CHAPTER III
DESCRIPTION OF THE KNEE JOINT

3.1 Knee Anatomy

Despite the fact that the knee is the biggest articulation of human body, it is injured very easily because of its anatomic structure with a very poor protection against mechanical injuries such as exposition to external forces and high pressures it supports in human beings normal activities like lifting heavy objects and high impact sports. [9]

The main parts of the knee are:

- Tibia: Bone of the shinbone or greater bone of the lower part of the leg.
- Femur: Bone of the thigh or bone of the superior part of the leg.
- Lozenge: Flat bone located in front of the knee joint.

The knee itself has three components the lozenge, the distal femoral condyles and the plates. It is considered as a joint in hinge, but actually is more complicated than that, since it also provides a rotational motion component. The femoral condyles have two rounded edges and them curvature is eccentric. On the front part, these condyles are flat, it provides more surface for contact and transmission of load.

The articular surfaces of the knee do not match. On the middle zone, the femur finds with the tibia as a wheel over a vault. The ligaments acts with other soft structures which provide the stability that knee most have. [11]

Lozenge is a more or less a triangular bone with the proximal side wider than the distal. When the knee is completely extended, lozenge slides over the superior part of the femur. This starts the flexion movement and the plates begin to articulate with the condyles until it reaches the complete flexion. At 45 degrees of flexion, the contact is displaced to the front until it gets the middle point of both joints. In a complete flexion and extension, the lozenge moves 7-8 cm in the radial direction.

3.2. Knee Biomechanics

The mechanical axis of the femur does not coincide with the anatomical, since a line that crosses from the center of the hip to the center of the knee has an angle of 6-9 degrees with the femur axis. In a turgid position, the transversal axis of the articulation laids closes the horizontal axis. Because of the differences between lateral parts of the joint, the knee has hinge and pivot characteristics, since it has flexional movement and some rotational movement when it flexes. Rotation is impossible with the knee extended.

The knee provides ranges of movement of around 120° – 130° for flexion and 180° for extension considering this as a complete extension. In addition to those movements, knee also presents a progressive rotational movement, which advances mean the flexion increases from 0 to 90 degrees; rotation is around 5 to 25 degrees with some variations and it is always higher the internal rotation than the external. Lateral movement is prevented by the collateral ligaments. [10]

Making an analysis of the contact points between femur and tibia makes us know that the roll and displacement proportion is not constant along the flexion, is a proportion of 1:2 at the beginning of the flexion and 1:4 at the end of it (Fig. 3.1)

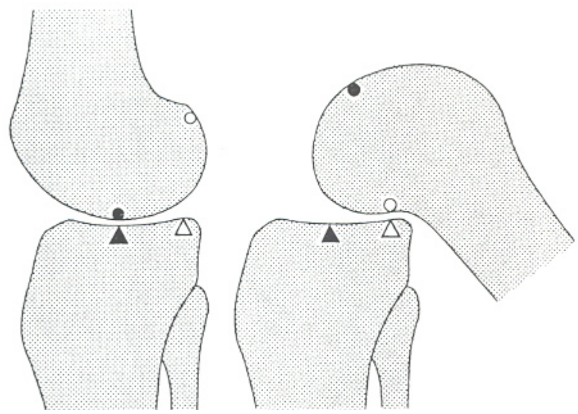

Fig 3.1. Femur movement with respect to the tibia during flexion

Normal extension and flexion range of movement are from 0 to 140 degrees, but in some cases it is possible to have a hyperextension of 5 to 10 degrees. In this position, it is almost impossible to have a rotational movement presents. In flexed position it is possible that a higher lateral movement presents, but it has not to be greater than 15 degrees.

3.3. Screw Holding

Screws used for medical application are, according to their elements, not very different to usual screws (Fig. 3.2), the diameter determines the resistance of the screw to be uprooted, and is in relation with the area of the bone in contact with the screw. The design of the thread is usually an ASIF or a V shape one. The tip of the screw can be rounded or not. If the bone is fragile and there is a possibility that the screw can be uprooted, it is better to use a screw with bigger thread diameter. But if the bone is strong and because of that is more probably a fatigue problem then is needed to be used a screw with a bigger internal diameter.

