THE SPRAINED ANKLE

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The ankle joint is a synovial joint of typical hinge pattern. The lower ends of the tibia and fibula provide a socket in which the upper part of the talus rocks around a transverse axis. Into this socket the superior part of the talus fits like a wedge. The convex superior surface of the talus is applied to the inferior surface of the tibia while the two lateral surfaces of the bone are in contact with the 2 malleoli. The superior articular surface of the talus is wider anteriorly and on its fibular side there is a bevelled edge against which the transverse ligaments of the inferior tibio-fibular joint plays in the flexion and extension movements of the joint. The joint is surrounded by a capsule and as is usual in a large joint it is weak in front and behind but is strengthened at the sides by collateral ligaments. A synovial membrane lines the fibrous capsule, and covers well marked fatty pads that lie in relation to the anterior and posterior ligaments. A synovial fold occupies the cleft between the tibia and fibula below the bone of the interosseous tibio-fibular ligaments. The capsule is innervated by twigs from the tibial and deep peroneal nerves.

The general continuity of the ankle joint capsule is strengthened by distinct and strongly developed bands. They are recognised as the deltoid ligament, the anterior talo-fibular and the posterior talo-fibular, and the calcaneo-fibular ligaments. These ligamentous bands that hold the talus in apposition with the bones of the leg are directed so that they grip the anterior and posterior extremities of the talus and as a consequence the bone is free to rotate in its socket but not to move backwards or forwards as a whole. If the upper articular area of the talus is examined 2 features are conspicuous. The first is the greater breadth of the articular surface on the fore part of the bone and it is obvious from this that as the foot is extended the area of the talus engaged in the tibio-fibular socket becomes increasingly firmly embraced by the malleolar articular areas. These 2 articular surfaces are prevented from being forced apart by the strong interosseous ligament that binds the tibia and fibula together. In the position of extreme extension there can therefore be no side to side movement of the talus in its socket. When the foot is completely flexed and the narrower posterior end of the articular area of the talus is engaged between the 2 malleoli a little side to side play is permitted and the talus moves with the bones of the foot in movements

other than pure extension and flexion. Since raising the foot produces a tightening of the ligaments of the articular socket the natural position of rest is that assumed by the foot depending in a position of partial flexion with the maximum relaxation of the joint ligaments. The second noteworthy feature of the upper articular surface of the talus is the triangular bevelled area on the fibular side of the posterior part of the main surface. The fibular articular area is confined to the anterior half of the malleolus for the posterior part or occupied by the non-articular malleolar fossa. The bony socket for the upper surface of the talus is therefore deficient behind on the fibular side of the ankle joint. This gap is occupied by a very specialised and important ligament. It arises in the malleolar fossa in common with the so-called talo-fibular ligaments or posterior fascicular of the external lateral ligament. These two ligaments have a conjoined attachment in the malleolar fossa and from this conjoined origin 2 strong fasciculi of fibres diverge the upper one passing to the posterior surface of the tibia where it merges with the other strands of fibrous tissue joining the bones together, the lower one to the talus where it is attached in the groove that runs to the fibular side of the posterior tubercle. As the foot is flexed and extended at the ankle joint these 2 fasciculi move like the blades of a pair of scissors in opening and shutting. In flexion the 2 bands come together lying parallel with each other and appearing as a single broad ligament. In extension the lower band attached to the moving talus moves away from the upper band running to the tibia and > shaped gap is left between them. It is during the backward and forward motion of the talus that the bevelled area of its upper articulated surface engages with the upper limb of the ligaments.

The functional importance of this ligament is to increase the depth of the posterior tibial flange and so deepening the tibial socket behind. Now in addition to the ligaments that bind the talus to the tibia and fibular each of the bones of the leg has its own strong band that passing sheer over the side of the talus grips the calcaneus below it. These ligaments are directed downwards with a backward trend as they pass to the calcaneus and they occupy the areas on the side of the sapsule between the anterior and posterior ligaments passing to the talus.

It is obvious that all these ligaments are arranged so as to permit the talus with the foot to rotate in one axis. The question is what extent can this rotation be carried out. Through how many degrees may the foot be flexed and extended by movements entirely restricted to the rotation of the talus at the ankle joint. Very different answers have been given by Anatomists, but the average range is estimated that from the right angled position the foot can be raised in a dorsal direction to 35° and depressed to 55° . Investigation has revealed however that there are very wide individual variations in the total range and the question of range of ankle joint movement has interest beyond the field of clinical investigation. Use and habit and, to a certain extent, race are involved in this matter.

It is easy to realise that individuals who sit on chairs and who walk mainly on flat surfaces have less need for a wide range of movement at the ankle than those who sit hunkered on the heels and walk habitually on the ups and downs of uneven contours.

As the talus is rotated backwards in its socket in the movement of extension of the foot the anterior widened extremity of the upper articular area becomes engaged with the articular area of the tibia. In manipulating the ankle joint of the normal European the articular area of the talus may be rotated backwards until its anterior margin comes to rest at the anterior margin of the tibial facet. In this position the neck of the talus is still some distance from the lower margin of the anterior surface of the tibia. In conformity with this normal range of movement the anterior surface of the lower end of the tibia is non-articulated and it is separated from the articular area of the inferior surface by a sharp edge to which the anterior ligament of the joint is allocated. Moreover the neck of the talus is also non-articular and is excluded from the cavity of ankle joint by the presence of a variable pad of fat and fibrous tissue and by the somewhat variable attachment of the lower end of the anterior ligament of the ankle joint to the bone behind the actual distal extremity of the neck. But in those races in which a high degree of extension of the foot on the leg is developed by squatting, the neck of the talus comes increasingly into relation with the lower anterior surface of the tibia, and the attachment of the anterior ligament of the ankle is made to the navicular articular margin of the head of the bone, the whole of the neck being within the cavity of the ankle joint. Not only are the squatting facets developed on the lower margin of the anterior surface of the tibia and on the neck of the talus but the tibial and fibular malleolar facets on the talus are carried farther forwards on the bone. This condition may even be present in people who possess a high degree of extension of the foot but who do not habitually resort to the typical position of rest assumed by many oriental races in squatting on their heels.

