

## Autogenous Bone Graft as a Surgical Method for Treatment of Simple Bone Cyst in Calcaneus

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### ABSTRACT

**Background:** Simple bone cysts are benign lesions with fluid content, commonly occur in the proximal femur and humerus and rarely occur in the calcaneus. Calcaneal bone cysts are usually asymptomatic, diagnosed incidentally on radiographs and rarely susceptible to pathological fractures, but it may present with heel pain. The site of the cysts is usually the neutral triangle of the calcaneus. Plain radiograph, CT, MRI and histopathology examinations are the diagnostic tools for simple bone cyst (SBC) in calcaneus.

**Objective:** To evaluate the results of using autogenous bone graft in surgical treatment of simple bone cysts in calcaneus.

**Patients and Method:** A prospective study held between February 2019 and February 2020, where 12 patients included with simple bone cyst in the calcaneus managed by curettage and autogenous bone graft were admitted to Orthopedic Department at Zagazig University Hospitals and followed up for 6 to 12 months.

**Results:** Age of the patients ranged from 5 to 30 years with mean age of 15.8 years. 8 [66.7%] patients were male and 4 [33.3%] patients were female. All of the patients had heel pain and two of them [16.7%] had pathological fractures. 10 patients [83.3%] had complete healing of the cyst while 2 patients [16.7%] of them healed with defect and all of the studied cases [100%] had complete clinical resolution. The observed complications during the follow-up period were superficial infection on one [8.3%] patient and delayed wound healing on another [8.3%] patient.

**Conclusion:** Curettage and autogenous bone graft is an effective successful method for treating SBC in the calcaneus.

**Keywords:** Autogenous bone graft, Calcaneus, Curettage, Simple bone cyst.

### INTRODUCTION

Simple bone cysts are benign lesions filled with fluid. The frequent sites are the proximal femur and humerus (75–80%). They rarely occur in the calcaneus but calcaneus is the most common tarsal bone affected<sup>(1)</sup>.

Contrary to other bone cysts, the calcaneal bone cysts are asymptomatic, rarely susceptible to pathological fractures and incidentally diagnosed as a result of minor trauma to the foot or ankle. However, pain is the major complain in many patients and it may be severe to affect their daily activities. The size of the cyst is generally less than 1/3–1/2 of the calcaneal length<sup>(2)</sup>.

The etiology of simple bone cysts remains unclear and the most accepted pathogenesis is the venous obstruction of the interstitial fluid drainage in an area of rapidly growing cancellous bone lead to development of simple bone cyst<sup>(3)</sup>.

The site of the cysts is usually the neutral triangle of the calcaneus where stresses are physiologically low<sup>(4)</sup>. Plain X-ray, CT, MRI and histopathology examination are the diagnostic

tools to determine these cysts<sup>(5)</sup>. SBC should be differentiated from other calcaneal lesions as ABC, lipoma, Ewing's sarcoma, GCT, osteoid osteoma, osteomyelitis and metastasis<sup>(6)</sup>.

In the majority of cases, conservative management is preferred due to the negligible symptoms and the rare incidence of pathological fractures<sup>(7)</sup>. The main indication for surgical treatment is pain or an impending pathological fracture. According to Pogoda's criteria, calcaneal cysts that take up 100% of the cross-section in the coronal plane or at least 30% of the calcaneus in the sagittal plane represent a potential risk for a pathological fracture and should receive prophylactic surgical treatment even if the cyst is asymptomatic<sup>(8)</sup>.

General treatment options include steroid injection, curettage with autologous or allogenic grafting, bone substitutes, multiple drilling and continuous decompressions through a cannulated screw. The risk of recurrence can be reduced by mechanical destruction of the inner cyst wall by application of chemical or thermal intraoperative



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adjuvants (95% ethanol, phenol, cryotherapy)<sup>(9,10)</sup>. Curettage with bone graft demonstrated significant improvements with low risk of complications<sup>(11)</sup>.

The aim of this work is to evaluate the outcomes of using autogenous bone graft in treatment of SBC in calcaneus.

## PATIENTS AND METHODS

**Research Design:** A prospective clinical trial conducted during the period of February 2019 to February 2020.

**Sample Size:** 12 patients with simple bone cyst in the calcaneus were admitted and operated in the Orthopedic Department of Zagazig University Hospitals. The follow-up period of the cases ranged from 6 -12 months.

**Ethical approval:** The study was approved by the local Patient Protection Committee and the study was registered. All patients were included after signed consent.

### Inclusion criteria:

- 1- Spontaneous onset of recurrent heel pain during daily activities.
- 2- SBC in calcaneus at risk for pathological fracture.
- 3- Failed conservative measures.
- 4- Surgically fit patients.
- 5- Both genders were included.

