FRACTURES
AND JOINT INJURIES

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PART III

INJURIES OF THE UPPER LIMB

CHAPTER XVIII

INJURIES OF THE SHOULDER

Surgeons who take anxious steps to prevent stiffness of the injured shoulder by early movement, passive stretching and repeated manipulation make the joint still more stiff by their worrying treatment. Movements too early, passive movements too vigorous, and manipulations too often, are the commonest causes of stiffness—and yet the fear that prompts such treatment is unfounded. There is no danger in immobilising a dislocated shoulder for three or four weeks even in elderly patients ; full movement will be regained if active exercise is relied upon to the exclusion of passive force. The only danger is that failure to immobilise may cause recurrent dislocation exactly as it does in every other joint. Many healthy young men have been disabled by recurrent dislocation of the shoulder through neglect to immobilise the first dislocation—a neglect that is foolish in healthy young men.

Moreover there is no greater danger of permanent stiffness when a shoulder is immobilised by the side than when it is immobilised in abduction ; it is no more difficult to regain abduction movement when the limb has been in a sling than to regain adduction movement when it has been in a frame. Much nonsense has been talked about the effects of gravity on stiffness of joints. The elbow that is stiff in extension can be mobilised just as surely as the elbow stiff in flexion ; the ankle stiff in equinus can be mobilised no less certainly than the ankle stiff in any other position ; the stiff knee, stiff hip, stiff back and stiff neck are mobilised not by gravity but by active exercise. Let there be no fear of immobilising an injured shoulder with the limb by the side of the trunk.

In one respect the shoulder differs materially from other joints. The rotator cuff, which includes the tendons of infraspinatus, supraspinatus and subscapularis fused intimately with the capsule of the joint, is exposed to unusual wear and often shows traumatic degeneration. This fibrotendinous cuff impinges against the acromion and the acromio-clavicular joint with every abduction movement of the limb, or at least it would do so without the protection of the subdeltoid bursa (Fig. 710). The bursa which is sometimes separated into two parts, the subacromial and subcoracoid, lies between the head of the humerus and the arch formed by the acromion, acromio-clavicular joint and coraco-acromial ligament. With increasing age and hard physical effort the bursal protection may become inadequate, especially if the acromion is thickened or if there is arthritis of the acromio-clavicular joint with osteophytes on its inferior aspect. Supraspinatus tendinitis then develops, occasionally with calcification, sometimes with almost spontaneous rupture of the degenerated fibres, and often with periarthritis and periarticular adhesions causing limitation of abduction and external rotation.

Such degenerative changes occur even when there has been no specific injury [1] but they may also complicate fractures or dislocations of the joint and cause greater difficulty in preventing stiffness. Nevertheless, even degeneration of the capsule and rotator cuff with its predisposition to adhesion formation does not condone early mobilisation, passive stretching or repeated manipulation ; indeed the danger is more real and the importance of active exercise without passive force is still greater.

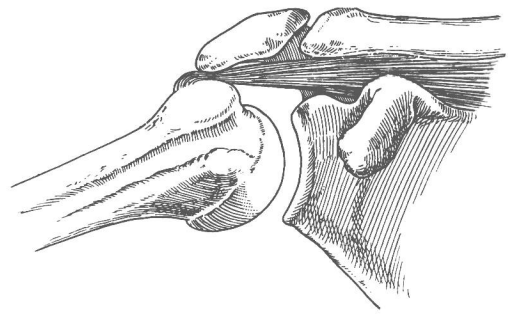

FIG. 710

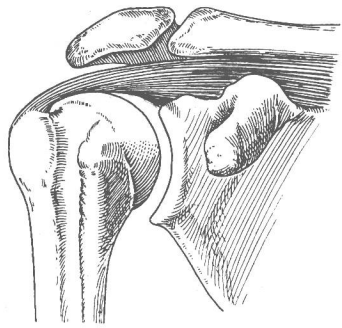

FIG. 711

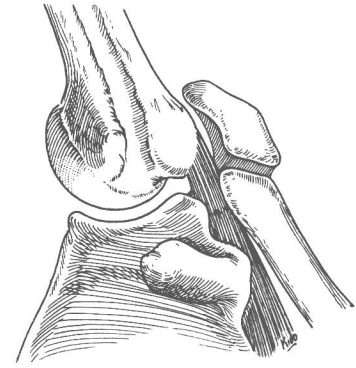

FIG. 712

The supraspinatus tendon is impinged upon by the acromion in the middle range of abduction, but not when the humerus is by the side nor when it is in full abduction.

