GENESIS OF THE BALL-AND-SOCKET ANKLE

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Ball-and-socket ankle is a rare deformity associated with such pre-existing conditions as congenital shortening of the lower limb, coalition of tarsal bones, absent digital rays and aplasia or hypoplasia of the fibula. We have observed seven patients with this deformity for an average of six years from initial examination at 20 days to 3.5 years. Arthrography showed that the configuration of the ankle was apparently normal in patients under 10 months of age and that a ball-and-socket joint develops by four to five years of age, possibly in compensation for the loss of inversion and eversion caused by tarsal coalition. Ball-and-socket joint is therefore probably not congenital, but is an acquired deformity secondary to various pre-existing congenital conditions.

Ball-and-socket ankle was first described by Lamb in 1958. It is a rare deformity characterised by a spherical articulation between the tibia and the talus. It is associated with congenital shortening of the leg, coalition of tarsal bones, absent rays in the foot and aplasia or hypoplasia of the fibula. Its aetiology has been the subject of controversy between two schools of thought: the congenital abnormal joint theory and the secondary adaptive joint theory. Those who subscribe to the latter insist that loss of movement at the tarsal joints is one of the causes of this deformity.

We were able to review 10 ball-and-socket joints in seven patients. These had been studied mainly by means of arthrography for an average of six years. This paper discusses the aetiology and development of the deformity.

MATERIAL AND METHODS

There were six boys and one girl with actual or potential ball-and-socket ankles; three were bilaterally involved. The patients’ ages ranged from 20 days to three and a half years when first seen and from 1 to 12 years (average 6 years) at latest review; the period of observation was from 1 to 12 years (average 4 years). The infants included in this study were those with one or more of the anomalies mentioned previously and who subsequently developed a ball-and-socket ankle.

All unilateral cases had shortening of the affected leg and the bilateral cases all had leg-length discrepancy; all the patients were below average height. Coalition of the tarsal bones was found in all but one (Case 7), a one-year-old boy whose centres of ossification were so small that this was uncertain. Not only was there talocalcaneal coalition but calcaneocuboid and talonavicular coalition also were present in many cases. Aplasia or hypoplasia of the fibula and anomalies of the toes including oligodactyly and symphalangia were observed in almost all patients and other deformities, such as pes planovalgus, tibia valga and congenital club foot, were also seen (Table 1). Seven joints in five patients had arthographic examination at an early stage and it was found that the joints were normal and rectangular in section at birth, but developed into a ball-and-socket shape at around four to five years of age.

ILLUSTRATIVE CASE REPORTS

Case 1. An infant boy was admitted to hospital with congenital club foot and oligodactyly 20 days after birth (Fig. 1). A corrective cast for the club foot was applied for three months and then a Denis Browne splint was used for two months, but no improvement was obtained. At the age of six months, arthrograms of the ankle were taken for pre-operative evaluation. These showed that the talocalcaneal joint was completely normal with medial and lateral joint facets extending deep to the periphery; there was no aplasia or hypoplasia of the fibula (Fig. 2). A posterior release procedure was performed to correct the deformity; at that time there was no visible subtalar joint but instead a coalition was found. Visual examination confirmed that a normal talocrural joint was present. Subsequently, it was found that the coalition extended to the cuboid and navicular bones, so that the tarsal bones were totally fused.

An arthrogram at the age of four years showed that the lateral and medial borders of the talus were slightly rounded with some hypoplasia of the fibula, suggesting that the joint was going to develop into a ball-and-socket ankle (Fig. 3). A radiograph taken at the age of 12 clearly showed a ball-and-socket ankle with curved medial and lateral facets (Fig. 4). The pes varus deformity of club foot at birth had become a pes valgus deformity; this was seen in other cases. Meanwhile at about the age of five years the right ankle, which was clinically normal at birth, began to develop the features of a ball-and-socket joint (Fig. 5).
Table I. Details of seven patients with 10 ball-and-socket ankles to show the incidence of congenital abnormalities

<table>
<thead>
<tr>
<th>Case numbers</th>
<th>1</th>
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<td>F</td>
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<td>R L</td>
<td>R L</td>
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<td>L</td>
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Case 1. Figure 1 – Photograph of a baby boy aged 20 days showing congenital left club foot with oligodactylia. Figure 2 – At 6 months arthrogram of the left ankle shows a normal talocrural joint and lateral facet. Figure 3 – At 4 years an arthrogram shows the round lateral and medial borders of the joint. Figure 4 - At 12 years the radiograph of the left ankle clearly shows a ball-and-socket joint. Figure 5 – Radiograph of the right ankle at 12 years shows a spherical articulation.
Case 4. This girl aged 5 years 6 months was found to have a ball and socket joint in her left ankle, the initial radiograph showing a spherical talus and leg-length discrepancy (Fig. 6).

Case 5. A boy aged 4 years 6 months with bilateral involvement of the ankles and an absent right fibula had an arthrogram which revealed that the medial border of the right talus was slightly rounded but not completely spherical (Fig. 7); the left joint was semi-spherical (Fig. 8). At follow-up, the right ankle had deformed into pes valgus, and radiographs showed that this joint was also becoming completely spherical in shape.

Case 6. An infant boy with a short left leg, absent fibula and pes valgus had an arthrogram two months after birth which revealed that the medial border of the talus was already slightly rounded (Fig. 9).

DISCUSSION

Since the ball-and-socket ankle was first described by Lamb in 1958, its aetiology has been a subject of controversy between the congenital theory advocated by Henssge and Engelke (1970), Pappas and Miller (1982) and others, and the acquired theory advanced by Imhäuser (1960, 1970) and Fischer and Refior (1972). Repeated examination of our patients from soon after birth revealed that their ball-and-socket ankles were not congenitally spherical but developed into this shape as they grew and that deformation was complete by four to five years of age. This conclusion strongly supports the acquired theory.

It is thought that loss of movement at the subtalar and mid-tarsal joints as a result of tarsal osseous coalition, causes the talocrural joint to compensate by allowing inversion and eversion. As the joint is immature until four or five years of age, it has a high remodelling capacity and may thus deform very easily. At the same time, the fibula, which is normal at birth, shortens and develops a curved facet due to the unusual movements of the talus.

A ball-and-socket ankle is rarely found in cases with fibrous or cartilaginous coalition, in which some movement has remained in the subtalar joint; nor in cases
where the Grice-Green operation has been performed at an early age. One of our older patients with a ball-and-socket joint, not in this series, had none of the other deformities usually found; her subtal ar synostosis was bony and seemed to have been caused by inflammation in infancy (Figs 10 and 11).

We suggest that synostosis of the tarsal bones, either congenital or acquired at an early age, results in a ball-and-socket ankle; and that coalition, not only of the subtalar joint but also of the calcaneocuboid and talonavicular joints, plays an important role in the development of this condition. In cases with congenital aplasia of the fibula, however, the condition may be different, since the joint is already slightly rounded at birth.

Our study shows that the ball-and-socket ankle is not a congenital deformity but is acquired; it is associated with hemimelia expressed by shortening of the lower limb, coalition of tarsal bones and absent digital rays. There have been reports of ball-and-socket ankles without coalition of tarsal bones, some in patients with an unstable ankle or paralytic foot; these may represent a different condition from the one discussed in this paper.

REFERENCES