Computed tomography in suspected tarsal coalition

Examination of 26 cases

Martin J. Warren[1], Martin A. Jeffree[2], David J. Wilson[1] and J. Craig MacLarnon[1]

Coronal plane computed tomography (CT) was performed in 26 consecutive patients with clinical suspicion of tarsal coalition. Twenty patients had plain CT and 6 had CT talocalcaneonavicular arthrography. Fifteen patients were found to have coalition. Of these 15 patients, 12 had talocalcaneal coalition (9 bilateral, 3 unilateral), 2 patients had combined talocalcaneal and calcaneonavicular coalitions, and the remaining patient had bilateral calcaneonavicular coalitions. Surgical findings corroborated the CT diagnosis in 9 patients with talocalcaneal coalition and in 2 patients with calcaneonavicular coalition.

Ossified talocalcaneal coalitions were found in children aged 6 and 10 years, i.e., well below the conventionally stated age range of 12 to 16 years.

CT is the investigation of choice in suspected tarsal coalition if plain radiography is not diagnostic. CT arthrography did not generally provide further information, but may be useful if plain CT is equivocal.

Bony coalition, particularly the calcaneonavicular type can be detected on routine radiographs. However, fibrous or cartilaginous coalitions, especially those involving the talocalcaneal joint are often elusive. Special projections (Bryan 1979) are frequently not diagnostic, and conventional tomography (Conway and Cowell 1969) and arthrography (Kaye et al. 1975) have been proposed.

Several reports describe CT of tarsal coalition (Deutsch et al. 1982, Sarno et al. 1984, Stoskopf et al. 1984, Pineda et al. 1986, Hertzenberg et al. 1986). The authors report their experience of CT in suspected coalition and the use of CT arthrography.

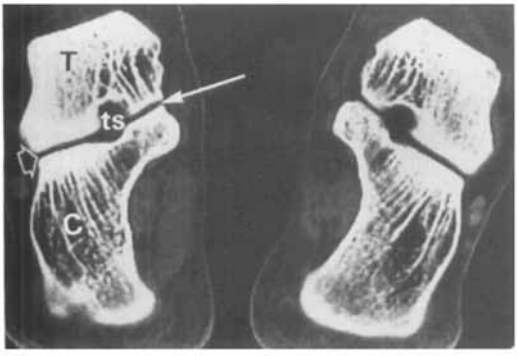
Department of Radiology[1], The Nuffield Orthopaedic Centre, Windmill Road, Headington, Oxford OX3 7LD, and Department of Neuroradiology[2], Brook General Hospital, Shooters Hill, London SE18 4LW, England

Patients and methods

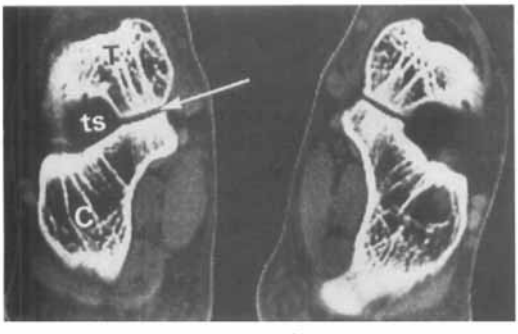
Between March 1984 and March 1988, 26 consecutive patients with clinical suspicion of coalition were investigated. The clinical evaluation included assessment of pain, deformity, peroneal spasm, and limitation of subtalar movement (Cowell 1975). The median age was 17 (6–33) years. The period of clinical follow-up after CT ranged from 2 to 6 years.

All the patients had plain radiographs and subsequently underwent CT. Talocalcaneonavicular arthrography with tomography was performed in 3 cases. In 3 patients plain radiographs showed calcaneonavicular coalition (bilateral 2, unilateral 1). Despite this, CT was performed to exclude associated talocalcaneal coalition. In Figure 1 representative sections show normal talocalcaneal articulations.