DEGENERATIONS OF THE ROTATOR CUFF OF THE SHOULDER—SUPRASPINATUS TENDINITIS

The progressive degeneration that causes tendinitis and leads ultimately to spontaneous rupture of the musculo-tendinous cuff and sometimes of the long tendon of biceps is illustrated in the radiographs of a seventy-three-year-old patient (Figs. 713-715). In 1945, at a time when radiographs showed early arthritis of the acromio-clavicular joint and slight sclerosis of the tuberosity of the humerus, there was clinical evidence of supraspinatus tendinitis. Friction of the tendon against the acromion, and osteophytes below the acromio-clavicular joint, caused pain in the middle third of abduction movement (Fig. 713). Two years later the changes were more advanced and there was periarthritis with adhesions limiting abduction and

[1] Harrison, S. H. "Painful Shoulder. Significance of Radiographic Changes in Upper End of Humerus." *J. Bone Joint Surg.*, 1949, **31-B,** 418.

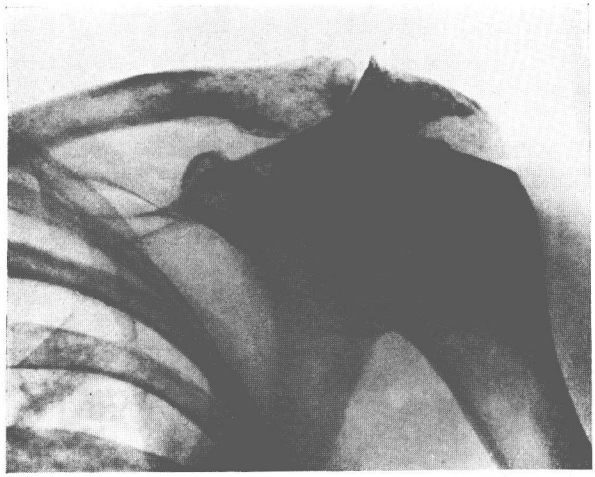

FIG. 713
Radiograph in 1945

FIG. 714
Radiograph in 1947

FIG. 715
Radiograph in 1949

Progressive degeneration and finally spontaneous rupture of the rotator tendinous cuff and long tendon of biceps

Evidence of supraspinatus tendinitis developed in this patient in 1945; radiographs then showed early sclerosis of the tuberosity and arthritis of the acromio-clavicular joint (Fig. 713). Two years later the changes were more advanced and there was clinical evidence of periarthritis with adhesions (Fig. 714). By 1949 there was much more sclerosis and irregularity of the tuberosity and adjacent part of the humeral head, and there had been spontaneous rupture of the whole rotator cuff (infraspinatus, supraspinatus and subscapularis) as well as of the long head of the biceps.

external rotation movement, but there was not yet loss of power (Fig. 714). By 1949 sclerosis of bone and irregularity of the tuberosity were much increased and suddenly one day, without recognised injury, there was complete rupture of the rotator cuff with inability to abduct the limb, and also spontaneous rupture of the biceps tendon with retraction of the muscle to the lower arm (Fig. 715). Continued wearing of the tendinous cuff against bone had first caused supraspinatus tendinitis, then periarthritis with adhesions, and finally spontaneous rupture of the tendons.

