FOOT AND ANKLE

Simple calcaneal bone cysts

A PILOT STUDY COMPARING OPEN VERSUS ENDOSCOPIC CURETTAGE AND GRAFTING

This pilot study analysed the outcome of open versus endoscopic curettage and bone grafting for the treatment of simple calcaneal bone cysts. A total of 26 patients were evaluated into two equal groups: group 1 was treated with traditional open curettage and bone grafting and group 2 was treated with endoscopic curettage and percutaneous bone grafting. Cyst size, operating time, length of stay, time to healing, complications, further surgery and radiological healing were recorded and differences were statistically compared.

The mean age of the patients was 22.9 years (18 to 28) and the mean follow-up was 28.7 months (24 to 36). There were no statistically significant differences in regard to age of patients, cyst size and the follow-up periods in the two groups. The operating time and mean length of stay of group 2 patients was significantly shorter than group 1 patients (p < 0.001). The time to healing was similar in the two groups. The overall success rates for groups 1 and 2 were 92.3% (12 of 13) and 100% (13 of 13), respectively, and there were no statistically significant differences regarding radiological healing. This pilot study suggests that endoscopic curettage and percutaneous grafting is a simple and safe form of treatment, with similar results to those following open treatment.

Many forms of treatment are available for simple calcaneal bone cysts, including observation, steroid injections, curettage without grafting, the use of bone substitutes, osseo-inductive materials or freeze-dried bone allografts, multiple drill holes and continuous decompression of the cyst using implants traversing the cyst cavity. The purpose of these procedures is to relieve pain, prevent pathological fractures, promote healing of the cyst and prevent recurrence and re-fracture.

One of the methods most commonly used is open curettage and bone grafting, with a reported success rate ranging from 55% to 65%. Patients with persistent or recurrent symptomatic cysts often require an open surgical procedure. Due to the high re-operation rate and associated morbidity with open procedures, alternative treatment options have been pursued using percutaneous techniques.

Although these have fewer soft-tissue complications, they also sacrifice the potential advantages of direct exposure. In order to overcome this limitation of inadequate exposure, percutaneous endoscopic curettage has been recommended. To our knowledge, this is the first study in the literature prospectively comparing open with endoscopic curettage and bone grafting for the treatment of unicameral bone cysts of the calcaneum.

The purposes of this pilot study were to analyse the outcomes of these two approaches and to compare the results after a minimum of two years follow-up.

Patients and Methods

Between January 2000 and December 2008, all patients with a simple unicameral calcaneal bone cyst, scheduled to undergo surgical treatment, were considered for this study. A presumptive diagnosis was established on the basis of the history, physical examination, characteristic radiological features, CT and MRI scans if needed. The diagnosis was confirmed histologically for all patients.

Inclusion criteria were recurrent or persistent pain in the heel during activities of daily living; failed conservative forms of treatment including rest and gradual re-introduction of normal activity with nonsteroidal anti-inflammatory drugs for at least six months, and the risk of impending fracture. The criteria for this were a cyst that completely filled the bone in the coronal view on CT scans and occupied at least 30% of the length of the calcaneum anteroposteriorly (measured from the articular surface for the cuboid to the dorsal tuberosity). Follow-up, including radiological review at two years post-operatively, was necessary. Patients with local symptoms...
from other possible causes such as bursitis of the heel, heel spurs, plantar fasciitis, tarsal tunnel syndrome, Achilles tendinitis or Haglund's deformity were excluded.

A total of 29 patients, who were all male, were enrolled into the study. Informed consent was obtained from all the patients. Two patients were lost to follow-up and one with a pathological fracture was excluded. Thus a total of 26 patients were available for the final analysis.

The patients were divided into two groups; 13 patients treated with traditional open curettage (group 1), and 13 treated with percutaneous endoscopic curettage (group 2) as previously described by Yildirim et al. For all patients in both groups, additional corticocancellous allograft was used.

The patient is placed in the supine position on the operating table with a sandbag under the ipsilateral hip. For those in group 1, an open lateral approach is made to expose the wall of the cyst. A cortical window is removed and the cyst debrided with curettes and washed out with saline solution. Corticocancellous allograft chips (TranZgraft; Tissue Banks International (TBI), Baltimore, Maryland) are introduced. For those in group 2, a needle is placed on the lateral side of the hindfoot under fluoroscopic control to locate the cyst exactly (Fig. 1).