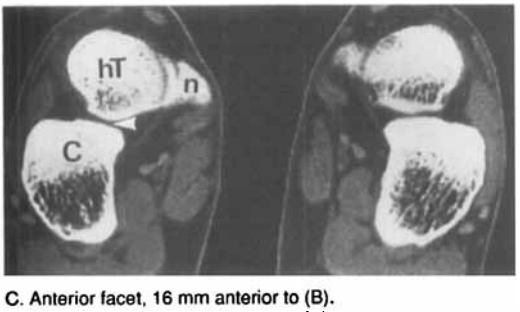
The use of CT talocalcaneonavicular arthrography was explored in 6 patients (unilateral 5, bilateral 1). Contrast used was 1.5 mL Urografin 290 (Schering) followed by 2–3 cm^3 air (3 patients) or 2–3 cm^3 air alone (3 patients). Injection into the talonavicular joint was under fluoroscopic control using a dorsal



A. Posterior facet (posterior subtalar) and middle facet.



B. Middle facet, 8 mm anterior to (A).



C. Anterior facet, 16 mm anterior to (B).

Figure 1. Near coronal CT of normal talcocalcaneal articulations, consisting of posterior subtalar joint and talonavicular (anterior subtalar) joints. T—talus, ht—head of talus, C—calcaneum, n—navicular, ts—tarsal sinus, open arrow—posterior facet, arrow—middle facet, arrowhead—anterior facet.

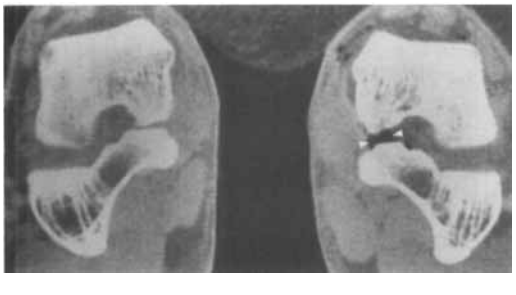


Figure 2. Normal negative contrast (air) CT talocalcaneonavicular arthrogram showing air (arrowheads) in the left middle facet joint space.

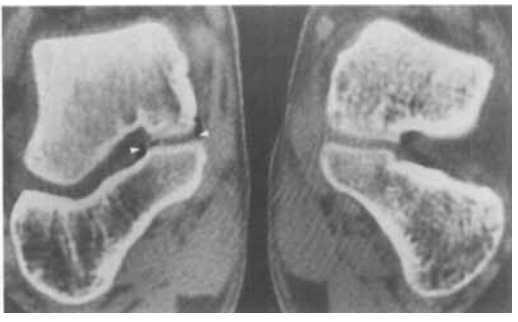


Figure 3. Case 10, aged 13 years. Negative contrast (air) CT talocalcaneonavicular arthrogram in right middle facet nonossified coalition—air (arrowheads) has failed to enter the narrow and ill-defined middle facet joint space.

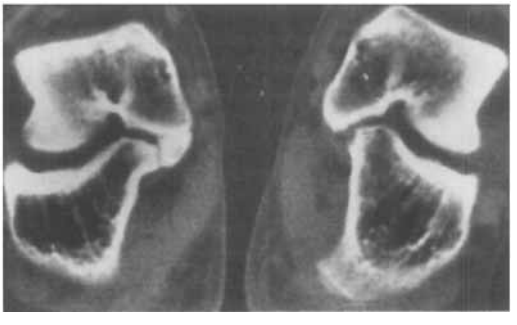
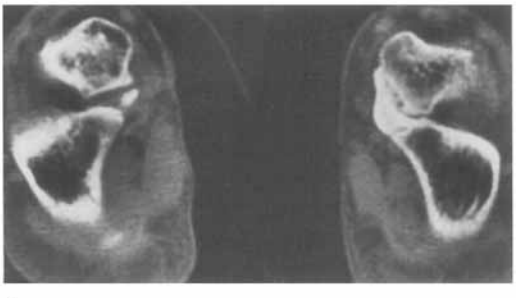


Figure 4. Case 14, aged 10 years. Bilateral partially ossified middle facet coalition.



A

B

Figure 5. Case 9, aged 6 years. Completely ossified middle and anterior facet coalition on left and partially ossified middle facet coalition on right (B) is 5 mm anterior to (A).