Supraspinatus tendinitis [1-4]—The patient complains of pain in the middle third of the arc of abduction movement, from about 70 to 120 degrees—the range through which the tender area impinges against the acromion. When the painful arc is passed, and the limb is in full abduction, movement is again painless ; but as the limb is brought down to the side there is sharp pain from 120 to 70 degrees of abduction. Movement is not limited in any direction as it is in arthritis, or in periarthritis with adhesions. Moreover, it is painful only in the middle third of the range of abduction, whereas in arthritis all movements are painful from the beginning, and in periarthritis with adhesions movements are painful beyond 90 degrees and increasingly painful as movement continues—there is no painless range at the limit of abduction.

The differentiation of simple supraspinatus tendinitis from early rupture of the tendon, where again there is a painful arc of movement in the middle third of abduction, is often difficult and sometimes can be determined only after surgical exploration.[5-6] In general, however, when there is no loss of power, and no recourse to trick movements with curious rotatory twists as the limb is raised or lowered, the diagnosis of simple tendinitis can be relied upon.

The symptoms often disappear after simple rest. Recovery may be accelerated by injecting about 10 c.c. of 1 per cent. novocaine.[7-9] Immediate relief of pain is dramatic but the patient should be warned that it may recur within a few hours and even be intensified. The pain then subsides and recovery is usually complete. In the few cases in which tendinitis with pain is persistent, or recurrent, excision of the acromion is indicated (see page 454).

Supraspinatus tendinitis with calcification—The degenerative change of supraspinatus tendinitis, like that of any other relatively avascular fibrous tissue, is often associated with a deposit of calcium salts—an amorphous mass of calcium carbonate and phosphate in semi-fluid state resembling toothpaste (Fig. 716). Such calcification is seen in old fibrosed tuberculous glands, the organised clots of varicose veins and hæmangiomata, the walls of sclerotic arteries, and the fibrous layers of costal cartilages. It is seen especially in degenerated tendons—the tendo Achillis many years after it has been tenotomised, the gluteal tendons at their insertion to the trochanter, the pyriformis tendon, the common extensor tendon at the elbow, the

[1] Codman, E. A. *Surg. Gynec. Obstet.*, 1931, **52,** 579.
[2] Codman, E. A. "The Shoulder." Boston : Thos. Todd Co., 1934.
[3] Meyer, A. W. *Arch. Surg.*, 1937, **35,** 646.
[4] Keyes, E. L. *J. Bone Joint Surg.*, 1935, **17,** 953.
[5] Brown, J. T. "Early Assessment of Supraspinatus Tears ; Procaine Infiltration as a Guide to Treatment." *J. Bone Joint Surg.*, 1949, **31-B,** 423.
[6] Ellis, V. H. Paper to Joint Meeting of Orthopædic Associations in London, 1952, advocating novocaine infiltration and also arthrography in diagnosis of early tears.
[7] Haldeman, K. O., and Soto-Hall, R. *J. Amer. med. Ass.*, 1935, **104,** 2319.
[8] Haggart, G. E., and Allen, H. A. *Surg. Clin. N. Amer.*, 1935, **15,** 1537.
[9] It may be still better to use xylocaine which causes less reaction.

subscapularis in front of the shoulder and, most common of all, the supraspinatus tendon beneath the acromion.[1-2]

The symptoms resemble those of uncomplicated tendinitis but the volume of calcium deposit so increases impingement against the acromion that the pain is much more severe. It is sometimes agonising and the patient may refuse to attempt abduction movement beyond 60 or 70 degrees. One patient was comfortable only when she sat with the limb hanging by her side, dependent from the shoulder—she could not tolerate even the support of a sling. In such cases pain may be referred beyond the deltoid insertion to the forearm and hand, and sometimes to the scapular and occipital regions.[3] The pain often subsides after simple bed rest and the calcareous deposit may disappear,[4] but large deposits cause pain so severe that continued expectant treatment is not justified. Evacuation of the deposit through wide-bored aspirating needles has been attempted [5] but it is better to make a short incision, split the fibres of the deltoid, and remove the grey-yellow paste with a small curetting spoon.

FIG. 716

Calcification of the supraspinatus tendon.

