S, Campanacci M (1982) The natural history of unicameral bone cyst after steroid injection. *Clin Orthop Relat Res* : 204-211.
15. Yandow SM, Lundeen GA, Scott SM, Coffin C (1998) Autogenic bone marrow injections as a treatment for simple bone cyst. *J Pediatr Orthop* 18: 616-620.
16. Killian JT, Wilkinson L, White S, Brassard M (1998) Treatment of unicameral bone cyst with demineralized bone matrix. *J Pediatr Orthop* 18: 621-624.
17. Wilkins RM, Kelly CM, Giusti DE (1999) Bioassayed demineralized bone matrix and calcium sulfate: use in bone-grafting procedures. *Ann Chir Gynaecol* 88: 180-185.
18. Ekkernkamp A, Lies A, Ostermann P (1995) Simple bone cysts treated by continuous decompression with screws. *J Bone Joint Surg (Br)* 77: 210.
19. Shinozaki T, Arita S, Watanabe H, Chigira M (1996) Simple bone cysts treated by multiple drill-holes. 23 cysts followed 2-10 years. *Acta Orthop Scand* 67: 288-290.
20. Brecej J, Suhodolcan L (2007) Continuous decompression of unicameral bone cyst with cannulated screws: a comparative study. *J Pediatr Orthop B* 16: 367-372.
21. Brecej J, Suhodolcan L (2007) Continuous decompression of unicameral bone cyst with cannulated screws: a comparative study. *J Pediatr Orthop B* 16: 367-372.
22. Santori F, Ghera S, Castelli V (1988) Treatment of solitary bone cysts with intramedullary nailing. *Orthopedics* 11: 873-878.
23. Roposch A, Saraph V, Linhart WE (2000) Flexible intramedullary nailing for the treatment of unicameral bone cysts in long bones. *J Bone Joint Surg Am* 82-82A: 1447-53.
24. de Sanctis N, Andreacchio A (2006) Elastic stable intramedullary nailing is the best treatment of unicameral bone cysts of the long bones in children?: Prospective long-term follow-up study. *J Pediatr Orthop* 26: 520-525.
25. Givon U, Sher-Lurie N, Schindler A, Ganel A (2004) Titanium elastic nail--a useful instrument for the treatment of simple bone cyst. *J Pediatr Orthop* 24: 317-318.
26. Wright JG, Yandow S, Donaldson S, Marley L; Simple Bone Cyst Trial Group (2008) A randomized clinical trial comparing intralesional bone marrow and steroid injections for simple bone cysts. *J Bone Joint Surg Am* 90: 722-730.
27. Chuo CY, Fu YC, Chien SH, Lin GT, Wang GJ (2003) Management strategy for unicameral bone cyst. *Kaohsiung J Med Sci* 19: 289-295.
28. Kaelin AJ, MacEwen GD (1989) Unicameral bone cysts. Natural history and the risk of fracture. *Int Orthop* 13: 275-282.
29. Neer CS, Francis KC, Johnston AD, Kiernan HA Jr (1973) Current concepts on the treatment of solitary unicameral bone cyst. *Clin Orthop Relat Res* : 40-51.
30. Mylle J, Burssens A, Fabry G (1992) Simple bone cysts. A review of 59 cases with special reference to their treatment. *Arch Orthop Trauma Surg* 111: 297-300.
31. Tey IK, Mahadev A, Lim KB, Lee EH, Nathan SS (2009) Active unicameral bone cysts in the upper limb are at greater risk of fracture. *J Orthop Surg (Hong Kong)* 17: 157-160.
32. Campanacci M, Capanna R, Picci P (1986) Unicameral and aneurysmal bone cysts. *Clin Orthop Relat Res* : 25-36.
33. Morton KS (1982) Unicameral bone cyst. *Can J Surg* 25: 330-332.