TRAUMATIC FIBULAR BOWING WITH TIBIAL FRACTURE: REPORT OF TWO CASES

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ABSTRACT: Two cases of children with traumatic fibular bowing associated with mid-shaft tibial fractures are presented. Healing of the mildly angulated tibial fractures without reduction of the bones was accepted. The case, followed 38 weeks, demonstrated corrective remodeling with growth and an excellent clinical result.

Traumatic bowing of the long bones is a rare entity which is becoming increasingly recognized. It is seen primarily in the forearm in children, where it may present as bowing of both the bones or, more commonly, as fracture of one with bowing of the other. Bowing of the ulna with dislocation of the radial head has also been seen. These previous reports have dealt exclusively with the forearm and have not included cases of traumatic bowing of the lower limb, although their absence was noted. With this in mind, the following cases are presented.

Case Reports

Patient 1

R.P., a 7-year and 7-month-old boy, was running and was struck by another boy, injuring his right leg. With his right foot firmly on the ground, the other boy’s knee struck him over the anterolateral aspect of the right leg. The patient did not stand on the leg after the injury.

Physical examination revealed swelling and tenderness at the mid-leg level with palpable crepitus of the tibia. The skin was intact. A mild valgus deformity without rotational component was seen.

Roentgenograms demonstrated an oblique fracture of the middle third of the tibia with a traumatically bowed fibula (Fig. 1A). The fibula was bowed an additional 5° laterally and 4° anteriorly compared to roentgenograms of the normal left side (Fig. 1B). The tibial fracture was angulated an identical amount laterally and anteriorly.

Closed manipulative reduction under local anesthesia was attempted, but failed to straighten the bow or decrease the tibial angulation. The limb was immobilized in a long-leg cast for five weeks. Roentgenograms at two and five weeks after injury showed progressive healing of the tibial fracture, but no subperiosteal bone formation was found on the bent fibula. At 38 weeks, remodeling had progressed such that both the fibula and healed tibia were now bowed only 3° laterally and 2° anteriorly (Fig. 1C), compared to the normal left side. The leg lengths were equal, and no perceptible clinical deformity was present.

Patient 2

C.C., a 5-year and 3-month-old girl jumped from a teeter-totter, falling approximately 4 feet to the ground. Landing on her left foot, she sustained a closed, angulated fracture of the left tibia with a traumatically bowed fibula. The patient was treated at another hospital with a long-leg posterior plaster splint. No reduction was attempted.

When seen at our clinic four weeks after injury, the tibial fracture was healed in the angulated position and no subperiosteal new bone could be demonstrated on the bowed fibula (Fig. 2A). Roentgenograms of the right leg confirmed that the left fibula was bent 4° laterally and 3° anteriorly compared to the normal (Fig. 2B). The healed tibial fracture was angulated similarly. The leg lengths were equal, and only a very mild clinical deformity could be detected.

Discussion

The forces needed to produce traumatic bowing of the long bones were studied by Chamay in dogs and summarized by Borden in his review of 17 forearm deformities. Longitudinally directed forces tend to
further bow normally bowed bones. With low load, in the elastic range, the bone returns to its original configuration when the load is released. Beyond the elastic limit, microfractures are produced on the concave side of the bowed bone and a maximum strength is reached. Beyond this point, the bones become weaker and plastically deformed, and finally fracture.

The duration of the force is also extremely important. Once maximum strength has been surpassed, continuous force will cause fracture. However, if the deforming force is removed just before fracture, plastic deformation is produced. Therefore, for traumatic bowing to occur, a longitudinally directed force of greater than maximal bone strength must be applied for a time shorter than the necessary to produce fracture. Nonlongitudinal forces are shearing forces and produce the common transverse fractures of the metaphysis and physis.

The mechanism of injury in the first case was a blow to the anterolateral aspect of the fixed leg. This obliquely directed force translates into both shear and compression force vectors. To produce the traumatic bowing of the fibula seen here, the compression component must have met the critical force requirements mentioned above, whereas the shear component must have been relatively insignificant. The tibia, however, was fractured, most likely from maximal and prolonged axial forces. In the second case, a fall from a height was responsible for the
longitudinally directed force necessary to cause the fibular bowing and tibial fracture.

The essential characteristics of traumatic bowing of the long bones are seen in these cases. In both, the fibula assumed a broad curvature convex posteromedially, an attenuation of the normal configuration. This exaggeration of the normal curve has also been shown to be the rule in traumatic bowing of the forearm.\textsuperscript{1,2} The broad bowing and the lack of subperiosteal bone from two to five weeks after injury serve to differentiate these deformities from the more common greenstick fractures.

Difficulty of reduction is usually seen also. It has been estimated that 100 to 150\% of the child’s total weight is necessary to produce and also to reduce the forearm deformities.\textsuperscript{3} Consequently, vigorous reduction of the affected forearms under general anesthesia has been advocated.\textsuperscript{1,2} Blount has even proposed a drilling osteoclasis at the apex of the curvature to facilitate reduction.\textsuperscript{3} In the first case presented here, manipulative reduction under local anesthesia failed to reduce the fibular bowing or the tibial fracture. Because the child was young and the deformity mild, healing of the minimally angulated tibia without reduction of the bones was accepted. Follow-up at 38 weeks revealed 40\% remodeling of the lateral bowing and 50\% correction of the anterior bowing. The tibia in the second case was also allowed to heal without the bones being reduced. Similar corrective remodeling is expected with growth.
Fig. 2A (AP)  Fig. 2A (Lateral)
Fig. 2A: Roentgenograms of the left leg four weeks after the injury. No subperiosteal new bone is seen on the bowed fibula. The tibia has healed in the mildly angulated position.

Fig. 2B (AP)  Fig. 2B (Lateral)
Fig. 2B: Roentgenograms of the normal right leg for comparison.

References