Supraspinatous tendinitis with ossification—It is known that calcified tendons may become ossified—as may any mass of pathological calcification. This is probably the cause of heterotopic ossification of the tendo Achillis.[6] So far as I am aware, ossification of the supraspinatus tendon and rotator cuff of the shoulder has not been reported except in the patient recorded in earlier editions of this book ; but exceptional as that case may have been it was important because it encouraged me to excise the acromion process—an operation that has proved to have wide application.[7] Eight years before, a calcareous mass had been removed through a short incision and relief of symptoms had been complete. There was then recurrence of severe pain, especially when the limb was abducted from 60 to 120 degrees, and radiographs showed extensive ossification of the whole rotator cuff of the shoulder (Fig. 717). Clearly this mass could not be excised without destroying the abductor mechanism of the joint—but the pain from impingement could be relieved by excision of the acromion. It was interesting to find that the patient regarded this as a minor operation

[1] Watson-Jones, R., and Roberts, R. E. *Brit. J. Surg.*, 1943, **21**, 461.
[2] Hamilton, A. R. *J. Bone Joint Surg.*, 1951, **33-B**, 573.
[3] Moseley showed that, in a normal individual, injection of less than 1 c.c. of 5 per cent. saline into the supraspinatus tendon caused pain referred to the deltoid insertion ; and that as the volume of injected fluid was increased the field of pain radiation was greater until it resembled " brachial neuritis " with pain from the occiput to the fingers. *Canad. med. J.*, 1942, **46**, 361.
[4] Jones, G. Blundell. " Calcification of the Supraspinatus Tendon." *J. Bone Joint Surg.*, 1949, **31-B**, 433.
[5] Patterson, R. L., and Darrach, W. *J. Bone Joint Surg.*, 1937, **19**, 993.
[6] Watson-Jones, R., and Roberts, R. E. " Calcification, Decalcification, Ossification " *Brit. J. Surg.*, 1934, **21**, 461.
[7] **Excision of the acromion**—I think that I was the first to suggest this operation but of course one never knows; it is difficult to believe that any procedure so obvious had not been done before. I reported it to the British Orthopædic Association in 1939. It was referred to by A. Steindler in 1944 in the treatment of ruptures of the supraspinatus tendon (*J. Iowa State med. Soc.*, April, 1944) ; it has been used by M. N. Smith-Petersen in certain cases of rheumatoid arthritis ; and it was described in detail by J. R. Armstrong in 1947 (" The Supraspinatus Syndrome," *Lancet*, 1947, **1**, 94) and again in 1949 (" Excision of the Acromion in Treatment of the Supraspinatus Syndrome. Report of Ninety-five Excisions." *J. Bone Joint Surg.*, 1949, **31-B**, 436). H. F. Moseley illustrated the operation in diagrams in 1951, but without comment on the merits and without reference to the literature (" Ruptures of the Rotator Cuff," *Brit. J. Surg.*, 1951, **38**, 359).

FIG. 717

FIG. 718

Ossification of the rotator cuff developing eight years after an operation for calcification of the tendons. There was severe pain in the middle third of the arc of abduction from impingement against the acromion (Fig. 717). Excision of the acromion relieved all symptoms, and despite the mass of bone in the tendons the patient was able to do heavy work without discomfort and has been free of symptoms for ten years (Fig. 718).

in comparison with the earlier procedure, which to me had seemed trivial, because recovery of movement after the second operation was so painless. Within a few weeks he had normal movement, and within a year he salvaged furniture from a bombed house and lifted wardrobes and dressing tables without difficulty.

Excision of the acromion—There is obvious merit in this operation for any degeneration or injury of the rotator cuff produced or aggravated by impingement against the acromion. It is not surprising that even the whole acromion can be excised without functional or cosmetic loss because scapulo-clavicular stability depends essentially on the coraco-clavicular and not the acromio-clavicular ligaments ; and moreover such fibres of the deltoid as are reflected can easily be stitched back. It is better to remove the whole acromion right up to the joint and not just part of it. The surgeon should take the anæsthetist's position and look down on the acromion which is exposed subperiosteally through a three-inch incision. The acromio-clavicular ligaments are cut, the bone is divided obliquely with a thin osteotome, and the deltoid is stitched back to the reflected periosteum. It is very easy and satisfactory, and is indeed the complete answer to problems of recurrent and persistent supraspinatus tendinitis with or without calcification. I believe also that it is an essential part of the operative exposure of ruptures of the tendon, and an important measure in accelerating recovery after that operation (Figs 722-723).

