

1 **Calcaneal bone bruise after surgery for insertional Achilles**  
2 **tendinopathy**

3 **Running title: Postoperative calcaneal bone bruise**

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## 23 **ABSTRACT**

24 **Background:** Excision of the postero-superior corner of the calcaneus (EPCC) is routinely  
25 undertaken in athletes following failure of conservative management of insertional Achilles  
26 tendinopathy. Some patients can experience sharp calcaneal pain during post-operative  
27 rehabilitation, a sign of a calcaneal bone bruise (CBB).

28 **Study design:** Case series, level of evidence IV

29 **Methods:** The present study reports 8 patients who developed postoperative CBB after having  
30 started impact training too early. We followed the patients clinically and studied the resolution of  
31 bone edema with serial MRI.

32 **Results:** Following routine EPCC for insertional Achilles tendinopathy, eight patients presented  
33 with sharp pain which occurred at a mean 7.1 weeks (range 5 to 11 weeks) before clinical suspicion  
34 of CBB. MRI showed clear evidence of a bone bruise, with a delayed diagnosis of CBB at an  
35 average of 10.8 post-operative weeks (range 6 to 16 weeks). CBB resolved with modified symptom-  
36 free loading. Patients returned to play (1 patient retired from the international level football) at  
37 average on 5.6 months (range 2-9 months) after the diagnosis of postoperative CBB.

38 **Conclusions:** We describe 8 athletes who developed painful CBB after routine EPCC for  
39 insertional Achilles tendinopathy after having increased their level of activities too fast. In these  
40 cases, the diagnosis of postoperative CBB can be formulated with MRI, and more cautious  
41 rehabilitation implemented.

42 **Clinical relevance:** Sports physicians should be aware of CBB, which is not a normal feature of  
43 postoperative course. When a CBB is diagnosed, rehabilitation should be re-tuned to allow  
44 appropriate recovery.

45 **Keywords:** Insertional Achilles tendinopathy; Surgical treatment; Calcaneal bone bruise; MRI;  
46 Athlete.

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## 50 **Introduction**

51 Insertional Achilles tendinopathy is a frequent cause of chronic heel pain in athletes. (Hunt et al  
52 2009; van Dijk, 2011) As part of the process, ossification of enthesial fibrocartilage may lead to the  
53 formation of bone spurs within the insertional portion of the Achilles tendon, with pain and stiffness  
54 in that area.(van Dijk, 2011) Chronic and disabling symptoms which have been resistant to  
55 conservative management can be relieved with excision of the postero-superior corner of the  
56 calcaneus (EPCC).(Thomas et al, 2010; Maffulli et al, 2019; Brunner et al, 2005) Post-operatively,  
57 patients mobilize in a step by step progression. Attempt at too early return to sport can however  
58 result in sharp pain in the operated calcaneus.

59 Bone bruises in the lower limb are mostly associated with a sudden sustained change in activity  
60 levels and repetitive regular stress without acute trauma.(Metcuk et al 2016; Pihlajamäki et al  
61 2019;Fernandez-Canton G, 2003; Papadopoulos et al 2003). A bone bruise can present as a sub-  
62 periosteal hematoma, intra-osseous bruising and a sub-chondral lesion, or a combination of these.  
63 (Mandalia & Henson, 2008) A bone bruise can affect the calcaneus (CBB), and can be a risk factor  
64 for subsequent stress fracture. (Dienst et al 2000; Greaser 2016) To our knowledge, no previous  
65 reports document the development of CBB after EPCC.

66 We report 8 patients who underwent routine EPCC and developed CBB, an atypical adverse event  
67 of EPCC procedure. We share our experience in CBB diagnosis and management.

