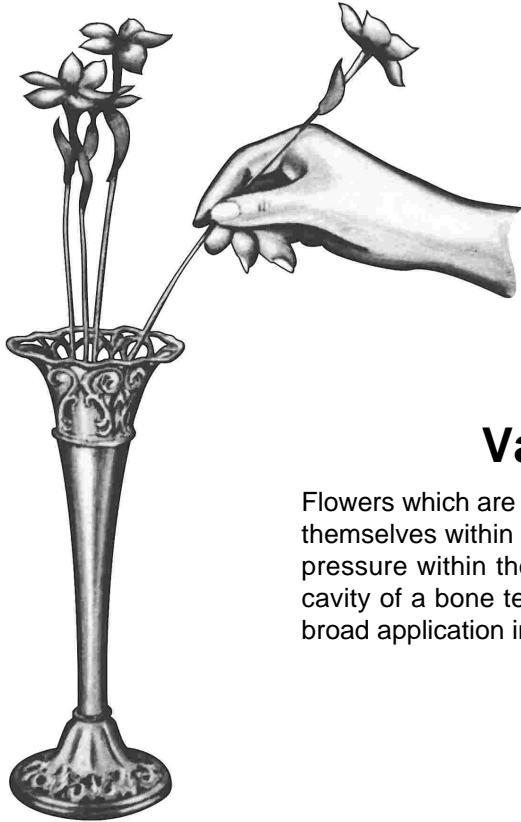


7 DYNAMIC FACTORS*



Vase of Flowers Principle

Flowers which are entered into a vase obliquely with flexed stems tend to aright themselves within the vase due to the resiliency of the stems which exert point pressure within the vase. A resilient rod introduced obliquely into the tubular cavity of a bone tends to react in the same manner. This principle has a very broad application in medullary pinning.

The principle of medullary pin fixation differs basically from that of marrow nailing. **Nailing** suggests utilization of bulk in which a rod is impacted within the marrow cavity. Thus mass is used to fix the bone directly, while passively resisting the muscle force of the extremity.

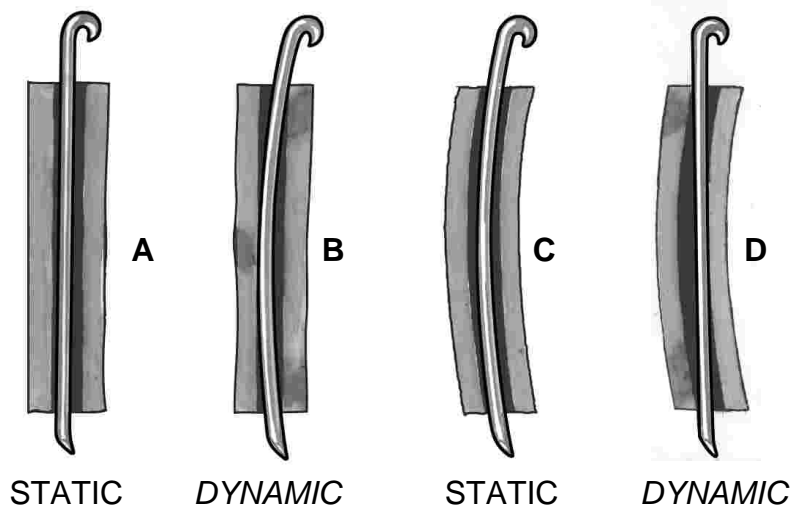
Medullary **pinning**, on the other hand, depends not upon bulk but upon its own dynamic forces and the utilization of the muscular forces of the extremity. It might be likened to the principal of ju jitsu, in which one utilizes to his own advantage the superior weight and strength of his opponent.

To limit medullary fixation to the narrow principle

of the ramrod in the gun barrel is wasteful of dynamic forces. It is a rare fracture that is not acted upon in some way by the intrinsic dynamic forces of an extremity. These forces can react to defeat the surgeon or, as in ju jitsu, can be utilized to his advantage.

Medullary fixation can be directed passively to resist the intrinsic dynamic forces of an extremity or it can exert continuous dynamic forces of its own. It must be assumed that the rod to be used is of optimum temper, i.e., possessing strength, limited resilience, and limited malleability.

Let us now examine these dynamic factors.

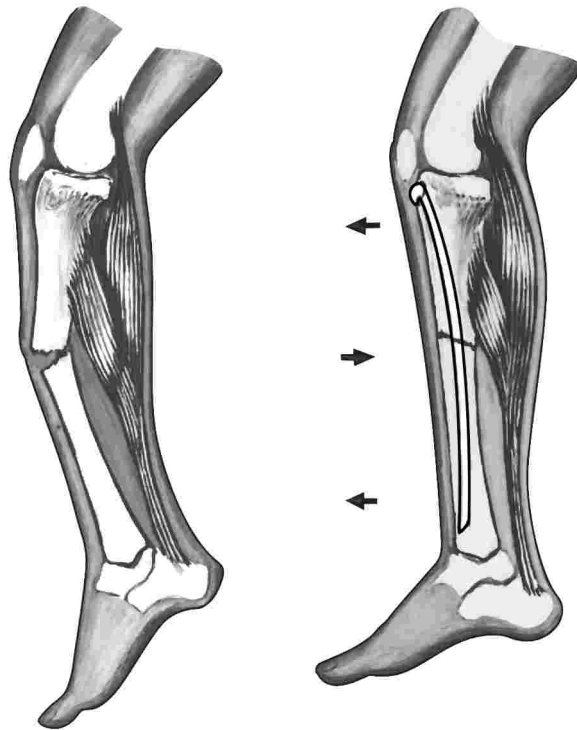


Influences of Preshaping Pin and Bone Contour

(A & C) Pin preshaped to contour of bone exerts no dynamic force.