INJURIES OF THE ROTATOR CUFF OF THE SHOULDER—RUPTURES OF THE SUPRASPINATUS

In former years insult was often added to injury when patients sustained ruptures of the rotator cuff of the shoulder—they were nearly all charged with malingering. This is perhaps not surprising because the injury was often trivial, and the somewhat remarkable physical signs were not understood. Being asked to raise his arm, the patient would puff and struggle and go red in the face, but still fail to elevate the limb beyond the right angle, whereas when the surgeon first raised it for him he would easily hold it in any required degree of abduction. That in itself did not seem genuine. When the patient complained of pain half-way through the movement, and no longer complained when movement was pressed still further, the unknowing surgeon's doubt was increased. And when finally the patient indulged in extraordinary antics, twisting and rotating the limb in a curious way as he raised and lowered it, even bending his trunk right over to one side in a manner that seemed unreal and demonstrative, the surgeon's worst fears were confirmed—the man was malingering. Such was the diagnosis in nearly every case. We owe a great debt to Codman of Boston for his studies of the shoulder.[1] He explained the reality of these curious, apparently unconvincing, signs and not only saved many labouring men from unjust charges but showed us how to treat their tendon injuries.

Clinical features of complete rupture of the rotator cuff—The patient is often a middle-aged labouring man who has worked hard all his life. The injury that precipitates the onset of symptoms is usually no more than a strain such as supporting a heavy weight with the abducted arm, or throwing out the limb to protect himself against a fall. Long-continued heavy work having caused attrition of the tendons, simple strain causes final rupture. Sometimes the rupture is a complication of dislocation of the shoulder,[2-4] but on the other hand there may be no recognised injury at all.

[1] Codman, E. A. " The Shoulder." Boston : Thos. Todd Co., 1934.
[2] Greeley, P. W., and Magnuson, P. B. *J. Amer. med. Ass.*, 1934, **102**, 1835.
[3] Bosworth, D. M. *J. Bone Joint Surg.*, 1940, **22**, 369.
[4] Watson-Jones, R. *Brit. med. J.*, 1938, **2**, 80.

Massive rupture of the supraspinatus and infraspinatus tendons gives rise to typical loss of power : active abduction is more limited than passive abduction despite vigorous contraction of the deltoid ; the limb cannot be abducted against resistance—even the resistance of gravity ; but if it is first raised passively, or if the resistance of gravity is evaded by trick movement such as bending the trunk to the opposite side, the limb can then be held in the elevated position. This is because the humerus cannot be abducted by the deltoid alone. The supraspinatus is an essential synergist with function like that of a builder's mate who stands with one foot on the

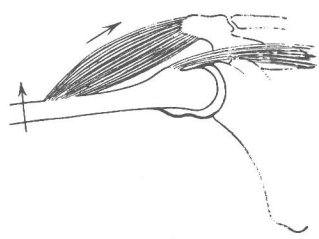

FIG. 719

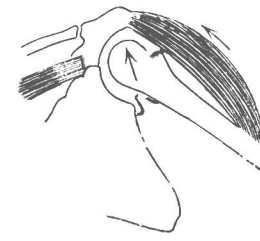

FIG. 720

The function of the supraspinatus is to fix the head of the humerus while the deltoid abducts the arm (Fig. 719). If the tendon is ruptured or avulsed, only weak abduction to 60 degrees by scapular movement is possible (Fig. 720).

