IVAR PALMER, STOCKHOLM:

REMARKS ON THE SO-CALLED SUPRASPINATUS RUPTURES IN THE SHOULDER-JOINT, THEIR DIAGNOSIS AND TREATMENT

The short muscles of the shoulder-joint—subscapularis, supraspinatus, infraspinatus and teres minor—form together peripherally a strong tendinous aponeurosis. This is at least in part in a vulnerable position, however, owing to the erect posture of man and the use of the arm as a clutching and lifting implement. Just think of the lever system in a movement of elevation with a load in the hand. The load of the hand is increased tenfold, for the reaction power, which is furnished in part by the supraspinatus and its tendon, has a lever that measures only one tenth of the length of the arm (see Fig. 1). The aponeurosis which is squeezed between the head of the humerus and the acromion is further exposed to mechanical strain in the form of knocks and pressure.

So, really it is not surprising that a part of this aponeurotic tissue in men with hard manual labour may sometimes fail relatively early; and it is not difficult to understand that even an increase in the normal use of the arm may elicit pathological changes in the aponeurotic tissue.

Intact, healthy, tendinous tissue does not rupture. Systematic loading tests on random muscles show that the limit for bursting is lower for the belly of the muscle and the bone tissue peripheral to the insertion of the tendon than for the tendon substance (MacMaster, and others). Of course, an isolated powerful trauma may produce a lesion in the part of the shoulder-joint directly concerned. This lesion does not localize

to the aponeurotic substance, however, but to the substantia spongiosa of the greater tubercle of the head of the humerus. In other words, an injury of the tearing fracture type.

An injury of this type requires a strong trauma, so powerful that it causes dislocation of the joint at the same time. The

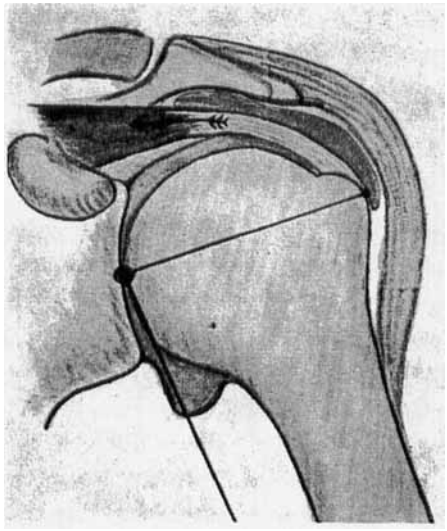


Fig. 1.

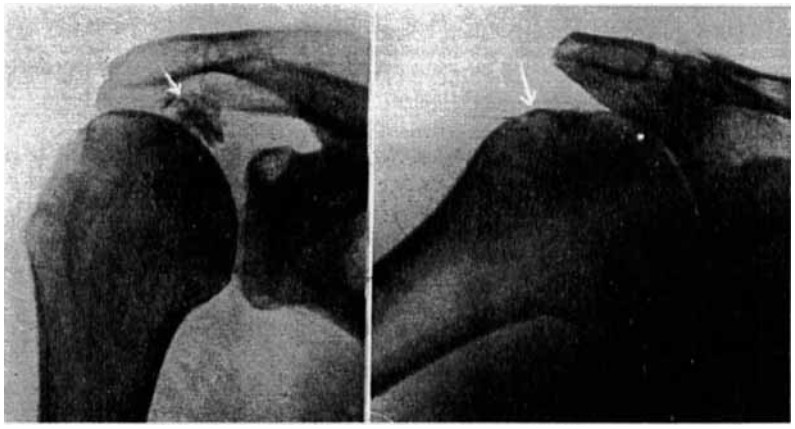
Scheme of a normal shoulder joint. The "inner" and the "outer" parts of the articulation are separated by the tentinous aponeurosis of the m. supraspinatus. The articular capsule is connected with the distal part of the tendon. There is no connection between the "inner" and "outer" parts of the joint.

injury is easy to diagnose by direct roentgenography, and easy to repair operatively (see Fig. 2).

Injuries to the substance of the tendon aponeurosis belong to an entirely different class, however. It is not to be denied that the injurious effect of the acute trauma here is augmented, and gets its particular character through previous changes. A pretraumatic vulnerability asserts itself!