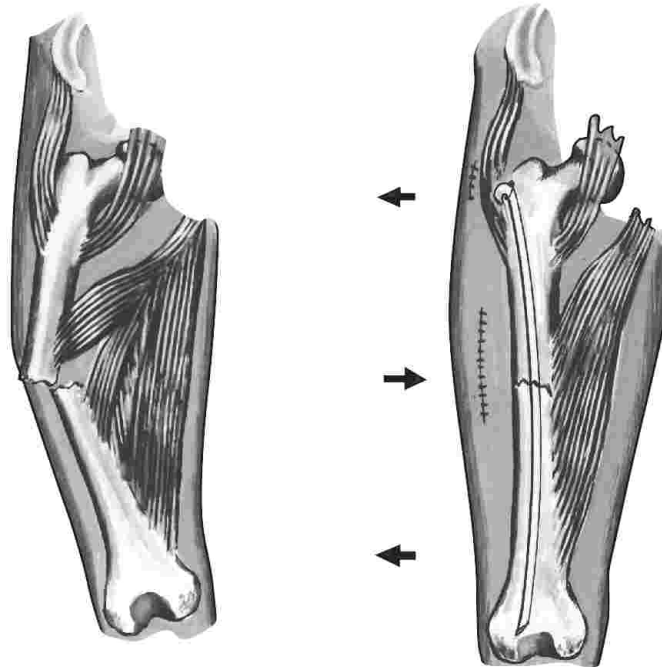
(B) Curved pin in a straight bone exerts pressure at three points.

(D) Straight pin in a curved bone exerts pressure at three points.



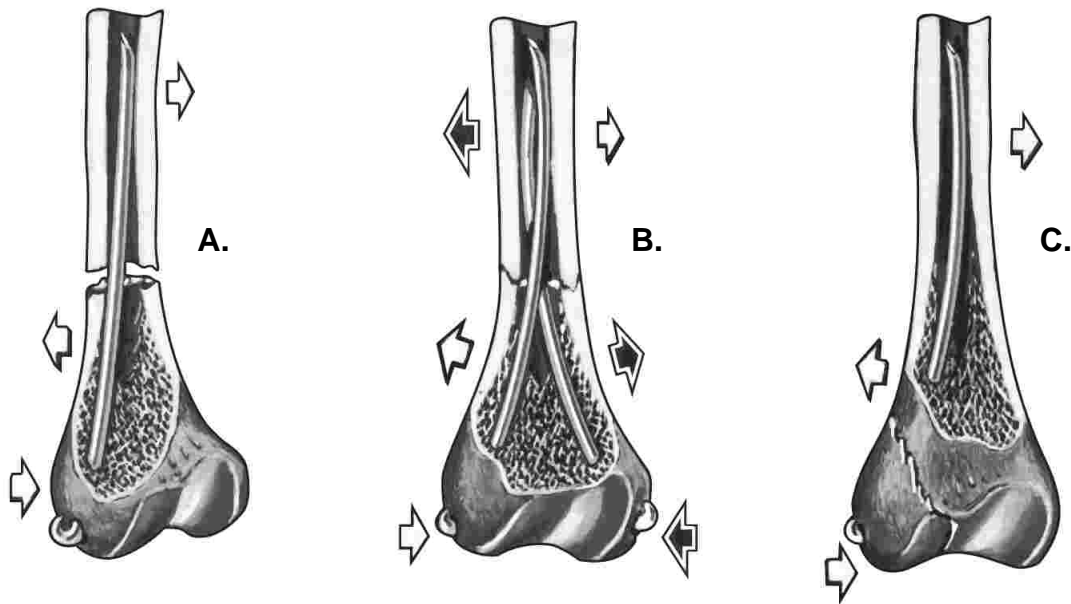
Dynamic Forces in Tibia Pinning

Gastrocnemius and soleus muscles act as bow string tending to angulate tibial shaft anteriorly. Curved pin resists these forces at three points to limit angulation and tends to control torque.



Dynamic Forces in Femur Pinning

The direction of muscle pull causes the bone to tend toward antero-lateral bowing. A curved pin resists these forces at three points to resist angulation and tends to limit torque.