### Exclusion criteria:

- 1- Asymptomatic cases.
- 2- Infection.
- 3- Patients with insufficient follow-up data or lost.
- 4- Patients who had previous surgical intervention related to the cyst.

The clinical data of the patients fulfilling the inclusion criteria were evaluated as follows:

### A) Clinical data:

Careful history taking was done for all patients with special care was given to the history of previous trauma, the affected side, occupation and any previous surgery involving the calcaneus bone. Careful examination was done to detect any associated injuries, exclude infection and other causes of heel pain as Achilles tendinitis, planter fasciitis and tarsal tunnel syndrome.

### B) Radiographic evaluation:

The patients had the following radiological examinations:

- 1) **Plain X-ray:** (Antero-posterior, lateral and axial views) to detect the lesion and exclude other causes of heel pain as heel spurs and Haglund's deformity.
- 2) **CT scan:** to detect extent of the lesion and the fracture.
- 3) **MRI:** to detect the fluid-fluid level.

### C) Laboratory investigations:

The patients had the following preoperative routine lab investigations:

Complete blood count, random blood glucose level, bleeding profile, ESR, CRP, liver and kidney function tests.

### D) Surgical technique:

- 1) 6 patients in the study were managed using general anesthesia, while 6 patients using spinal anesthesia, prophylactic broad spectrum antibiotic was taken before induction of anesthesia and tourniquet insufflation by about one hour.
- 2) The patient was placed in the lateral decubitus position with a mid-thigh pneumatic tourniquet to aid hemostasis. Fluoroscopic AP and lateral axial views were performed before draping to confirm adequate visualization.
- 3) Draping the entire lower abdomen free from the umbilicus line distally was performed, including the involved lower limb.
- 4) Configuration of the calcaneal bone cyst: A needle was placed on the lateral side of the hind foot under fluoroscopic control to locate the cyst cavity exactly.
- 5) A lateral approach through a small skin incision was made just on the lateral aspect of the calcaneal cyst (Fig. 1).
- 6) Meticulous dissection to avoid sural nerve injury.
- 7) The peroneal tendons sheath was opened and the peroneal tendons were retracted downward.
- 8) Round shaped bone windows were made at the lateral wall of the cyst (Fig. 2).
- 9) After biopsy of the inner wall, the cyst was curetted through the bone windows and washed out with saline solution.
- 10) An autogenous bone graft from the anterior iliac crest, fibula, proximal or distal tibia was used to fill the cyst completely under fluoroscopic control (Fig. 1).



**Figure (1):** Complete filling of the calcaneal cyst with bone graft is confirmed by fluoroscopy in the operating room.



**Figure (2):** Skin incision on the lateral aspect of the calcaneal cyst and round shaped bone windows were made at the lateral wall of the cyst .

**Follow up and rehabilitation program:**

A short leg cast was placed on every patient for 3 weeks. All patients were followed with serial lateral and axial radiographs on a monthly basis for the first 3 months then every 6 months. After the first dressing change, full range of motion exercises was permitted and the patients used crutches with non-weight-bearing for 6 weeks. Partial-weight bearing for 2 more weeks and full-weight-bearing without crutches was permitted at the end of 8<sup>th</sup> week.

**Statistical analysis**

Patients’ data were presented as frequency and percentage for categorical variables, mean and SD for numerical variables. Groups were compared by independent samples Student t-test and X<sup>2</sup>-test for numerical and categorical data, respectively. All data and statistical analyses were handled by statistical

package for the social sciences (SPSS, IBM, SPSS Inc.Chicago, USA) computer package version 22.

**RESULTS:**

12 (8 males and 4 females) patients with simple bone cysts in the calcaneus were treated at Zagazig University Hospital by curettage and autogenous bone graft (Table 1).

**Table (1):** Demographic data of the studied group.

Item	No=12	%=100
<b>Age (Years.)</b>	<b>Mean ± SD:</b> 15.81 ± 8.13	
	<b>Range:</b> 5-30	
<b>Sex:</b>		
• <i>Males</i>	8	66.7
• <i>Females</i>	4	33.3

This table shows the basic data of the patients.

**Table (2):** Basic data of the studied group.

Item	No=12	%=100
<b>Size of calcaneus/Size of cyst (mm.)</b>	<b>Mean ± SD:</b> 68.33 ± 9.29/ 20 ± 4.7	
	<b>Range:</b> 54-82/13-29	
<b>Side of injury:</b>		
• <i>Right</i>	5	41.7
• <i>Left</i>	7	58.3
<b>The physis:</b>		
• <i>Open</i>	5	41.7
• <i>Closed</i>	7	58.3

This table shows that all of the studied group had heel pain.