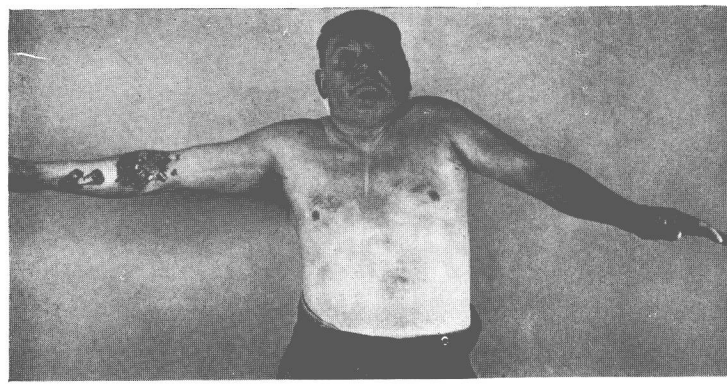

FIG. 721

Rupture of the supraspinatus tendon of the left shoulder (complicating a dislocation of the joint).

bottom rung of a ladder to fix it while it is being raised. The supraspinatus fixes the head of the humerus to the glenoid to provide a fulcrum for the deltoid (Figs. 719-720) and, if there is no such fixation, strong contraction of the deltoid merely pulls the humerus up towards the acromion and holds it there while the scapula rotates. In this way, weak abduction to 60 or 70 degrees is possible ; the more the patient struggles to elevate the arm the more he shrugs the shoulder (Fig. 721). The analogy between the supraspinatus and the builder's mate is very close because in the same way that when a ladder is once raised the workman need no longer stand on the bottom rung, so when the arm is first raised passively by an examiner it can often be held elevated by the deltoid even when the supraspinatus tendon is ruptured.

Clinical features of incomplete rupture of the rotator cuff—Less massive tears of the rotator cuff cause equivocal signs, and incomplete ruptures may present no more than the clinical features of supraspinatus tendinitis. Active abduction is often possible through a normal range, but the movement cannot be performed against resistance, and there is pain in the middle third of the arc of abduction. To escape this pain, which arises from impingement against the acromium of the torn and therefore thickened capsular margin, the patient may raise and lower the limb by a curious circumduction—the arm being so rotated as to minimise the friction. There is also reversal of scapulo-humeral rhythm ; the scapula rotates first and only then does the humerus move on the scapula.

Treatment of ruptures of the rotator cuff—Conservative treatment is often successful when tears are small and recent. If the patient had no disability until an injury was sustained, and the clinical features suggest incomplete rather than massive rupture, treatment by immobilisation alone should be tried ; but if there have been grumbling symptoms of tendinitis for several months or years, and the physical signs indicate a massive tear, it is a waste of time to use a frame or plaster spica—it will be found that the smooth rounded capsular margin is pulled far away from the eburnated bone, and spontaneous repair is obviously impossible.

Conservative treatment—The torn fibres are brought into apposition by abduction, forward flexion and external rotation of the shoulder, and this position should be maintained unremittingly for not less than eight weeks ; the limb must never be lowered, even momentarily, until the power of active abduction is regained. Moreover, it should be understood that in approximating the torn surfaces external rotation is just as important as abduction. If a frame is used instead of a plaster spica, special care is needed. A platform splint supporting the limb in neutral rotation is quite useless. Many failures have also arisen from the careless use of frames, applied loosely with only two or three bandages, so that within a few days the splint was sliding down the trunk. At least ten or a dozen wide bandages are needed and they should be hitched under every available screw, nut and bar, and be passed over both shoulders. It is still better to use a plaster spica (Fig. 803).

Operative treatment[1-6]—An incision two or three inches long is centred on the top of the acromion which is exposed subperiosteally and excised. The central part of the deltoid is then retracted laterally. If more exposure of the front of the capsule is needed the anterior fibres of deltoid may be split for two or three inches. Very small tears lie transversely just above the tuberosity, but more massive tears are tri-radiate in shape, the supraspinatus and infraspinatus being retracted not only upwards but also backwards (Fig. 722). The apex of the triangle lies near the biceps tendon : one side is the bared tuberosity ; the other is a split in the capsule roughly in line with the biceps tendon ; and the base is the retracted part of the cuff. In the course of operative repair the centre of the base must be stitched to

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