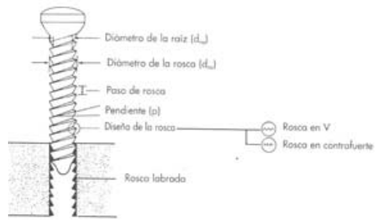

Fig 3.2. Elements of the screw

The purpose of using screws to treat fractures is to transform the torsion strength into compressive strength. To accomplish this objective, it is needed to have the head of the screw exerts a force that approximates the ends of the fracture. It is important to be careful in the choice of the angle in which the screw is going to be placed and is important to use a special medical technique named interfragmentary compression (Fig. 3.3). [11]

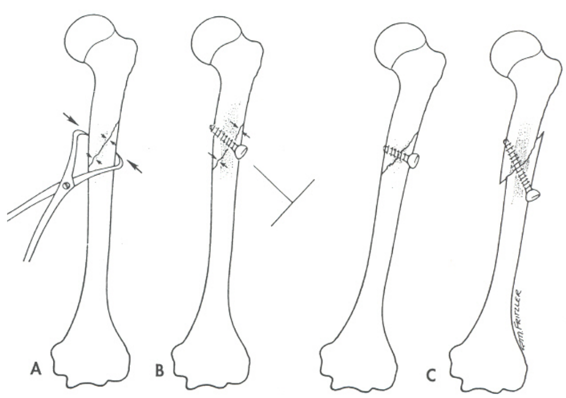

Fig 3.3. Principles of compression screws
A. How to find the best inclination and position
B. The screw most be placed in that position
C. The screw must be placed perpendicular to the fracture line.

There are two principal types of screws, the mechanized screws and the ASIF screws (Fig. 3.4). The first ones are more commonly used to treat hip fractures, that have thread in all the length, at the end they have a sharp edge to perforate while the screw advances, a bigger hole than needed will produce a weak holding and a very small hole will not allow the introduction of the screw; in order to prevent that the diameter of the used reel, must be little smaller than the root diameter of the screw. The ASIF screws have bigger thread, it provides a stronger hold and are the most used ones in soft zones.

Fig. 3.4. Examples of screws

3.3.1 Screws Fixation Technique

When the fracture presents a cross sectional or an oblique line, the screws must be combined with plates or any other fixation item. If the screw has its length completely threaded then will only work as a positional screw that is why it most be placed another element to provide the pressure needed to compress the fracture ends (Fig. 3.5).

The technique recommended by the AO is the following:

First fix the fracture ends with some provisional Kirschner nails, locate where is the screw going to be placed taking good care that this place is in the middle of the ends of the fracture, it most be introduced perpendicularly to the fracture plane or shear stresses will be presented while the torsion moment generates the compression needed on the fracture line. Then drill the hole, and countersink the hole to have a maximum contact of the head of the screw with the bone. The Kirschner nails should not be removed until the screw is perfectly placed. [9]

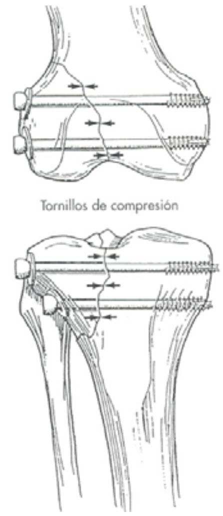

Fig. 3.5 Compression screws

3.4 The Fracture: Superior metafisis of tibia fracture

This is a very demanding surgery, requires having the instruments complete, and to know also how to work with them. In order to avoid unsatisfactory results is needed that the surgeon carries out correctly all the basic principles and technique. The fixation is justified if and only if the bone surface can be completely restored, the fixation is rigid enough to avoid any external fixation, the screwing process produces stability enough to do the exercises and, the skin and soft weaves are in good shape to be put under a surgery.

3.4.1 Technique

The patient must be face up in the surgery table, then make an incision along the area of the knee on a side, try to expose the superior extremity of tibia and place a Steinmann nail on the lateral face but trying not to cross completely the bone. Use this nail as a handle an place the fractured piece where it is supposed to be and fix it using some Kirschner nails, as shown in fig. 3.6.

Fig. 3.6 Radiography when the provisional Kirschner nail is removed

After doing that collocate three Kirschner nails as a guide to know where to place the screw, choose early the screw dimensions and introduce it at 90 degrees of the surface until it completely seats. Check that the contouring part fits perfectly with the face of the bone. This provides extra stability. Finally close the injury and place quilted bandaging (Fig. 3.7). [9]

Fig. 3.7 Radiography after the surgery