This may be done in two ways: The one method is to remove a wedge or slice from the posterior part of the head and then apply the cartilage to the raw surface of bone.

FIG. 16.—Hallux valgus. Showing flap to cover the end of the metatarsal bone in the operation illustrated in Fig. 15

otherwise the traction of this muscle will tend to reproduce the deformity.

Technique of the Operation and After-Treatment.

The skin incision should be a linear incision along the inner side of the joint. The flap incision round the bursa described by Mayo has not proved entirely satisfactory in my experience.

The skin having been freed and retracted, a flap incision is made in the underlying tissues with a second knife. The knife used for the skin may be infected with *Staphylococcus albus* from the skin; it is therefore a wise precaution never to use the skin knife for any deeper dissection, especially in plastic operations where the least infection may destroy the value of the operation.

The joint is thus opened, and the head of the metatarsal freely exposed. The surgeon can then decide how much bone he is to remove and exactly how the wedge is to be made so that the toe will be correctly in line after the operation. He can also decide whether he can usefully retain the articular cartilage or is to dissect out a flap of the wall of the bursa to cover the raw bone.

It should be noted that the sesamoid bones should rarely be removed, as they seem to form an essential part of the tread of the ball of the great toe. The pad of fat between the sesamoid bones is, however, sometimes thickened, red, and tender; if so it may be clipped away.

The whole operation must be carefully carried out with the most scrupulous attention to three points:

1. Preservation of part of the lower or weight-bearing portion of the head.
2. Restoration of free dorsiflexion, or the soldier will not march freely.
3. Correction of the valgoid deformity in cases of hallux valgus.

The valgoid deformity is purposely placed last, for in a sense it is the least important from the point of view of restoring the man's marching power.

FIG. 17.—Splint for hallux valgus after operation.

A hallux valgus splint should be applied at the end of the operation. The splint I use is made of thin metal, as shown in Fig. 17. The hole in the splint fits over the inner side of the head of the metatarsal bone and prevents pressure from occurring at this prominent point. The base of the splint is strapped or bandaged to the inner side of the foot. The toe is then drawn inwards and secured to the narrow end of the splint, care being taken that the alignment is correct.

After-treatment in cases of hallux rigidus and hallux valgus is quite as important as the operation if we are to succeed in restoring function. Three weeks after the operation the patient may walk, provided he has a proper boot. Gradual exercise and the correct bearing of the body weight in a properly designed boot is an essential part of the treatment.

The boot, in the first instance, should be made of soft material with a stiff leather sole. On the sole is put a

leather bar $\frac{1}{2}$ in. thick and $\frac{3}{4}$ in. to 1 in. wide behind the heads of the metatarsal bones. The body weight thus falls for the time on the necks of the metatarsals rather than on the heads. Further, the heel should be made $\frac{1}{2}$ in. higher on the inner side than on the outer side, in order to deviate body weight to the outer side of the foot and relieve strain on the inner side and great toe. This is, of course, also the appropriate treatment for the flat-foot so commonly associated both with hallux valgus and rigidus. The inner border of the boot must be straight, so as to allow the toe to be drawn inwards freely, so that no pressure of the boot will tend to reproduce the valgus deformity.

As a rule, patients shod in this way can walk at once with comfort. Later, an ordinary boot may be altered in the same way. The operation area is too tender to bear the pressure of leather for two or three weeks after operation.

It is while walking in these boots, with the body weight carried on the outer edge of the foot, that the real cure takes place. Under the normal physiological stimulus of walking repair is hastened, and the small muscles of the foot recover strength.

To let the patient get up in a slipper is absurd, for the weight falls then on the head of the metatarsal, and by irritating the new bone formed at the site of operation it sets up a fresh process of osteo-arthritis, which may leave him worse than he was before. The patient must therefore be strictly kept reclining, and never allowed to set foot to the ground till the time has come when he may be allowed to walk in a properly altered boot.

A CASE OF ARTERIO-VEIN ANEURYSM OF THE SUBCLAVIAN ARTERY AND VEIN

TREATED BY EXCISION OF THE SAC AND THE SECOND AND THIRD PARTS OF THE ARTERY.

BY

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ARTERIO-VEIN aneurysm of the subclavian artery and vein has been until this war an unusual condition, and records of its treatment by operation appear to be very rare, if not entirely wanting.

A private of the Cameron Highlanders was admitted to the Middlesex Clearing Hospital, Eastern Command, Clacton-on-Sea, on October 1st, 1915. He had been wounded in Flanders on September 26th, a rifle bullet striking him just outside the axillary border of the right scapula near its inferior angle, and emerging just above the middle of the right clavicle. The wound of entrance was healed and the wound of exit practically healed, but underlying it in the subclavian triangle was a pulsating swelling about the size of a double walnut. There was a very marked thrill, which could be felt and heard even as far as the bend of the elbow. The right arm was entirely paralysed.