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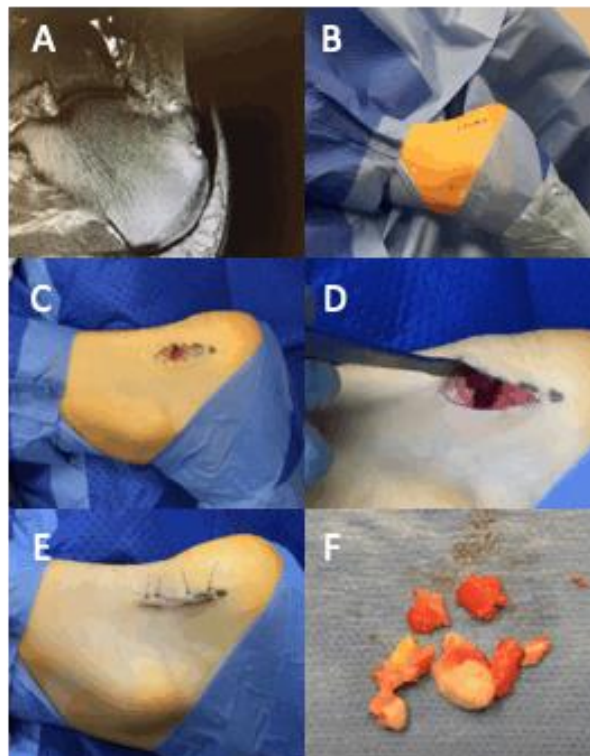
## 70 **Methods**

71 In all patients, the original diagnosis of chronic insertional Achilles tendinopathy was formulated  
72 clinically and confirmed by MRI (Figure 2). The patients had no other tendon or posterior heel  
73 pathologies clinically nor detected at MRI or noted at surgery. Also, since the Achilles tendon was  
74 not disinserted from the calcaneus, no anchor augmentation was undertaken. This study was  
75 approved by the investigational review board of our institution. All patients gave their written  
76 informed consent to take part in the present study.

77 Following surgery, a standard postoperative rehabilitation program was implemented (Table 2).

78 Of the patients operated, 8 patients (7 males) presented with marked postoperative pain 6 weeks  
79 (median; range 5-11 weeks) after the index procedure (Table 1).

80 **Figure 1. Perioperative images of excision of the postero-superior corner of the calcaneus using a posterolateral  
81 para Achilles tendon incision: A) preoperative MRI; B) marking of the planned skin incision; C) skin incision  
82 and a single longitudinal lateral para-Achilles tendon incision was made, exposing the Achilles tendon insertion.;  
83 D) The postero-superior corner of the calcaneus is visualized and resected that the calcaneal bone did not come  
84 into contact with the anterior aspect of the Achilles tendon during dorsiflexion of the ankle.; E) simple mattress  
85 sutures for wound closure; F) the excised bony parts.**



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88 **Figure 2. Images (MRI) of the development and resolution of calcaneal bone bruise (CBB) after excision of the**  
 89 **postero-superior corner of the calcaneus ( 1=sagittal; 2=axial): A) preoperative (arrow=bony prominence; B) 1-**  
 90 **month postoperatively (no CBB); C) 3-months postoperative, time for the diagnosis of CBB (T1- and T2-images,**  
 91 **arrows showing monocortical lesion of CBB); D) 6-months postoperative, pain-free, symptomless and healed**  
 92 **CBB.**



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94 **Table 2. Postoperative rehabilitation protocol after excision of the postero-superior corner of the calcaneus.**

Sutures 10–12 days
First 1-2 weeks limited weight bearing, crutches, elastic bandage with light ankle movements
Then gradually increasing weight with help of crutches, important to increase stress for the Achilles tendon and calcaneus using a step by step rehabilitation protocol
Aqua training after 3 weeks
Stationary cycling, spinning and cross-trainer after 4–6 weeks
After pain-free cycling, proceeding to Alter-G treadmill running and walking
Progressive return to sports-specific exercise without pain, usually 4–6 months

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96 Clinically, these patients presented marked tenderness on the medial and/or lateral aspect of the  
 97 calcaneus on palpation. A routine MRI was taken post-operatively if sharp pain occurred during  
 98 training. At MRI, a CBB with intra-osseous edema and a cortex lesions in the posterior facet of the  
 99 calcaneus near the site of the resected bony tuberosity were seen (Figure 2).  
 100 Following such findings, protected weight bearing without immobilization was started. No bony  
 101 stimulators, or vitamin D or calcium supplements were used. The time to occurrence of sharp  
 102 postoperative pain, the time to diagnosis and the time to full activity after surgery are shown in  
 103 Table 1.