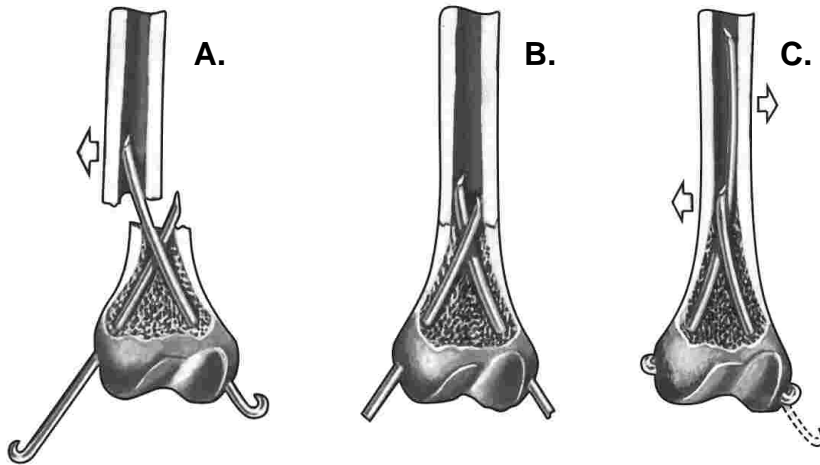


Vase of Flowers Principle As Applied to Lower Femur

(A) A single pin driven upward from the condyle exerts three-point pressure resulting in angulation and insecure fixation.

(B) A second pin to oppose the first gives three opposing points of pressure resulting in secure fixation.

(C) vertical fracture of the femoral condyle can be securely fixed by the three point pressure of a single pin. In this instance a continuous compression of the fracture surfaces is accomplished, which is conducive to rapid healing.

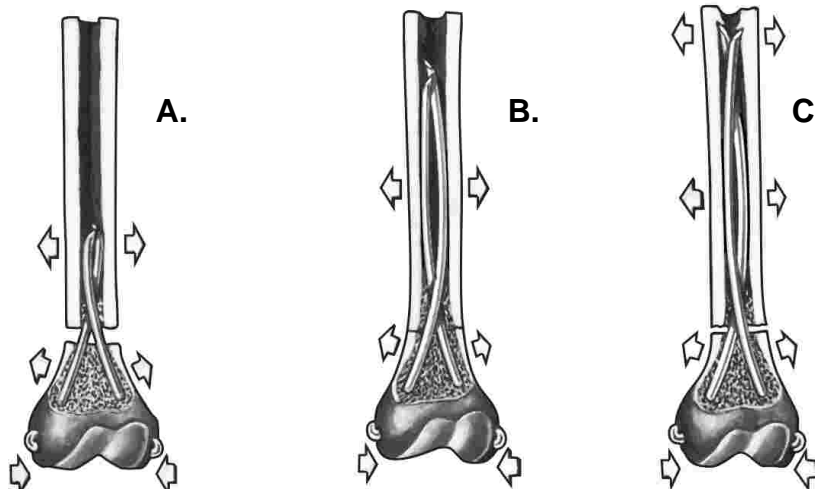


Driving Double Pins

(A & B) Double pins must be driven simultaneously — pressure of a single point will displace the shaft. When both pins are driven simultaneously the shaft will not displace.

(C) Effect of length on migration. The long pin

exerts pressure by its shaft against the cortex and does not tend to migrate. The short pin is exerting pressure by its point against the cortex and will tend to migrate backwards by this continuous pressure. Motion of the fragment will cause a short pin to “walk”.



(Dynamic forces indicated by arrows.)

Influence of the Length of Pins upon the Bone

(A) **Pins are too short.** Continuous forces exerted by the point against the wall of the bone causes the pins to migrate backward carrying with them the distal fragment. This will result in distraction and non-union.

(B) **The pins are of the proper length.** Lateral pressure is exerted by the shafts of the pins against the wall of the bone. This results in good fixation and permits the shaft of the bone to telescope upon the pins so that the muscle pull of the extremity can produce

compression of the fractured surfaces to stimulate good healing.

(C) **Pins too long.** Note that the pins that have crossed a second time so that the points are impinging, fork-like, against the wall of the bone. Some bone absorption at the fracture site occurs during the healing process. The fracture surfaces may thus be held apart to prevent compressions with the result of delayed healing or non-union. This can be used to an advantage in comminuted fractures.

Recapitulation

- (1) The vase of flowers principle (point pressure within the bone) can often be utilized for secure medullary fixation without the need of impacting the marrow cavity with large masses of metal.
- (2) For dynamic fixation, pins must possess the qualities of strength, limited malleability and limited resiliency.
- (3) Dynamic forces can be exerted by a straight pin within a curved bone or by a curved pin within a straight bone.
- (4) Bone fragments in many regions tend to angulate during the healing period because of continuous dynamic forces exerted by the muscles of the extremity.
- (5) The dynamic forces can be resisted to the surgeon's advantage by the intelligent application of straight or curved pins.
- (6) Improper use of dynamic pin forces can produce angulation and deformity. Intelligent use of pin forces can correct existing deformities and produce compression of the fracture surfaces.
- (7) Improper use of pins can cause distraction and non-union. Intelligent use of pins can result in secure fixation with compression and stimulate osteogenesis.