Radiographic appearances following surgical correction of the partially fused epiphyseal plate

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Abstract. Surgical correction of partial post-traumatic fusion of an epiphyseal plate by resection of the bony bridge across the plate and replacement of the bridge by a fat implant causes a characteristic radiographic appearance which is illustrated by two patients and an animal model. Failure to recognize this characteristic postoperative pattern may lead to a misdiagnosis of infection or other bone pathology.

Key words: Epiphyseal bony bridge – Epiphysodesiolysis – Epiphyseal surgery

Partial closure of a growth plate by formation of a bony bridge following trauma results in a significant angular deformity and growth retardation in a long bone. Surgical correction involves excision of the bony bridge and interposition of a material such as fat, silastic, or methacrylate in order to prevent reformation of the bridge and to allow growth of the remaining physis [1, 2, 5] (this procedure has been called epiphysodesiolysis by Langenskiold personal communication 1977). A characteristic radiographic appearance develops following surgery. Removal of the bony bridge and its replacement by fat produces a lucent defect spanning the physis in a position corresponding to that of the resected bony bridge. As bone growth is re-established, changes in the size and appearance of this lucent defect occur. Failure to recognize these characteristic postoperative radiographic appearances may lead to a mistaken diagnosis of infection or other pathology. The radiographic changes following this type of operation have not been previously described in the radiology literature. We present two patients and animal studies to illustrate the characteristic radiographic features.

Materials and methods

Preoperative and postoperative radiographs were reviewed in two patients who underwent surgery for correction of partial closure of a growth plate following trauma. In each case, preoperative tomograms demonstrated a bony bridge in the region of a previous fracture of the growth plate. The osseous bridge had caused some growth retardation of the bone and was beginning to produce an angular deformity. In each case, the bony bridge was resected and the resulting bone defect was packed with fat (Fig. 1).

In addition, radiographs were reviewed from a previous experiment in which rabbits were used as a model to test materials interposed to prevent formation of a traumatic bridge [5]. The rabbits were sacrificed 120 days following interposition of fat or cartilage into a surgically created physeal defect in the distal femur. The femurs were radiographed and the lucent defects were compared to those in our patients. There was no evidence for infection in any of the animals.

Results

In each patient there was a characteristic radiographic evolutionary pattern. Immediately following surgery a lucent defect appeared in the distal metaphysis crossing the growth plate and extending into the epiphysis in the region of the resected bony bridge (Fig. 1). Follow-up radiographs over the next 5 months showed the development of sclerosis and some irregularity and fragmentation of the margins of the lesion (Fig. 2). As the bone grew, the lucent area progressively increased in size. This enlargement occurred in a fashion which reflected the growth pattern of the bone. The proximal point of the lucency remained constant both in size and position as evidenced by its constant relationship to the metallic needle which was intro-
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Fig. 1. A lateral view of the ankle with an intraoperative needle marking the epiphyseal plate demonstrates the well-defined lucent defect largely within the metaphysis but crossing the epiphyseal plate and extending into the epiphysis.

Fig. 2. An anteroposterior view of the right ankle obtained 5 months postoperatively shows the well-defined lucency extending across the epiphyseal plate. There is irregular sclerosis and fragmentation at the margins of the defect, an appearance which may closely resemble infection. Note the position of the intraosseous marker which was placed at the time of surgery.

Fig. 3. An anteroposterior view of the ankle in the same patient as Fig. 2 obtained 22 months postoperatively shows an obvious increase in the size of the lucent defect. The relationship of the proximal portion of the defect to the marker needle is unchanged. Enlargement of the defect has taken place completely within the metaphysis underlying the resected bony bridge and epiphyseal plate. The margins of the defect are better defined and smoother with no evidence of fragmentation. Growth is taking place across the entire width of the bone with no angular deformity.

...duced into the cortex at the time of surgery. In addition, the ratio of the change in bone length to the change in bone width (2.4 in the illustrated case) corresponded exactly to the ratio of the change in height of the lucent area to its change in width indicating proportionate growth of the bone and the defect. As the lucent defect increased in size, the margin became more evenly and smoothly sclerotic and the fragmented appearance resolved (Fig. 3). With closure of the physis at the end of growth, the lucent defect no longer increased in size. In fact in one patient there was a decrease in the size of the defect and reossification of its periphery. At the time of the last radiographs, there was only minimal angular deformity at the ankle joint and the growth plate was fused in one patient and was in the process of fusing in the other. At no time was there clinical evidence for infection in either patient.

In the rabbit model, some specimens showed a radiolucency at or near the growth plate at the site where foreign material had been interposed 120 days previously (Fig. 4). In others the lucency extended well into the metaphysis and was eventually found in the diaphysis. No evidence of infection was noted. These findings parallel the evolution of the lucencies seen in our patients.

Discussion

When a transphyseal bone bridge forms following injury, continued growth of the remaining physis will be tethered resulting in development of a progressive angular deformity and incongruity of the joint surface of the long bone. In addition, retardation of the growth of the entire physis results in overall shortening of the long bone.

Langenskiold first demonstrated that a post-traumatic transphyseal bony bridge could be resected and its reformation effectively prevented by the interposition of fat in the defect left by the resection [2, 3, 4]. Following surgery normal longitudinal growth resumed and existing angular deformities tended to correct spontaneously as long as 50% of the physis remained.

Following successful surgery there is a characteristic radiographic progression which takes place until the epiphyseal plate fuses and growth of the bone ceases. Immediately following the operation there is a well-defined lucent defect where the resection was done in the distal metaphysis and adjacent epiphysis (Fig. 1). Subsequently the margins of the lucent area become irregularly sclerotic and assume a slightly fragmented appearance near the growth plate (Fig. 2). As growth from the physis...