104 **Table 1. Patients with postoperative calcaneal bone bruises (CBB).**

Activity level	Gender	Age (years)	Emergence of sharp postoperative pain	Time to diagnosis of CBB	CBB treatment	Full RTP after CBB diagnosis
Orienteering, national, top level	Male	17	10 weeks	16 weeks	conservative	7 months
Soccer, international top-level player	Male	25	6 weeks	6 weeks	conservative	4 months
Soccer, international top-level player	Male	29	5 weeks	12 weeks	conservative	retired
Track and field, 1500m, international top-level runner	Male	32	6 weeks	12 weeks	conservative	9 months
Recreational runner	male	34	8 weeks	12 weeks	conservative	2 months
Recreational runner	male	45	5 weeks	10 weeks	conservative	5 months
Recreational runner	male	50	11 weeks	12 weeks	conservative	6 months
Recreational runner	female	51	6 weeks	6 weeks	conservative	6 months

105 RTP: return-to-play

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## 110 **Results**

111 We identified 8 patients with postoperative CBB after EPCC. All were running athletes aged  
112 between 17 and 51 years (mean age 35 years) at the time of the index operation. All the athletes  
113 reported to have experienced sharp pain at the heel at a mean of 7.1 week (range 5-11 weeks) after  
114 the index procedure. All patients reported to have become pain-free after the procedure and were  
115 fully weight bearing. All reported to have increased their level of weight bearing activities, and,  
116 being pain free, to have introduced impact activities without consulting the operating surgeon.  
117 They were diagnosed with CBB at a mean of 10.8 weeks (range 6-16 weeks) following onset of  
118 symptoms. In all patients, impact activities were suspended. We implemented a regimen of non-  
119 impact mobilization, with proprioception exercises, core training, cycling, closed chain exercises of  
120 the lower limb, and gentle isometric and concentric exercises of the gastro-soleus complex. All 8  
121 patients with postoperative CBB improved with such conservative management regimen. Overall, 7  
122 patients returned to their preoperative level of activity at an average of 5.6 months (2–9 months)  
123 after the diagnosis of CBB, and one patient decided to forego his professional football career. An  
124 MRI taken following return to pain-free full loading activities showed absence of bone bruise  
125 (Figure 2).

126

## 127 **Discussion**

128 This case series highlights the necessity to be aware of CBB after surgery for insertional Achilles  
129 tendinopathy if a sudden onset of sharp pain occurs during post-operative rehabilitation after EPCC.  
130 All our patients with CBB recovered fully with simple pain-free weight bearing restriction without  
131 any additional immobilization. We suggest that postoperative CBB should be managed stopping  
132 impact activities until pain subsides.

133 CBB typically heals with conservative treatment, consisting of rest and modified activities.  
134 (Gehrmann, 2006). Most CBB are located in the posterior facet of the calcaneus and our patients  
135 experienced CBB close to the area of excision, the site - posterior aspect of the calcaneus – where  
136 bone edema could be seen on MRI. In these patients, the onset of CBB is likely related to a too  
137 rapid increase of impact loading to the heel area (Sormaala et al, 2006). After ankle or foot surgery,  
138 there is usually a period of restricted mobilization which could induce osteopenia (Minaire 1989).  
139 Also, the calcaneus may be temporarily weaker because part of the postero-superior cortical bone is  
140 excised during the index operation. Following the procedure (Oshri 2012), we allow our patients  
141 limited weight bearing to avoid the adverse effects of total immobilization, such as ankle joint  
142 stiffness, muscle atrophy and soft tissue swelling (Oshri 2012).  
143 Our patients reported to have been pain free soon after the operation, and, being keen to return to  
144 their usual activities, autonomously decided to start impact activities, developing a CBB when they  
145 tried to return to full sports activity too rapidly. Essentially, they started running too soon, abruptly  
146 increasing mechanical stresses to the operated calcaneus. Accordingly, MR images obtained after  
147 the onset of the sharp pain showed acute CBB. This contrasts with the MRI findings in  
148 asymptomatic athletes, in whom an MRI taken 1 month following EPCC for the purposes of  
149 another study did not evidence any bone edema.  
150 Physicians should be aware that there could be a marked delay to diagnose a CBB. Therefore, after  
151 operation, patients should be informed about the risk of CBB so that they do not progress to impact  
152 activities without explicit advice from their surgeon. If patient experience postoperative pain at the  
153 calcaneus and clinical examination shows sharp pain on palpation of the medial and the lateral  
154 aspects of the calcaneus, a high suspicion of CBB is warranted, and MRI is indicated.(Dienst 2000)  
155 Trauma related bone bruises are well described in the knee, but their incidence in the foot and ankle  
156 is not well studied. Bone bruises can occur to the talus or medial malleolus after lateral ligament  
157 injury (Alanen et al 1998; Labovitz et al 1998; Sijbrandi et al, 2000) and a CBB normally follows