**Table (3):** Clinical presentation among the studied group.

Item	No=12	%=100
<b>Heel pain</b>	12	100
<b>Pathological fracture</b>	2	16.7

This table shows the previous treatment received by the patients.

**Table (4):** Types of previous treatment among the studied group.

Item	No=12	%=100
<b>Previous treatment:</b>		
• <i>No</i>	3	25
• <i>Conservative treatment</i>	8	66.7
• <i>Steroid injection</i>	1	8.3

According to **Chang** classification (Table 7)<sup>12</sup>; healed cysts were observed in 10 cysts (83.3%) while two cysts (16.7%) were healed with defect.

The observed complications during the follow-up period of our study were superficial infection on one patient treated with systemic antibiotic and repeated dressing and delayed wound healing on another diabetic patient managed by good control of blood glucose level (Table 5).

**Table (5):** Postoperative data among the studied group.

Item	No=12	%=100
<b>Complications:</b>		
• <i>No</i>	10	83.3
• <i>Superficial infection</i>	1	8.3
• <i>Delayed wound healing</i>	1	8.3
<b>Chang radiological results:</b>		
• <i>Healed</i>	2	16.7
• <i>Healed with defect</i>		
<b>Clinical resolution:</b>		
• <i>Complete</i>	12	100

This table shows follow-up period and time until return to activities.

**Table (6):** Follow-up and time of return to activities among the studied group.

Item	Length of Follow-up (months)	Time until return to activities (months)
<i>Mean ± SD:</i>	8.7 ± 2.5	4.4 ± 0.6

**Table (7):** Radiological classification of simple bone cysts according to **Chang et al.**<sup>(12)</sup>.

Classification	Description
<b>Healed Cyst</b>	-The cyst had filled with new bone formation. -Small static radiolucent area(s) is less than 1 cm in size may still present.
<b>Healing with defect</b>	-The majority of the cyst had filled with new bone. -The radiolucent area(s) is less than 50% of the diameter of the bone. -There is adequate cortical thickness to resist fracture.
<b>Persistent cyst</b>	-The radiolucent area is greater than 50% of the bone diameter. -There is a thin cortical rim. -No increase in cyst size. -It needs continuous restriction of activity and repeated treatment.
<b>Recurrent cyst</b>	-The cyst reappears in a previously obliterated area. -There is a residual radiolucent area that has increased in size.

**CASE PRESENTATION**

A 25 years old female was admitted to Zagazig University Hospital with simple bone cyst in the left calcaneus.

The main complaint of the patient was left heel pain 1.5 year ago not responding to medical treatment and limiting her ability to walk. There was no history of any previous trauma. Preoperative investigations were done (Figs. 3 and 4).

Surgical treatment of the cyst was done using curettage and autogenous bone graft from the iliac crest (Fig. 5, 6). Biopsy from the inner wall was done to confirm the diagnosis (Fig. 7).

Radiographs on the left ankle were taken 1 month, 3 months, and 6 months after surgery (Figs. 8, 9, 10).



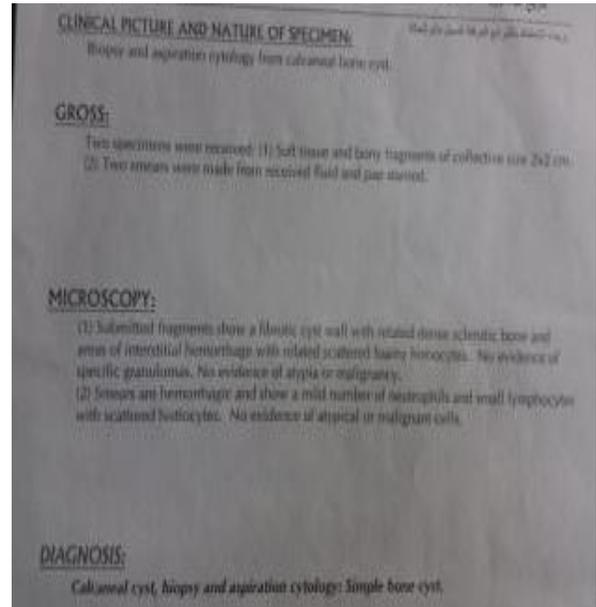
**Fig. (3):** Preoperative radiographs showing a well defined osteolytic lesion within the neutral triangle of left calcaneus (SBC).



**Fig. (4):** Preoperative axial view CT scan of the left calcaneus showing a cystic lesion without any pathologic fracture.



