FRACTURES OF THE UPPER TIBIAL PLATEAU

THESIS

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INTRODUCTION

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At first glance, it may seem pointless to devote a study in depth to fractures of the upper extremity of the tibia and infact, there is already an extensive bibliography on this subject, which presents major serious and thought provoking problems of a fracture in a major weight bearing joint; the knee joint.

Every thing that can be said on the subject would seem to have been said and resaid. Nevertheless, for some years now, many authors have been intrested in the complex problems presented by injuries to the upper tibial plateau region and have already made certain suggestions as to methods of treating them.

So far as we know, no study has appea during the past decade, that makes a synthesis of the problems and tries to supply a satisfactory solution.

We wanted to compare the results obtained from conservative treatment with those obtained from operative treatment and to see whether and, in the event, why these results differ.

We have included some (rare) proximal epiphyseal separation fractures sustained by young people, for it is not unusual for the articulation to be affected fairly directly by this particular lesion.

ANATOMY OF THE UPPER END OF THE TIBIA

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To start with it is well to remember that although in the frontal view the articular surface of the tibial table is perpendicular to the longitudinal axis of the bone, the same is not true in the sagittal view. Seen in profile, the tibial table slopes backwards at an angle of 10° - 15° to the horizontal (Fig. 1).

This tilt is maximal in the newborn and should normally undergo a straightening out process as the age advances (KATE and ROBERT, 1965).

The backward inclination of the upper end of the tibia relative to the long axis of the shaft varies considerably in different individuals. When excessive, it seems to imply an attitude of squatting position as among the natives of India.

A groove deep to the ligamentum patellae characterizes the squatters' tibiae. This groove results from tendinous pressure during movement of the knee, the lateral lip of which is one of the factors that prevent the lateral displacement of the patella.

Furthermore, the tendinous pressure of the ligamentum patellae increases the backward tilt of the upper end of the tibia, as shown by the significant increase of the angle of quatters' tibiae if compared with nonsquatters (KATE and ROBERT, 1965).

The upper end of the tibia is widely expanded especially in its transverse axis, to provide a good bearing surface for the body weight transmitted through the lower end of the femur. It flares from the shaft proximally in the sub-condylar area, providing contours and bony prominences for ligament and tendon attachments, a small articulation for the proximal tibio - fibular joint and relatively flat articular surfaces to support the femoral condyles (Fig. 2 and 3).

It is surfaced by a very thin compact bone which is fragile particularly around the margins of the plateau.

It comprises two prominent masses, named medial and lateral condyles and a prominent tuberosity projecting anteriorly from its lower part.

Superiorly each of the condyles is covered with an articular surface.

The two being separated by an irregularly roughened nonarticular intercondylar area . (Fig. 4).

A knowledge of the trabecular bony structure of the upper extremity of the tibia can contribute to an understanding of the different types of fracture, liable to occur there, as well as of their prevalence (DUPARC and FICAT, 1960)*

The trabecular architecture of the bone has been described by DUPARC and FICAT, 1960* and also by BELGRANO, RONCALLI-BENEDETTI and SOAVE, 1967.* These authors referred to COULOUMA, 1928* but do not always reach the same conclusions .

Discussing the frontal view, DUPARC and FICAT described (Fig. 5);

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* Indicates that the author is quated from COURVOISIER, 1973.

THE UPPER PLATEAU OF THE TIBIA ; (Fig. 4 a and b).

It is the knee surface of the tibia, it comprises two condylar surfaces, medial and lateral, and an intercondylar area.

<u>The articular surface of the medial condyle</u>; is oval in shape with its long axis anteroposterior and is perceptibly the longer of the two condyles in conformity with the differences which exist between the tibial surfaces of the two femoral condyles.

It is related around its anterior, medial and posterior margins to the medial meniscus, and the area of contact is flattened. The imprint of the meniscus, which is widest behi and narrow at the medial surface and infront can often be recognised on the bone, the rest of the surface is concave and the articular cartilage of its raised lateral margin covers the medial intercondylar tubercle.

<u>The articular surface of the lateral condyle</u> is more nearly circular in shape and is related to the corresponding meniscus and bears its flattened imprint, elsewhere the surface is very slightly concave to adapt to the surface of the corresponding femoral condyle and its raised medial margin is continued on to the raised aspect of the lateral intercondylar tubercle.

The edges of the two articular surfaces are sharp except at the posterior lip of the lateral surface, where the margin is smooth and rounded off where the lateral meniscus slides posteriorly with flexion of the knee, in this position the tendon of the popliteus is intimately related to the bone.

<u>The intercondylar area</u> is a roughend non-articular strip on the superior surface between the articular surfaces of both condyles.

It is narrowest in its middle where it is marked by an elevation termed the *intercondylar eminence* (*the spine*).

The lateral and medial parts of this eminence project upwards and constitute the lateral and medial intercondylar tubercles of which the medial is slightly more prominent (GRAY, 1967).

Both behind and infront of the eminence the intercondylar area becomes wider as the curved margins of the articular surfaces recede from each other. The non articular areas infront and behind the spine show well marked facets for attachment of horns of the menisci and the cruciate ligaments (Fig. 4 b).

•• <u>The anterior intercondylar area</u> is widest anteriorly;

• In its antermedial part, just infront of the medial artcular surface, it bears a slight depression which gives attachment to the anterior horn of the medial meniscus;

• Behind that depression a relatively smooth area affords attachment to the lower end of the anterior cruciate ligament;

• The anterior horn of the lateral meniscus is attached infront of the intercondylar eminence and lies lateral to anterior tibiofibular ligament (composed of three bands) and an extension of the biceps tendon. The posterior part of the capsule is reinforced by the posterior tibio-fibular ligament (composed of a single band) and the popliteus tendon.