In the highly mobile foot of the Australian native the facet on the talus for the tibial malleolus approaches very near to the end of the bone, in some instances having only a small roughened area separating it from the facet for the navicular. But in these people there is as a rule no cartilage-covered articular area on the upper surface of the neck for articulation with the anterior surface of the tibia, for the Oriental squatting position is not habitually assumed by them. Nevertheless they develop other facets on the bones of the leg in accordance with the peculiar position assumed when resting. It is perhaps being unnecessarily provocative to point out that although these articular facets are acquired by the characteristic habit of squatting adopted by the adult they are present in the foetus. It would seem not irrelevant to remark that this might appear to provide an instance in which characters acquired in response to the demands of habit are, in fact, inherited.

The significance between the physiological anatomy of the ankle is shown in the correlation of ankle joint mobility and the incidence of sprains. The ankle and foot which is highly mobile with a greater range of total movement is less liable to injury than the stiffer less mobile foot. Training in professions such as ballet dancing and acrobatics increases the general flexibility and elasticity and increases the range of movement of the ankle and tarsal joints, thereby reducing the potential dangers. The usual mechanism resulting in a sprain is forced inversion of the plantar-flexed foot. With this mechanism the anterior talo-fibular ligament is most commonly ruptured since the ligament or fasciculus of the collateral ligament is parallel to the long axis of the tibia when the ankle joint is in this position. This is the common sprain and as I shall describe later yields readily to simple treatment. But before one diagnoses a so-called sprain we must most carefully assess the relative importance of damage to the various components of the whole capsular ligaments and in particular the effect on the stability of the ankle joint. Generally speaking there are two types of instability.

The first occurs when a tear in the anterior talo-fibular ligament allows anterior displacement of the talus in the ankle joint mortise in the coronal plane. In addition rotational displacement of the talus medially on its vertical axis occurs. An associated tear of the lateral capsule may allow a tilt of the talus of as much as 7 degrees. The second type of instability resulting from rupture of the anterior talo-fibular and calcaneo-fibular ligaments is exemplified by marked instability in the long axis of the talus. With a combined tear of the anterior talo-fibular and the calcaneo-fibular ligaments, lifting of the talus in its mortise may be from 12-30 degrees. A rupture of all 3 ligaments renders the ankle completely unstable. It is interesting to note that the posterior talo-fibular ligament remains intact in practically all cases.

Radiographic diagnosis is essential. Antero-posterior radiographs are taken of the ankle with the foot in the fully inverted position. If the injury has been the simple sprain of the anterior talo-fibular ligament the talus remains quite stable in the tibio-fibular mortise. More extensive ligamentous and capsular damage is shown by the degree of tilting of the talus.

Up to now we have focussed our attention upon actual ligamentous injury but we must not overlook the fact that the traumatic pathology includes the surrounding areolar tissue and overlying tendon and muscle sheaths and also a nerve lesion not yet visualized in pathological studies. Detailed examination of a sprain reveals increased oedema of the synovial fluid in the joint and sub-acute inflammation and haemorrhage into the synovial membrane and into loose areolar peri-articular tissue especially those surrounding the tendon sheaths on the affected side. In severe sprains there is evidence of degenerative changes in the

articular cartilage. The pathology of a sprain and its healing, although a continuous process, can be divided into four stages:

1. The tearing of tissue and its resulting haemorrhage.
2. Haematoma formation.
3. Haematome absorption.
4. Fibroblastic proliferation.

The first stage of tearing the tissue is the actual injury but the remaining reactionary stages concerning the actual healing processes can be modified by local and systemic treatment. Immediately, the haemorrhage and extravasion of fluid in the tissues must be controlled by the application of extreme cold by ice or a cold spray. 2 cms. of Hydrocortisone are injected by exact localisation of the ligamentous injury. To reduce capillary bleeding systemic injections of symphathomimetic agents containing adrenalus such as adrenoxyl should be given at once. Haemostatic action minimises the reactionary effusions and thereby reduces the period of absorption. Compression by either a crepe or rubber bandage is then applied.

It is at this stage that a firm and accurate diagnosis of the extent of the injury must be determined with the aid of radiography. Here we must differentiate between a stable or unstable talus. A stable talus indicates a tear of the anterior talo-fibular ligament only while an unstable talus indicates more extensive ligamentous damage. The simple sprain, although involving the surrounding tissues can be treated by immediate activity without the necessity for immobilisation, while the sprain producing the unstable talus requires complete immobilisation in a plaster for 10 weeks. Following this it is essential to build up the strength of the ligaments so that they are able to withstand the normal stresses of the joint during normal activity and thereby reduce the liability of recurrent sprains. This can only be done by resistance exercises, for it has been shown that just as muscle fibres can be increased and strengthened by progressive resistance so also the capsule and ligaments can similarly be strengthened. In order that the athlete does not solely rely on protective strapping to prevent further injuries it is essential that all the muscles acting upon the ankle joint be strengthened to an advanced state and thus help to compensate for any residual weakness left by the ligamentous injury.