Table 1. Clinical features and CT findings

Case	Pain	Deformity		Reduced subtalar movement	CT findings (Joint and facet)					Verified surgically
		FF	PS		CN	TC	Anterior	Middle	Posterior	
Coalition detected by CT (n 15)										
1	R			R		R + L		+		+
2	R + L	+		R + L		R + L		+		
3	L			L		L		+		
4	R + L	R	R	R		R		+		+
7	R + L	+	+		R + L					R
8	R		+	R	L	R		+		R
9	R + L	+	+	R + L		R		+		+
						L	+	+		+
10	R + L	+		R + L	R + L					+
						R		+		
11	R			R		R		+		+
12	R + L			R + L		R + L		+	+	R
14	R + L	+		R + L		R + L		+		+
15	L			L		R + L			+	L
16	R + L			R + L		R + L		+		
21	R + L			R + L		R + L	+			
25	R			R		R + L		+		R
Miscellaneous abnormalities (n 4)										
13	R + L					bilateral OA			+	
19	L	+	+			L loss of bone density. Disuse osteoporosis?				
22	L					post-traumatic chondrolysis				
24	R + L					abnormal alignment of both posterior facets				
Normal CT (n 7)										
5	L	+[a]	+	L						L[b]
6	R + L	+[a]								
17	R									
18	R									
20	R + L	+		R + L						
23	R									
26	R + L									

Deformity: FF Flat feet, PS peroneal spasm, [a] hindfoot valgus.
CT findings: CN calcaneonavicular coalition, TC talocalcaneal coalition.
[b] bony cubo-navicular coalition at surgery.

(Kaye et al. 1975) or medial approach. The foot was then manipulated to ensure an even distribution of the contrast. In the normal foot, air injected into the talonavicular joint passed into the middle facet of the talocalcaneal articulation (Figure 2). Air did not enter the posterior subtalar joint because it is separated from the talocalcaneonavicular joint by the tarsal canal.

CT was performed using a General Electric 8800 or a Siemens Somatom DRI scanner. Patients were examined with hips and knees flexed and feet flat on the couch to produce near coronal contiguous sections from the posterior aspect of the posterior talocalcaneal articulation to the navicular. Section thickness was 4 or 5 mm in all except 2 patients, in whom it was 1.5 or 2 mm.

Lateral foot radiographs were not performed in all the patients, but if available they were examined for secondary signs (Conway and Cowell 1969, Beckley et al. 1975, Harris 1955).

Results

Tarsal coalition was detected in 15/26 patients. Of these 15 patients, 12 had talocalcaneal coalition (bilateral 9, unilateral 3), 2 had unilateral talocalcaneal combined with calcaneonavicular coalition (bilateral 1, contralateral 1), and the remaining patient had bilateral calcaneonavicular coalition. The commonest site of talocalcaneal coalition was the middle facet, which was involved alone in 10 patients and in combination with other facets in another 2 patients (Table 1).

Surgical confirmation was obtained in 9 patients with talocalcaneal coalition and in 2 patients with calcaneonavicular coalition. Surgical exploration of 1 patient with normal CT and persistent symptoms revealed a bony cubonavicular coalition (no CT section passed through this area). The remaining 6 patients with normal CT did not undergo surgery. Talocalcaneal coalition exhibits a variety of CT appearances. The most subtle type, seen in 3 patients,

showed narrowing of the joint space and poor definition of the articulating facets. The negative contrast CT talocalcaneonavicular arthrogram of such a case in which air had not entered the right middle facet suggested fibrous or cartilaginous coalition (Figure 3). Unfortunately, the middle facet was not explored during excision of the coexisting calcaneonavicular coalition.

More obvious joint space narrowing with cortical hyperostosis, irregularity, and abnormal angulation of the involved facets was seen in 7 other cases of nonossified coalition. Partial (Figure 4) and complete (Figure 5) ossification of talocalcaneal coalitions were also observed.

