At the present time many fractures of the os calcis must be treated without proper equipment, and for this reason, too, a simple operation will be described which successfully reduced a fracture we had failed to reduce by skeletal traction. The equipment needed is minimal, and the ease and the simplicity make it suitable for use by persons with no special surgical skill.

Case Report

An aircraftman in the Fleet Air Arm, aged 22, fell twenty-five feet on November 21, 1940, and landed heavily on his left foot. On admission to a hospital ship he was found to be suffering from compression fracture of the left os calcis, with severe comminution and gross upward displacement of the posterior fragment.

First Operation.—On November 22, under pentothal and spinal anaesthesia (Dr. R. F. Woolmer), a Steinmann pin was inserted through the soft tissues above the posterior fragment, behind the ankle. By means of this, screw traction was carried out with a Watson-Jones lower-leg-fracture traction apparatus. While full traction was maintained, lateral compression of the fracture was effected by means of the handles of a pair of Stille's plaster shears, used like a nut-cracker. When reduction was thought to have been effected the limb was plastered and the Steinmann pin removed.

Radiographs, however, showed that reduction had not been attained. The fracture was so grossly displaced that it could not be left as it was. We had two alternatives: continuous skeletal traction by means of a Kirschner wire through the posterior fragment, or immediate fusion of the subastragaloid joint. A Kirschner wire seemed unlikely to succeed any more than a Steinmann pin, and arthrodesis was dangerous on account of the fear of sepsis with the unhealed wounds present from the Steinmann pin. The simple procedure described below was therefore carried out.

Second Operation.—On November 28, under pentothal and spinal anaesthesia (Dr. R. F. Woolmer), a small incision was made over the posterior surface of the os calcis, and into this a strong Steinmann pin was inserted forwards through the body of the posterior fragment until the point was judged to be at the fracture through the waist of the bone. The handle of the pin was then rotated in a plantar direction, the effect being to

Discussion

It is obviously impossible to discuss the method on one successful case, especially as I was unable to follow up the patient; but the simplicity of the procedure and the few instruments needed for its performance—especially at this time when many fractures must be treated in hastily equipped hospitals—justify publication.

The reduction clearly showed that descent of the anterior part of the posterior fragment is a factor in the displacement that has not been sufficiently recognized. It is difficult to see how simple traction on the posterior part of the fracture can be as successful in reducing this displacement as the torque force applied by a pin passing through the fragment.

By this method immediate and full reduction can be obtained safely, and no special skill or knowledge is required to carry out the operation. A carpenter's chest supplies accessible instruments which could easily be substituted for the Steinmann pin and the Stille shears. It is true that a simple closed fracture is rendered compound by the method, but our experience in all varieties of fractures shows that little is to be feared from this unless some foreign body, such as a plate, is left at the site of fracture.

Summary

A simple operation for reduction of fractures of the os calcis has been described which requires the minimum of equipment and of surgical skill.

Attention has been drawn to the downward displacement of the anterior part of the posterior fragment and to the ease with which it can be elevated into position.

The operation seems so obvious that I fear it may have been previously described. I can find no record of it, but if there has been I would offer my apologies.

Medical Memoranda

Traumatic Rupture of the Pectoralis Major

Although traumatic rupture of a muscle or tendon is by no means uncommon, the following case is thought to be worthy of record as I have been unable to find any previous description of the pectoralis major being so affected.

CASE REPORT

The patient, a miner aged 47, of excellent physique, sustained a severe blow on his right shoulder whilst working in the pit on February 6, 1941. He was knocking out some pit props when a large piece of stone, weighing approximately 25 cwt., struck his right upper arm a glancing blow; at the moment of impact the arm was in the position of abduction and external rotation. He immediately experienced severe pain in the right shoulder and right upper arm, and was subsequently unable to move the arm. After a few hours considerable swelling of the shoulder was noticed; this was followed by bruising, which soon became severe, over the anterior aspect of the shoulder-joint, the anterior axillary fold, and the upper half of the right arm. The patient attended the casualty department the same day, but a radiograph of the shoulder-joint and upper arm revealed no bony injury. He was not seen again until March 4, when he attended the surgical out-patient department complaining of a painful and weak right shoulder. He stated that he had been unable to move his right arm for six days after the accident and that he was gradually getting back the use of the arm, but that it still felt weak. He had recently noticed that his shoulder muscles "had gone to nothing."