A diagnosis of arterio-venous aneurysm of the third part of the subclavian artery and vein and injury to the brachial plexus was made, and as the swelling in the neck was steadily enlarging and the patient was painfully conscious of the loud thrill, it was decided to operate.

Operation.

An angular incision was made: its lower limb ran along the clavicle, while the upper followed the middle line of the sterno-mastoid muscle; a skin flap was turned up which included the wound of exit. The external jugular vein, which was greatly distended, was ligatured in two places and divided. The deep fascia was then incised, but in doing so the sac of the aneurysm, which lay immediately underneath, was opened and a great gush of blood followed. This was restrained by pressure with a finger while the clavicular fibres of the sterno-mastoid were divided.

An attempt was now made to reach the artery on the proximal side of the sac, but owing to the cramped space and infiltrated state of the tissues it failed, and a second

puncture was made in the sac, the outflow of blood from which was restrained by the pressure of a second finger.

The clavicle was resected between the costo-clavicular and the coraco-clavicular ligaments. The subclavian vein was then exposed at its junction with the internal jugular vein, and in the angle formed by that junction the first part of the subclavian artery was isolated and divided between two silk ligatures outside the origin of the thyroid axis.

By means of the outermost ligature (left long to act as a tractor) the distal portion of the artery was pulled forwards and outwards until the inner edge of the scalenus anticus was reached; the superior intercostal artery was divided in the process. The muscle being divided with scissors, the second portion of the artery was pulled up, and it became possible to insinuate the finger between the third part of the artery and the first rib, and raise it and the sac forwards.

One blade of a long artery forceps was thrust in behind the raised mass, along the upper edge of the subclavian vein, and the forceps being shut, the tissue was divided parallel with the blades.

The bleeding, which had been considerable in spite of the digital pressure exercised on the holes in the sac, now ceased, and it was possible to separate deliberately the sac from the lower cords of the brachial plexus. A ligature was then placed on the uppermost part of the axillary artery, and the mass of tissue, which consisted of the aneurysmal sac, and the third, second, and part of the first portions of the subclavian artery, was completely cut away. The forceps, which had been applied along the subclavian vein, and which controlled a small hole in its wall, was replaced by a lateral ligature.

All the bleeding now stopped; the excised clavicle was wired into position, and the skin flap was sutured back after the exit wound had been excised. None of the cords of the brachial plexus appeared to have been divided by the bullet, but the patient's condition and the infiltrated state of the tissues precluded very thorough examination.

Dr. Beattie administered the anaesthetic most skilfully.

Description of Parts Removed.

The sac lay between the third part of the subclavian artery and vein, and communicated with both. The aperture into the vein was fortunately small, and was situated about the point where the external jugular joins it. The sac wall was very thin. Its front part was formed by the deep cervical fascia; behind and above it adhered to the brachial plexus, while the first rib and clavicle had limited it below.

After-History.

There was some shock, but although the pulse could not be felt either at the wrist or at the bend in the elbow, or in the line of the brachial artery, no gangrene or even discoloration of the arm occurred. Slight oedema of the upper arm appeared about a week after the operation, but subsided in a few days.

The result of the replacement of the excised clavicle was not successful; suppuration occurred in the wound after the lapse of ten days, and the bone, failing to unite, had to be removed nearly a month later.

On the twelfth day fairly free bleeding from the wound took place; it was stopped by pressure. During November and December the patient had six further haemorrhages, the blood on each occasion flowing from a deep sinus that probably led down to the ligature on the end of the subclavian artery. The bleeding could always be stopped by

pressure on the mouth of the sinus. The amount lost varied; on the fifth occasion it was so severe that the patient required intravenous saline infusion, and as a result of these losses of blood he became extremely anaemic and ill.

Re-ligature of Subclavian Artery.

The last haemorrhage occurred at the end of December, in the early hours of the morning. The case appearing desperate, one of us (V. B.) who was on duty at the time, determined to tie the innominate artery. An incision was made along the anterior edge of the sterno-mastoid, and from thence downward somewhat over the sternum. The lower portion of the common carotid was exposed and freed from its sheath, and, by means of a loop of silk passed under it, the vessel was pulled up until the point of origin of the subclavian artery was reached. A second loop was then passed under the latter vessel, and by making traction on both loops the innominate artery was brought fairly into view. It was then found that traction on the loop passed under the subclavian artery arrested the pulsation which till then had been visible at the site of the sinus. The innominate artery was therefore not tied, but a catgut ligature was placed on the subclavian about one-quarter of an inch from its origin from the innominate.

No ill results followed this operation, although the new wound suppurated slightly, nor was there any further bleeding from the sinus. A small amount of haemorrhage from the new wound took place some three weeks after the second operation, but there was reason to believe it was caused by the patient fumbling the part.