Five of the 6 patients examined by CT arthrography had talocalcaneal coalition (4 nonosseous, 1 osseous). In these cases, contrast failed to enter the involved middle facets, substantiating the other CT signs. The negative contrast (air) arthrograms were easier to interpret because the iodinated contrast had a similar Hounsfield number to bone cortex. In all except 1 patient (Figure 3), the diagnosis would have been clear on plain CT.

Eleven patients with talocalcaneal coalition had lateral foot radiographs, and of these, 5 (age range 17–33 years) had one or more secondary signs. None of these signs were present in the remaining patients except for 1 with marked arthrosis.

Discussion

Our experience confirms that CT reliably and accurately detects tarsal coalition. The CT appearances were very striking in most cases. However, the fibrous or cartilaginous type of talocalcaneal coalition may show only subtle abnormalities. Negative contrast arthrography may substantiate this diagnosis if plain CT is equivocal, although more data is required on normal CT talocalcaneonavicular arthrography.

Calcaneonavicular coalition was difficult to appreciate in the coronal plane, and transverse axial CT provides a better demonstration (Sarno et al. 1984) if plain radiographs are insufficient.

In common with most other published data (Conway and Cowell 1969, Beckly et al. 1975, Hertzenberg et al. 1986), middle facet involvement was most frequent in this study and often bilateral. None of our patients had coalition posterior to the sustentaculum tali without involvement of adjacent facets as reported by Lee et al (1989). If hypertrophic bone was observed in this area, it was an extension of middle facet coalition.

Onset of symptoms often occurs during childhood or adolescence and is thought to be related to ossification, which is said to occur in talocalcaneal coalition between the ages of 12 and 16 (Jayakumar and Cowell 1977). However, we found completely ossified talocalcaneal coalitions in 2 patients aged 6 (Figure 5) and 10 years.

Acknowledgements

We thank Jane Talbot and the radiographers of the Churchill Hospital and Radcliffe Infirmary CT units for performing the examinations, Nicola Green for manuscript preparation, and Stanley Ashington for photography.

References

Beckly D E, Anderson P W, Pedegana L R. The radiology of the subtalar joint with special reference to talo calcaneal coalition. Clin Radiol 1975; 26: 333–41.

Bryan G J. Diagnostic Radiography. Churchill Livingstone, Edinburgh, 3rd ed. 1979: 163–4.

Conway J J, Cowell H R. Tarsal coalition: clinical significance and roentgenographic demonstration. Radiology 1969; 92 (4): 799–811.

Cowell H R. Diagnosis and management of peroneal spastic flat foot. Instr Course Lect 1975; 24: 94–103.

Deutsch A L, Resnick D, Campbell G. Computed tomography and bone scintigraphy in the evaluation of tarsal coalition. Radiology 1982 ; 144 (1): 137–40.

Harris R I. Rigid valgus foot due to talocalcaneal bridge. J Bone Joint Surg (Am) 1955; 37: 169–83.

Herzenberg J E, Goldner J L, Martinez S, Silverman P M. Computerized tomography of talocalcaneal tarsal coalition: a clinical and anatomic study. Foot Ankle 1986; 6 (6): 273–88.

Jayakumar S, Cowell H R. Rigid flatfoot. Clin Orthop 1977; 122: 77–84.

Kaye J J, Ghelman B, Schneider R. Talocalcaneonavicular joint arthrography for sustentacular talar tarsal coalitions. Radiology 1975 ; 115 (3): 730–1.

Lee M S, Harcke H T, Kumar S J, Bassett G S. Subtalar joint coalition in children: new observations. Radiology 1989; 172 (3): 635–9.

Pineda C, Resnick D, Greenway G. Diagnosis of tarsal coalition with computed tomography. Clin Orthop 1986; 208: 282–8.

Sarno R C, Carter B L, Bankoff M S, Semine M C. Computed tomography in tarsal coalition. J Comput Assist Tomogr 1984; 8 (6): 1155–60.

Stoskopf C A, Hernandez R J, Kelikian A, Tachdjian M O, Dias L S. Evaluation of tarsal coalition by computed tomography. J Pediatr Orthop 1984; 4 (3): 365–9.