On examination the left shoulder and arm were normal, the muscles being well developed. The right shoulder region presented a most striking picture. There was pronounced "hollowing" over the anterior aspect of the chest wall on the right side, the anterior axillary fold was absent, and the upper ribs were

FIGS. 1 AND 2.—Diagrams showing reduction of fractured os calcis by means of a Steinmann pin. These are exaggerated to show the torque effect produced by depressing the handle of the Steinmann pin.

lever down the posterior part of the fractured bone and at the same time to elevate the anterior part. The patient was then taken to the x-ray department, with the pin still *in situ*, and the movement carried out under the screen, when it could be clearly seen that depression of the handle produced a "torque" effect on the fracture, the posterior part being depressed and the anterior part being elevated into its proper relation with the astragalus. Very little force was needed to bring this about, and full correction was easily obtained. A plaster cast was then applied around the fracture, which included the pin, the foot being in plantar flexion. We intended to leave the pin in position, fearing redisplacement, but when the cast had hardened it was found that there was no strain on the pin, which was accordingly removed.

Radiographs taken two days later showed no displacement of the fragments, and the patient was allowed to return to his ship.

unduly prominent. On attempted active contraction of the affected pectoralis major it was at once obvious that the whole of the sterno-costal part of the muscle had been ruptured at its musculo-tendinous junction, some 2 inches from its insertion into the lateral lip of the intertubercular sulcus of the humerus. The divided ends were easily palpable; they were widely separated, the main mass of the muscle being bound down to the inner aspect of the chest wall in the region of the sternum. The tendinous insertion could be felt to be comparatively freely movable, but the muscle itself had become firmly adherent in a contracted position and could not be moved apart from its surrounding structures. There was a gap of approximately 5 inches between the two ends, as measured with the arm to the side. There was at this time no external evidence of trauma, no swelling, and no bruising, and the patient stated that the pain steadily decreased as he regained the use of the limb. The movements of the shoulder-joint were almost full and were accompanied by relatively little pain. There was some weakness of adduction and internal rotation of the arm as compared with the normal side, but this was not unduly marked.

DISCUSSION

The following points are of interest:

1. The rarity of complete traumatic rupture of the sterno-costal head of the pectoralis major. The muscles and tendons usually ruptured by trauma are the quadriceps extensor cruris, the adductor longus, the tendo Achillis, and the plantaris in the lower extremity, and the supraspinatus and biceps in the upper extremity. The rectus abdominis may also be ruptured, but this is usually in association with the convulsions of tetanus.
2. Despite the fact that the blow was undoubtedly a very severe one the humerus suffered neither a dislocation of its head nor a fracture of its shaft, the pectoralis major alone being torn. The site of the rupture was at the junction of the muscular and tendinous portions, this being the usual place for such a rupture to occur.
3. The mechanism of this particular injury would seem to have been a sudden involuntary contraction of the muscle against a severe wrench which forced the arm to take up a position of extreme external rotation and abduction.
4. That a negative radiograph of the shoulder-joint may lead the unwary into a sense of false security, and the pronounced swelling be put down to simple though severe bruising. Looking back on the case the symptoms were quite characteristic. At the time of the initial injury the patient experienced a sudden sharp pain at the site of rupture of the pectoralis major, though he was not aware of "something having snapped," as is often the case. This was followed by loss of function of the affected part, which in turn was followed by severe swelling, accompanied by ecchymosis. As the swelling subsided the patient noticed a gap between the two retracted ends of the muscle and somewhat naturally assumed that his shoulder muscles were "wasting away."
5. That active movements of the arm were very good and after four weeks were almost painless. The power of the arm was relatively little impaired, adduction and internal rotation being carried out mainly by the teres major, subscapularis, and the latissimus dorsi.