158 axial loading (Dienst, 2000). The time of resolution for CBB is debated. If identified promptly,  
159 bone marrow edema ameliorates within 2 to 4 weeks as the level of activity is reduced (Sofka  
160 2006). Based on the findings of the present study, the clinical symptoms seem to correlate with the  
161 MRI findings, and, as symptoms subside, the increased signal at MRI attenuates. Dienst & Blauth  
162 reported a patient in whom a CBB resolved in 6 months (Dienst 2000). In our experience, too fast  
163 progression to intensive activity will expose the patients to a high risk of CBB after excision of the  
164 postero-superior corner of the calcaneus. Normally, RTP takes at least 6 months, and more  
165 commonly 9 months, after uneventful postoperative rehabilitation. (Oshri et al. 2012; Saxena 2003)  
166 Surgery involving the Achilles tendon may delay the return to normal function compared to the  
167 simple EPCC reported in the present investigation (Anderson 2008).

168 Most studies emphasize the effectiveness of MRI to diagnose bone marrow edema. Kijowski et al  
169 have classified tibial stress injuries by MRI, (Kijowski 2012) but such a classification is not  
170 available for calcaneus. In our patients, postoperative CBB was seen in MRI as a large area of  
171 edema located in the posterior portion of the calcaneus. This is in line with a previous study where  
172 MRI diagnosed CBB, at times associated with an actual stress fracture, in the posterior tuberosity in  
173 56% of Finnish army recruits (Sormaala 2006). CBB related edema in our patients were  
174 monocortical: if bone edema extends to both cortices the diagnosis of a stress fracture should be  
175 considered. Gehrman & Renard proposed a treatment algorithm for actual calcaneus stress fracture  
176 which emphasizes pain-free level of activity, and healing takes 6 to 8 weeks (Gehrman 2006).  
177 Postoperative CBB, as in our patients, can take up to 9 months for full return to play, although  
178 athletes can return to normal activities quicker.

179 This study has several limitations. For example, it includes a cohort of only eight individuals.  
180 However, in our hands this event has proven to be rare. We cannot exclude, obviously, that some  
181 athletes may have developed a CBB, and interpreted the symptoms as part of the normal recovery  
182 process following the surgery they underwent. However, we follow up our patients very carefully,

183 and we are confident that we would have been able to identify such abnormal post-operative course  
184 had a CBB occurred.

185

186 **Conclusion**

187 Our series of 8 patients reports an atypical postoperative condition – CBB – after surgery for a  
188 common ailment of the insertion of the Achilles tendon. CBB resolved with proper conservative  
189 management, consisting of pain-free weight-bearing without immobilization. Physicians should  
190 have a high level of suspicion of CBB if uneventful EPCC is followed by a sudden onset of sharp  
191 calcaneal pain during rehabilitation, and the patients reported to have started impact loading without  
192 the advice of the operating surgeon. MRI is a useful tool to diagnose and follow-up CBB to plan  
193 return to play.

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