The viewing portal incision is made at the lateral aspect of the calcaneum, centred directly over the cyst (Fig. 2). A blunt trocar is then introduced through the lateral wall of the calcaneum. A 4.0 mm, 30° arthroscope is inserted into the cystic cavity through the lateral wall in order to visualise the contents of the cyst (Fig. 3).

Fig. 1
Clinical photograph showing a needle placed on the lateral side of the hindfoot in preparation for isolation of the cyst with the fluoroscope.

Fig. 2
Radiograph under fluoroscopic control showing the precise localising of the cyst cavity.

Fig. 3
Clinical photograph showing the placement of the 4.0 mm, 30° endoscope into the cystic cavity through the lateral wall in order to visualise the contents of the cyst.

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The viewing portal incision is made at the lateral aspect of the calcaneum, centred directly over the cyst (Fig. 2). A blunt trocar is then introduced through the lateral wall of the calcaneum. A 4.0 mm, 30° arthroscope is inserted into the cyst to visualise its contents (Fig. 3). Next, a second portal is created approximately 2 cm anterior to the viewing portal (Figs 4 and 5). The contents of the cyst are evacuated through this portal, and tissue is procured for biopsy. A 30° arthroscope is used for visualisation of the cavity (Fig. 6), and to allow guided curettage with a shaver, followed once more by the introduction of corticocancellous allograft chips (Fig. 7). A below-knee cast was retained for all patients in both groups for three weeks. Partial weight-bearing was allowed as tolerated for the next three weeks and then full weight-bearing.

All clinical assessments were done by two investigators (CY and KK) blinded to the radiological outcome. The size of the cyst (measured from the articular surface of the cuboid to the dorsal tuberosity), the operating time, length of hospital stay, time to healing and any further procedures...
were recorded. Complications, including delayed wound healing, sensory deficit and pain, were also recorded. Time to healing (in weeks) was recorded as the period required for consolidation of the cyst on anteroposterior and lateral radiographs. Serial lateral and axial radiographs were evaluated on a monthly basis for the first three months and every six months thereafter. At the final follow-up visit, two investigators (OS and IA), blinded to the clinical outcome, evaluated the radiographs using the classification system of Chang, Stanton and Glutting,\textsuperscript{13} which was a modification of the original Neer classification system\textsuperscript{14} (Table I). The procedure was thus considered successful if the cyst was completely healed or had healed with a defect. When there was no radiological evidence of consolidation of the cyst or cortical thickening six months after the procedure (persistent cyst), or when recurrence occurred (recurrent cyst), an additional procedure was carried out and the outcome was deemed a failure.

**Statistical analysis.** Differences between the two treatment groups in regard to age, the size of the cyst, the length of follow-up, the operation time, the length of hospital stay and the time to healing were analysed using the Mann-Whitney U test. Differences in radiological evidence of healing between the two groups were analysed using Fisher’s exact and chi-squared tests. Statistical analysis was performed using the SPSS 11.0 software package (SPSS Inc.,...
Chicago, Illinois) and the level of significance level was set at $p < 0.05$ with 95% confidence intervals (CI).

A power analysis indicated a cut-off value of 0.8. Below this value was accepted as an under-powered study sample size. Our power analysis revealed that, our sample size for this study was under-powered with a value of 0.31. For this reason, the study was accepted as a pilot study for a possible future randomised controlled trial.

**Results**

The mean age of the patients at operation was 22.9 years (18 to 28), and the mean follow-up was 28.7 months (24 to 36). There were 15 (57.7%) cysts in the right and 11 (42.3%) cysts in the left calcaneum. The mean size of the cysts was 26.8 mm (21 to 36). There were no statistically significant differences between the two treatment groups with regard to age, cyst size and length of follow-up ($p = 0.797$, $p = 0.224$ and $p = 0.088$, respectively).

The presenting symptom was pain in 17 cases (65.4%); and in nine patients (34.6%) the cyst was an incidental finding during investigation of local trauma, which was judged to present a risk of pathological fracture according to the criteria of Pogada et al.\(^1\) All cysts were located at the base of the calcaneal neck inferior to the anterior portion of the posterior facet with a pyramidal shape, sclerotic borders, pure lysis with no septi or trabeculations (Fig. 8a).\(^1\)\(^5\)

The mean operating time was significantly longer for the patients in group 1 (67.3 minutes (60 to 75) *versus* 45 minutes (40 to 50); $p < 0.01$).

