Circular External Fixation

Circular ring fixation is a relatively new technique which, although more complex than traditional external fixators, offers superior mechanical properties and control over bone healing conditions. The components of the framework include rings connected to threaded connecting rods. Nuts attached to the threaded rods can be rotated and used to move the rings relative to one another. Transosseous tensioned wires are then attached to the rings with specialized clamps. The constructs are versatile and allow placement of fixation wires in any direction at multiple levels so that muscles, tendons and important neurovascular structures can be avoided. By adjusting the rings relative to one another, major bone segments can be manipulated to achieve interfragmentary compression, distraction or angular corrections. Circular fixators are well tolerated by small animal patients being robust and lightweight.

Antebrachial deformities are the most commonly reported limb deformities in dogs. They may result from asynchronous, decreased or absent ulnar or radial physeal growth, secondary to trauma, chondrodysplasia, metabolic disease, hypertrophic osteodystrophy, metabolic disease, hypertrophic osteopathy or rickets. Progressive lameness with elbow pain and a visual deformity is the classic presenting complaint. The goals of treatment are to correct angular deformity in the craniocaudal and mediolateral planes, to correct rotational deformities when present, to maintain the mechanical axis of the limb, to achieve lengthening when length deficeit is present and improve elbow congruency to minimize the progression and severity of osteoarthritis. In some dogs, angular deformities are corrected acutely, with a one-stage, intraoperative realignment. This is the preferred approach if the deformity is mild and the patient has minimal residual growth potential remaining. Circular fixators allow progressive angular correction of deformities and simultaneous or delayed leg lengthening. Hinges are used between rings to change the angle between adjacent rings and align the major bone segments after performing an osteotomy. Excessive tension in regional soft tissues, such as muscles and tendons, can be overcome by applying a distracting force across the area of the deformity which stimulates hyperplasia and results in the production of new soft-tissue. In a similar process, a column of new bone can be produced to fill a bone gap if controlled distraction is achieved after performing an osteotomy. This process has been called *distraction osteogensis*. Intensive postoperative physical therapy and regular radiographic evaluation are required to achieve success and reduce the incidence of complications.

Most recently, circular fixation has been used to successfully manage fracture cases. The relative advantage of circular fixation compared to conventional external fixation is that the constructs are very effective in resisting bending forces whilst allowing a controlled amount of axial micromotion which has been shown to encourage bone healing. Healing times are reduced and the quality and quantity of fracture callus are increased. Smaller diameter transfixation wires tend to create less soft tissue damage, especially in high-risk areas such as those in which the surgeon must penetrate thick muscle. The use of rings and crossed wires also allows the placement of two to four wires in short distal or proximal fragments that would not be possible with conventional fixators. Special wires with stops attached allow for manipulation of bone fragments for reduction and compression. Additional wires can be easily added to the apparatus after the postoperative radiographs have been taken or additional fixation is required at a later time.