Codman thinks that repeated small traumata in the course of the daily work cause marginal ruptures in the attachment of

the aponeurosis, and that the aponeurosis in this way is weakened and diminished. This gives rise to the formation of a threshold at the border of the greater tubercle. Then the inferior sliding surface of the exterior part of the joint does no longer form a smooth curvature as normally; the friction-free sliding course



a. *Fig. 2.* b.

a. The great severely bruised fragment of the tuberculous majus is rather retracted.

b. The fragment is replaced and fixed with silk-sutures through drill-holes in the osseous tissue.

is interfered with, and the strain on the aponeurosis is further increased. Thus a vicious circle is established, where the links in the chain are: chronic trauma—small ruptures, acute trauma —greater rupture, articular dysfunction with additional chronic trauma, and so on.

Briefly this course might be presented schematically in the following way:

1. Injury to the aponeurosis from exposure to chronic trauma.
2. A moderate acute trauma gives a rupture, to which the true joint comes in open connection with the subacromial-subdeltoid bursa, and the gliding course of the outer joint is spoiled.

3. Then follows an articular dysfunction which elicits progressive destructive processes in the joint (see Fig. 3).

Diagnosis.—Once we have realized the nature of these cases with a wide rupture in the aponeurosis of the shoulder-joint, they present a quite typical picture. For the present, however, roentgenography combined with arthrography is that method

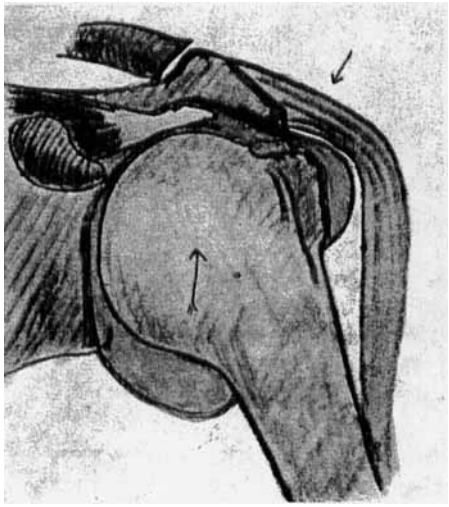


Fig. 3.

Scheme of a shoulder joint with a ruptured and retracted tendinous aponeurosis. A broad communication is established between the "inner" and the "outer" parts of the joint. An upward subluxation of the humerus has occurred. The secondary arthrosis on the inner surface of the acromion and on the tuberculum majus are slightly indicated in the sketch.

of examination which will give the decisive evidence. This method has been worked out and first applied clinically by K. Lindblom, to whose studies I refer those who want to know the details of his technique (Nordisk Medicin 1939).

In the Surgical Clinic II, Sabbatsberg Hospital, Stockholm (Chief: Professor K. H. Giertz), since April 1938, we have had ten cases of wide rupture of the shoulder aponeurosis under sur-

gical treatment. They were all men of 40 years or older, occupied with heavy manual work. Among these patients two were blacksmiths, two timber-yard workers, one iceman, one fireman, and four unskilled labourers. The accident is not so severe that it causes fracture or dislocation. Usually it involves a fall in which the patient puts out his hands to break the fall with extended arms. In doing so he may feel something snapping in the shoulder and a burning pain. It is quite characteristic that the discomfort after the injury is rather moderate, so that the patient remains at his working place and merely spares the arm while he tries to keep working. During the following night, however, the discomfort increases, and from now on he is unable to work. Even when there has been considerable length of time between the accident and the operation, our operated patients have not been capable of resuming work.

The clinical state of the case is due in part to the abolition of muscular function, partly to destruction of the outer joint.

a. A constant and most conspicuous symptom is a disturbance of the humeroscapular rhythm, that is, a disorder of the physiological proportion between the mobility in the true shoulder-joint and the mobility through shifting of the scapula against the chest wall, in the different phases of elevation. The disturbance may be characterized in this way, that the movement in the humeroscapular joint is delayed as long as possible in the upward phase as well as the downward phase of the elevation. If we designate the hanging arm as flexion in the humeroscapular joint, and the elevated arm as extension, the type of movement may be characterized as ascending in flexion and descending in extension. This is a constant but not pathognomonic symptom.

b. If true elevation is possible, it is carried out only with a very marked decrease in power. Most often the patient is not able even to overcome the weight of the arm itself but has to support the injured arm with the other at the critical moment.