The mean hospital stay was significantly longer for the patients in group 1 (4.7 days (4 to 6) *versus* 2.2 days (2 to 3); $p < 0.01$).

The cyst showed complete radiological evidence of healing at a mean of 14.6 weeks (12 to 32) for group 1 and 12.8 weeks (12 to 15) for group 2, with no statistical significance between the groups ($p = 0.345$). Daily activities returned to normal after complete healing and all patients have remained asymptomatic.

Two patients in group 1 had wound drainage for four or five days; this was treated with wound dressings and oral antibiotics. There were, however, no wound infections or any other complications in group 2.

In the radiological follow-up, according to Chang’s criteria,\(^1\)\(^3\) nine patients in group 1 had a healed cyst, three had healing with defects and one had a persistent cyst and underwent further surgery six months after the original

### Table I. Radiological classification of unicameral bone cysts according to Chang, Stanton and Glutting\(^1\)\(^3\)

<table>
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<tr>
<th>Classification</th>
<th>Description</th>
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<tbody>
<tr>
<td>Healed</td>
<td>Cyst filled by formation of new bone with or without small static, radiolucent area(s) $&lt; 1$ cm in size</td>
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<tr>
<td>Healed with defect</td>
<td>Static, radiolucent area(s) $&lt; 50%$ of the diameter of bone with enough cortical thickness to prevent fracture</td>
</tr>
<tr>
<td>Persistent cyst</td>
<td>Radiolucent areas $&gt; 50%$ of diameter of the bone and with a thin cortical rim. No increase in cyst size. Continued restriction of activity or repeated treatment is required</td>
</tr>
<tr>
<td>Recurrent cyst</td>
<td>Cyst reappeared in a previously obliterated area or residual radiolucent area has increased in size</td>
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Fig. 8a

Lateral radiographs of a 23-year-old patient, a) pre-operatively, showing the septal cystic cavity, and b) at a follow-up of 12 months, showing no recurrence of the solitary cyst of the calcaneum.

Fig. 8b
operation and complete healing was achieved two months later. In group 2, eleven patients had a healed cyst (Fig. 8b) and two had healing with defects. There was no persistent cyst and no recurrence. The overall radiological success rates for group 1 and 2 were 92.3% (9 healed and 3 healed with defect, out of 13) and 100% (11 healed and 2 healed with defect, out of 13), respectively.

Using chi-squared and Fisher’s exact tests, there was no statistically significant difference regarding radiological healing between the two groups at final follow-up (p = 0.308 for chi-squared and p = 0.500 for Fisher’s exact test).

Discussion
The generally accepted guidelines for treatment of calcaneal cysts depend on the presence of symptoms and the threat of pathological fracture. In our study, only patients that required surgical management were included. Those who had responded to conservative treatment and those who were at no risk of pathological fracture were excluded from the study.

Pathological fracture through a calcaneal cyst is rare. Pogoda et al proposed that cysts reaching 100% of the internal cross-sectional diameter in the coronal plane and 30% in the sagittal plane, were at risk for pathological fracture. In the current study, these criteria and the presence of pain were the indications for surgical treatment in our patients.

Previous studies have included a few patients only, without a comparator, and the optimum treatment has remained unclear. Thus we designed a prospective pilot study.

Recently, minimally invasive treatment with drainage of cysts using ceramic or titanium screws has been described, with quite good results despite implant-related problems including irritation at the site of insertion of the screw insertion, implant failure and infection. It has been reported that curettage and bone grafting yields better results than steroid injections. Curettage and autogenous bone grafting remains a satisfactory form of treatment with a low rate of recurrence. However, there are no prospective comparative data in the literature. It may be easier to completely evacuate the lesion endoscopically, and thus reduce the rate of recurrence, and this is supported by our study.

Although our study was underpowered, we have shown that an endoscopic approach is a simple and effective method for treating symptomatic cysts of the calcaneum. In order to obtain more powerful results, a randomised prospective trial with more patients should be performed.

Supplementary material
A table detailing the demographics and outcomes of all 26 patients in the study is available alongside the electronic version of this article on our website www.ibjs.org.uk

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