**Fig. (5):** Preoperative MRI showing SBC of left calcaneus.



**Fig. (7):** The report of the biopsy obtained from the lining cyst wall.



**Fig. (8):** Lateral radiographs on the left ankle one month after surgery.



**Fig. (6):** Immediate postoperative radiographs (Lateral and AP views).



**Fig. (9):** Lateral radiographs on the left ankle 3 months after surgery.



**Fig. (10):** Lateral radiographs on the left ankle 6 months after surgery.

## DISCUSSION

Simple bone cysts are benign lesions with fluid content rarely occur in the calcaneus<sup>(1)</sup>. There are no established guidelines for the management of simple bone cysts in the calcaneus<sup>(13)</sup>. In spite of recommendation of surgical treatment by many authors to avoid pathological fracture, others recommend non operative treatment as most of the cysts are asymptomatic and discovered incidentally on radiographs<sup>(14)</sup>. However, most authors recommend the operative treatment for painful, large sized cysts which are at risk of pathological fracture especially on patient with heavy physical activity<sup>(13)</sup>.

CT and MRI help us to identify the extent of the lesions, exclude other pathologies and detect the risk of pathological fracture (there is high risk of fracture if the cyst occupy most of the calcaneus from the lateral to the medial wall)<sup>(5)</sup>.

Curettage and filling of the cyst with autogenous bone graft is the main method for surgical treatment of calcaneal simple bone cysts being successful method with good outcomes in spite of the disadvantages associated with donor site morbidity as infection and persistent pain<sup>(14)</sup>. Other methods of treatment include allogeneic bone graft, bone substitutes as calcium phosphate and corticosteroid injection which has a high rate of recurrence<sup>(13)</sup>. The disadvantages of allografts are the risks of disease transmission and immune response against the graft<sup>(15)</sup>.

The goals of surgery are to prevent or manage the pathological fracture, promote cyst healing, prevent cyst recurrence and re-fracture and provide a good quality of life without any activities restriction<sup>(16)</sup>.

**In this study**, regarding epidemiology, the mean age of the participants was  $15.81 \pm 8.13$ . The majority of

cases were males (66.7%) with left side prevalence (58.3%).

Our follow-up period was 6-12 months and the mean follow-up period was  $8.7 \pm 2.5$  months. An excellent result was recorded in 10 patients, with the other 2 cysts defined as residual defect. Healed cysts according to **Chang** classification were observed in 10 cysts, two cysts were healed with defect which may be due to insufficient amount of the autogenous bone graft. There was no any persistent or recurrent cysts.

**Nishimura et al.**<sup>(17)</sup> reported the outcomes of surgical treatment of simple bone cysts in the calcaneus by curettage and calcium phosphate cement (CPC) in 8 patients (3 Male and 5 Female). The mean age was  $13.0 \pm 3.2$  and the mean follow-up period was  $44.3 \pm 23.2$  months. The radiographic assessment at the final follow-up visit showed no recurrence or pathologic fracture in any patient. However, one patient (12.5%) developed temporary irritation at the sural nerve area and one patient (12.5%) experienced CPC leakage along the peroneal tendon sheath, which was seen immediately in the radiograph after surgery. The patient felt pain in that area for 4 months after surgery then the patient's pain had decreased and CPC leakage was not seen on the radiograph.

So the results of this study are better than results of the study of **Nishimura et al.**<sup>(17)</sup> because of sural nerve injury, CPC leakage and peroneal tendons irritation are not detected on this study due to careful dissection during surgery and the dependence on autogenous bone graft and not on any exogenous material.

In a study done by **Polat et al.**<sup>(18)</sup> on 36 calcaneal cysts in 33 patients (19 Male and 14 Female), 3 patients showed bilateral involvement. The mean age was 37.9 years and the mean follow-up period was 2 years. Calcaneal cysts were treated surgically, of these 10 patients (27.7%) were treated with curettage and autogenous iliac wing grafting. Regarding **Chang** classification, complete healing was achieved in all cases (100%). However, 3 patients had postoperative disc heel pain and one patient developed osteoarthritis of the subtalar joint. No signs of recurrence were detected. The higher incidence of complications in this study may be due to the higher number of surgically treated patients and the longer period of follow up in comparison to our study<sup>(19)</sup>.

So the results of this study are compatible with the results of the study done by **Polat et al.**<sup>(18)</sup> as complete healing was observed in all cases treated with autogenous bone graft, which has an osteoinductive and an osteoconductive activity. The complications in this study were much lower.

## CONCLUSION

Curettage and autogenous bone graft is an effective successful method for treating SBC in the calcaneus as it provides good results of complete cyst healing of most of the cases with low incidence of postoperative complications.

**Conflict of interest:** None of the authors declare that they have any conflict of interest related to this work.

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