As regards the subsequent treatment it was obvious that at the time the condition was diagnosed no surgical measures could be undertaken with any hope of success. The muscle ends had retracted widely and the sterno-costal portion had become firmly adherent to the inner half of the chest wall, leaving a gap which could not be successfully bridged.

It is usually agreed that primary suture of a torn muscle should be undertaken within the first five or six days of the injury, and that secondary suture, even if the ends can be approximated, usually yields a disappointing result, owing to the undue amount of fibrosis present and to the adhesion of the divided muscle ends to the adjacent structures. It is more than likely that an unsuccessful attempt to suture the muscle in the above case might well have led to considerably more disability than at present exists, and in this connexion it is worth recalling that rarely do patients following on a radical amputation of the breast complain of weakness in the affected arm, though it must be admitted that these patients are not engaged in heavy manual work.

I wish to thank Mr. H. Blacow Yates, honorary surgeon to the Royal Hospital, Sheffield, for allowing me to publish this case.

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Reviews

THE LYMPHATIC SYSTEM

Lymphatics, Lymph, and Lymphoid Tissue: Their Physiological and Clinical Significance. By Cecil Kent Drinker, M.D., D.Sc., and Joseph Mendel Yoffey, M.Sc., M.D., F.R.C.S. (Pp. 406.) Massachusetts: Harvard University Press. 1941.

Whether war advances or retards the progress of science is a problem which many have debated during these last two years without coming to agreement, but there can be little doubt that it accelerates the practical application of new knowledge. The problems raised by war injuries, whether from toxic gases, burns, trauma, or shock, have forced clinical workers to modernize their intellectual and technical equipment and to realize that names like Rous, Menkin, Adrian, and Florey should mean as much to surgeons as Robert Jones, the Mayos, Harvey Cushing, or O'Shaughnessy. At first sight this technical monograph on the lymphatics by Drinker and Yoffey might be regarded as suitable only for the physiologist, the experimental pathologist, or the haematologist. In reality it contains more of value for the thoughtful physician and surgeon than the numerous primers on war medicine and surgery which are considered appropriate for them. It is by no means easy reading, and it would have been better for the general reader if a dogmatic summary had been appended to each chapter.

The book begins with a description of the anatomical and physiological organization of the lymphatic apparatus. In the lower vertebrates the lymphatic vessels and the lymphoid tissue are completely separate, and it is only in the higher mammals that we find an intimate association of lymph nodes and vessels, such that lymph never reaches the blood without passing through at least one lymph node. On the other hand, in all vertebrates there is a close association between lymphoid tissue and the alimentary tract. The function of the lymphatic vessels is obvious. They return to the blood stream the fluid—including protein, particulate matter, and cells—which has filtered through the blood capillaries and is unable to re-enter them. The agencies in this flow, which is greatly increased in inflammation, are the tissue tension and the active and passive movements of the part. The function of the lymphoid tissue is much more obscure. It is true that the nodes act as filters, but they are mechanically less effective against viruses than against larger particles and bacteria. Any barrier action of the lymph nodes is more than offset by the dangerously rapid extension of disease that lymphatic vessels render possible, and the organisms are excluded from the action of antibodies which are of high molecular weight and unable to pass from the blood capillaries into the lymphatic system. "It appears from Menkin's work that in a focus of bacterial inflammation the exclusion of bacteria from the lymphatic vessels is much more to be desired than that they should enter and be transported rapidly to the regional nodes." Hence the superiority of chemotherapy by diffusible drugs such as the sulphonamides. The function and fate of the lymphocyte remain a complete mystery. Although lymphocytes survive for several days *in vitro*, enough cells are passed into the blood stream every day to replace the circulating lymphocytes two or three times over. What happens to them all? Yoffey thinks they go to the bone marrow to be the precursors of the red cells and granular leucocytes, but his arguments are not altogether convincing.

The book ends with a chapter entitled "Practical Considerations," but throughout the volume the clinical reader