In this movement of elevation the edge of the acromion slides directly against the upwards subluxated, uncovered, head of the humerus. Soon the moment comes when the edge of the acromion

meets the threshold of the greater tubercle. Here the patient has a sensation of something catching. He feels a pain that usually is manifest in the play of his facial features. Sometimes the arm is locked in this position by reflex action from increased muscular tonus. If the patient can be persuaded to relax the musculature, the arm may be moved farther up, by passive motion, to full elevation; in this position the pain is absent, and the patient feels a certain relief. From this it is evident that the inhibition of motion is not due to rigidity of the joint.

On operative opening of the lesion it is also found that the peritendinous space shows no tendency to formation of adhesions or obliteration—but rather the contrary. The wall of the bursa is thickened, it is true, but the bursa is rather distended. This is easily explainable, for the elevating movement forces the synovial fluid out of the true joint, through the rupture into the bursa, distending the latter. Another very serviceable method of examination for exclusion of rigidity in the joint is to let the patient bend forwards, with the arm swinging forwards through its own weight. Here all muscular effort is eliminated. Thus the humerus does not get into a position of subluxation through the action of the deltoid, and the greater tubercle slides in under the arch, at a distance from the acromion and without any pain.

c. On passive elevation, in which the phenomenon is not covered up by tension of the deltoid, one feels a soft coarse crepitation during a certain phase of the elevation. At the same time, the patient feels pain in the joint.

d. When the arm is hanging down with the forearm turned straight forwards, the greater tubercle is turned straight laterally. Now one palpates between the edge of the acromion and the greater tubercle, over the insertion of the supraspinatus tendon. When the rupture is fairly recent, one feels here a well localized tenderness on pressure, and in thin persons the groove between the edge of the acromion and the greater tubercle is deeper than that on the normal side. This finding is explained in part by the retraction of the 3—4 mm. thick plate of aponeurosis, partly by an inflammatory process on the greater tubercle.

In case of tendinitis without rupture the palpation will give

an impression of bolstring due to oedema and, possibly, depositing of lime salts.

Briefly summarized, then, the syndrome of rupture of the supraspinatus involves the following points:

Treatment:

For operative opening of the injuries it is recommended in the literature to make a so-called "sabre-cut incision", *i.e.*, an incision that divides the deltoid in the direction of the fibres, continuing up through the acromioclavicular joint, and then cleaves the acromion. This gives a deltoid flap than can be turned down, and then there is good access to the site of the injury. This incision complicates the operation not inconsiderably, however, and it has not been necessary in any of our cases. An incision from the acromion down through the deltoid has been sufficient.

At first it seems technically impossible to get in under the arch of the acromion, for the head of the humerus is pressed firmly against the arch. But this is not due to tension of the soft part—only to the negative pressure of the joint. When this pressure is abolished by pulling the arm downwards and outwards, a smacking sound is heard, as air is sucked into the joint through the rupture, and now the access is surprisingly good. The head can be moved almost 2 cm. from the inferior surface of the acromion. Under the acromion arch one will now find the thick retracted aponeurosis, which may be seized with a pair of Russian forceps. Under cautious stretching it is pulled down over the bare head of humerus—like a cap.

After the margin of the tendon has been freshened, it has to be fixed. I have found the method given by Wilson to be excellent, and I have used it in all ten cases. A groove is chiseled in the neighbourhood of the anatomical neck, corresponding in length to the width of the rupture. The trimmed margin of the tendon is pressed down into this groove and fixed by means of sutures through drill-channels from the lower part of the tubercle to the bottom of the groove. For the sutures I have made use of the plantaris tendon from the leg; it is strong and pliable.

Presumably a coarse silk suture might be used just as well. When the tendon has been fixed, the sliding surface has to be smoothed. It is important to see that the surface of the tubercle and the tendon plate form a regular curve. The tubercle is trimmed, with removal of the osteophytes, and the inferior sliding surface of the outer joint is reproduced.

Thus the operation serves two purposes: to connect the deep muscles with their insertion, and to restore the sliding surface of the outer joint.

DISCUSSION:

Waldenström, Stockholm:

W. demonstrated a case of supraspinatus rupture that took place in November 1937 and was combined with a dislocation, which was put back in place in the usual way. After this the shoulder was never well; the arm could be abducted merely 60°, and the patient could "sling the arm all the way up" but not lower it again. The operation revealed a rupture, measuring about 4 cm. in length that was sutured after the Wilton method.

On a study journey in America I realized how much more common this lesion is than we are used to think. I hope that the knowledge of the refined and precise diagnosing that is practised over there will be useful to us here at home.