2. Groove for the popliteus tendon which lies just above and to the medial side of the fibular facet on the posterior surface of the lateral condyle, the tendon plays across the bone here lubricated by a synovial recess intervening between them (the popliteus bursa) ; (Fig. 8).

3. Smooth facet for the iliotibial tract, often well marked, though flattened, over the anterior surface of the lateral condyle. The lateral and anterior surfaces of the condyle are separated from the lateral surface of the shaft by a sharp margin which gives attachment to the deep fascia of the leg (Fig. 10).

Below the facet for the iliotibial tract a ridge slopes down to the tuberosity. A similar ridge extends from the medial condyle. Expansions from the vasti lateralis and medials known as the patellar retinacula are attached to these ridges.

Near the fibular facet the uppermost fibres of the extensor digitorum longus and occasionally small upward expansion of the peroneus longus arise from the lateral convexity of the condyle infront of the facet. Small slips from the tendon of biceps femoris above and infront of the fibular facet overly the upward expansion of the peroneus longus and extensor digitorum longus.

THE TUBEROSITY OF THE TIBIA

It is placed at the upper end of the anterior border of the shaft and is the trunkated apex of the triangular area of the front of the bone where the anterior surfaces of the two condyles become continuous.

It forms a low eminence and is divided by a line or crest into a smooth oval upper and a rough triangular lower portions, this marks the position of the epiphyseal line between the upper epiphysis and the shaft.

.. The ligamentum patellae is attached to the smooth portion; its superficial fibres may extend to the crest and lower rough portion where the lower limit of the attachment may be marked by a slight ridge.

.. The lower part is a small rough triangular area and can be felt through the skin from which it is separated only by a bursa termed the subcutaneous infrapatellar bursa.

.. Above the tuberosity the bone is related to the deep surface of the ligamentum patellae, but the deep infrapatellar bursa and some fibro-fatty tissue intervene.

OSSIFICATION OF THE PROXIMAL TIBIA

The ossific centre for the upper end of the tibia is usually present at brith, from it, at about the age of 10 years, a thin tongue shaped process extends in front to form the smooth upper part of the tuberosity. An additional centre for the tongue shaped process is not uncommon, it appears at about the twelfth year and soon fuses with the upper epiphysis.

The epiphyseal cartilage plate cuts across the lower margin of each condyle and is horizontal as seen from the back, and infront dips down to include the upper smooth part of the tuberosity (Fig. 11).

The chief points to be noted are that the fibular facet and the attachment of the semimembranosus and ligamentum patellae are on the epiphysis.

The upper and the growing end joins the shaft at 16 - 18 years in females and at 18 - 20 years in males.

The epiphyseal plate of the upper end of the tibia consists of dense collagenous tissue, the fibres of which are aligned with those of the ligamentum patellae. This peculiar structure is attributed to the large tensile stresses to which this part is subjected through the ligament.

BLOOD SUPPLY

• Anastomosis between the ascending branch of the nutrient artery; branch of the posterior tibial artery, and central vain. It has only large tributaries near the upper metaphysis. These tributaries drain in the upper part of the marrow cavity and are arranged in the from of a fan.

Connected with these veins are many anastomotic venous channels which pass through the thin cortex of the metaphysis to join the periosteal net of the veins before ent ring the general venous system (TRUETA & CAVADIAS, 1964).

During growth, the epiphyseal plate separates the epiphyseal vessels from the rest of the blood supply of long bone.

After the epiphyseal plate closes anastomosis exists between epiphyseal metaphyseal vessels and the latter anastomose with the terminal vessels of the nutrient artery.

INNERVATION

MALCOLMR et el (1963) investigated the innervation of human long bone by methylene blue immersion methods.

They found small myelinated and amyelilated nerve fibres entering the numerous foramina of the epiphyseal and metaphyseal regions. These fibres traverse the thin cortex and supply the interior of the bone. Small myelinated fibres spread out on the under surface of the articular cartilage and a small knob like tremination end in close relationship to the endosteum.

Furthermore, the walls of intertrabecular marrow arterioles contain myelinated and unmyelinated nerve fibers, the epiphyseal metaphyseal arteries, these enter the endosteal surface of the cortex as cortical branches of the nutrient artery, these undergo further subdivision to supply the vessels of Haversian canal.

. The periosteal vessels orginate from branches that traverse the posterior and lateral surfaces of the tibia. These branches arise from the anterior tibial artery (PATRICK and NELSON, 1961). Each branch is accompanied with two veins and they undergo further subdivisions and anastomose with each other to form a network of vessels on the posterior and lateral surfaces.

. The anteromedial surface does not have such arrangement , but an irregular anastomotic pattern is seen.

Nelson (1960) stated that the periosteal vessels usually play only a minor role in supplying arterial blood and they constitute a potential source of blood supply, for the cortex in cases of damage to the medullary blood vessels. This concept was supperted by TRUETA and CAVADIAS (1964). So one of the main functions of the periosteal vascular system is to supply vessels for the new Haversian systems that develop on the external surface of the cortex.

VENOUS DRAINAGE

Venous blood is contained in the sinusoids. The central vein is fromed by the conglumeration of venous sinusoids.

The upper half of the tibia is drained by one large