FRACTURE REPAIR COMPLICATIONS

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The lecture will be formatted as a series of case discussions. The following notes are designed to reinforce the principles of fracture assessment and planning because suboptimal planning is the commonest cause of postoperative construct failure after fracture repair.

Fracture Assessment
Information from the history, clinical examination, laboratory data and radiographs should be drawn together to formulate a plan of treatment for the patient. This should also include a realistic prognosis for the owner and an estimation of costs.

Fracture Patient Assessment Score
This is a simple scale that aims to simplify the process of fracture assessment. Three areas are considered and a numerical score assigned to each area for the given patient. The cumulative score then gives a guide to the severity of the fracture and which treatment method should be employed.

Mechanical factors
The fracture itself is assessed from radiographs. Factors to be considered include:

- Inherent stability of the fracture
- Bodyweight
- Physical activity level
- Presence of other limb injuries

A simple relatively stable fracture is assigned a high score. Severely comminuted fractures are assigned a low score. It is important to consider the disruptive forces that will be acting on the fracture after repair and how these can be neutralized. The ability to surgically reconstruct a fracture and achieve load sharing between implants and bone is also assessed.

Biological factors
This considers the health and healing potential of a fracture. The fracture itself and the overall health of the patient must be considered. In general, a more comminuted, highly traumatized fracture will have a lower score than a simple fracture due to the degree of accompanying soft tissue damage present. Older patients with concurrent disease such as hypothyroidism or Cushing’s disease will also be associated with lower scores.
Clinical factors
The ability of an owner to comply with postoperative instructions and the ability of a patient to cope with aftercare must also be considered. For example, a savage Rottweiler with a monolithic owner will be associated with a lower score than a well-behaved Labrador owned by a veterinary nurse.

The actual score given is not critical – what is important is to go through the process of fully assessing the fracture and the patient to identify potential problems and apply pre-emptive solutions to that case. As a general rule, fractures with a lower score require stronger, more rigid, longer-term fixation than those with a high score.

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Aggressive owner

Figure 1: Fracture Patient Assessment Score (FPAS)
Other key questions

In order to select the most appropriate method of fracture treatment, a number of key questions should be answered:

- Does any mechanical advantage of reconstruction outweigh the biological disadvantage of surgical interference with the fracture site?
- What are the forces acting on the fracture which must be controlled by the fixation?
- What methods of fixation are possible for the fracture?
- Are the principles of fracture fixation being addressed?
- What method of fixation best addresses the requirements of the fracture?
- Can I apply this technique or should the case be referred to a centre with better facilities and more experienced surgeons?
- Is the surgeon fully prepared for surgery and what is the plan A, B and C?

In the field of fracture repair, selection of the most appropriate fixation is influenced by variable mechanical factors including the site and type of fracture, biological factors including the operative approaches and predicted rate of bone healing, and clinical factors including the predicted program for postoperative care. The guiding principles for fracture fixation were defined in 1958 by a group of Swiss surgeons who formed the Arbeitsgemeinschaft fur Osteosynthesefragen (AO), known later in North America as the Association for the Study of Internal Fixation (ASIF). The original principles defined by the AO/ASIF (Box 1) are still applied today, although the emphasis on each principle varies according to the unique fracture environment. The recent trend towards a ‘biological’ approach to fracture repair emphasizes the principle of atraumatic surgical technique at the expense of anatomical reduction. Using this approach, restoration of normal spatial limb alignment can be achieved using bridging fixation of the fracture with minimal manipulation of fracture fragments.

Box 1: AO/ASIF principles

- Anatomical reduction of fracture fragments, particularly in articular fractures
- Stable fixation satisfying the biomechanical requirements of the fracture
- Preservation of blood supply to bone fragments and soft tissue by atraumatic surgical technique
- Early pain-free movement and weight bearing of the traumatized limb

The ability of an implant to resist the disruptive forces acting on a fractured bone depends on the implant’s design and material properties and the location of the implant relative to the bone. In clinical cases, a combination of disruptive forces usually exists (Figure 2), and all these forces must be neutralized by the chosen fixation technique.
Figure 2: Disruptive forces acting on the fractured bone.
A – **Bending** – In diaphyseal fractures this is frequently the most important disruptive force
B – **Rotation**
C – **Axial** – In comminuted or oblique fractures, axial forces manifest as disruptive shear forces. In transverse fractures, axial forces manifest as non-disruptive compressive forces
D – **Avulsion** – In fractures resulting from the application of an avulsion force, this is usually the only disruptive force

With the exception of avulsion fractures, where only a single disruptive force must be neutralized, other fractures require implant systems that are capable of resisting multiple disruptive forces. If an important disruptive force is not neutralized, this will frequently result in delayed union, non-union or malunion of a fracture. The best example of this problem is the use of intramedullary pins (which only neutralize bending forces) as the sole fixation in diaphyseal femoral fractures that are also subjected to important rotational and shear forces.