Present Condition.—Both wounds are practically healed. No abnormal pulsation can be found in the neck, nor any pulsation at all in the arm, which is normal in warmth and colour. The arm, however, is still paralysed, though there is some return of power in the muscles of the shoulder and the flexors of the forearm. There is loss of sensation over that part of the hand supplied by the ulnar nerve.

PREVIOUS CASES.

Several cases of arterio-venous aneurysm of the subclavian have already been

published during the present war, but none of these had been operated upon. From the South African war one case is recorded by Makins, the history of which is very interesting.¹

Arterio-venous Aneurysm of the Subclavian.—This patient had a pulsatile swelling with a thrill which was considered to be an arterio-venous aneurysm of the right common carotid, just at its origin from the innominate artery.

No operation was performed, and the man was invalided out of the service. After a considerable period he improved sufficiently to be able to do light work, and although the swelling still remained, the thrill gradually disappeared.

Nine years afterwards he began to have cerebral attacks deemed to be due to small emboli originating in the aneurysm sac. Distal ligature of the common carotid was therefore performed, but the patient died during the operation. *Post-mortem* examination showed a large aneurysm of the subclavian artery. The communication with the vein had closed.

Traumatic Aneurysm of the Third Part of the Subclavian Artery.—A case of this condition, not, however, communicating with the vein, has been recorded lately.² Ligatures were placed on the first part of the artery and on the brachial artery, but the patient died of respiratory failure before the operation was concluded.

REMARKS ON THE CASE HERE RECORDED.

We decided to operate because (1) the sac was obviously enlarging, and (2) if the enlargement continued the difficulties of the operation would speedily have become so great as to make any such attempt useless.

A perusal of Makins's case—the only one in which the

Diagram to show the position of the sac, and the ligatures S = Scalenus anticus. R = First rib. (1) Position of first ligature applied to the subclavian artery; (2) ligature on uppermost part of axillary artery; (3) lateral ligature on subclavian vein; (4) position of second ligature applied to the subclavian artery.

after-history of an arterio-venous aneurysm in this situation is available—and the successful result we have attained appear to us to justify our decision.

We had to choose between, on the one hand, attempting to place a ligature on the artery on either side of the sac and, on the other, excising the whole sac and the involved portion of the artery. We chose the latter alternative because of the difficulty in isolating and ligaturing the artery sufficiently near to the sac (especially on the distal side, on account of the enormously dilated veins) to ensure against collateral channels re-establishing circulation into the sac.

If we ever have to perform the operation again we shall not replace the resected clavicle, for we think that if we had not done this the suppuration which determined the subsequent haemorrhages from the ligatured end of the artery might not have occurred. It would have been better not to have used silk for the main arterial ligatures. In military surgery, where asepsis of the wound can rarely with certainty be attained, catgut of an absorption rate of not more than twenty days should be used for large arteries, so as to minimize the duration of a ligature sinus if such occur, and which, so long as it exists, is a menace of haemorrhage.

NOTES ON A CASE OF PENETRATING WOUND OF THE HEART.

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THE following case is the only example of a wound of the heart in a series of 123 wounds of the thorax and its walls which have passed through this casualty clearing station during the last ten months. The great majority of penetrating wounds of the lungs have progressed sufficiently well to be sent to the base, and it is a recognized fact that most of these cases ultimately recover. Probably nearly all cardiac wounds produce death from haemorrhage too quickly to allow of the patients being removed alive even to a short distance from the battle-field.

In the case recorded here the patient was wounded, whilst in the upright position, by a rifle grenade, at 12.15 a.m., on March 23rd, 1916. He was admitted to this hospital the same day at about 7 p.m., with a diagnosis of "gunshot wound of chest and right arm, compound fracture left elbow." His tally showed that he had had hypodermic injections of antitetanic serum (500 units) and of morphine ($\frac{1}{2}$ grain) at the field ambulance.

On admission, he was cold, suffering very severely from shock, short of breath, and cyanosed, but his lips were pale. Temperature 101° F., pulse 112, respiration 28. He was too ill for his wounds to be dressed then, but with brandy, salines, and hot-water bottles he improved sufficiently to have this done the following morning. His left arm, which was fractured, was transferred from a straight splint to a Thomas's, and the wound of his right arm, which was slight, was dressed. There was a small wound $\frac{1}{2}$ in. to the inner side and $\frac{1}{4}$ in. above the left nipple. A catheter was passed, and about a pint of normal urine drawn off. The patient was still very short of breath, and the dressing of his wounds was as much as his condition

In regard to ligature of the first part of the right subclavian artery, it is much easier, with an aneurysmal condition of the third part, to gain access to it inside the jugular vein and just outside its point of origin from the innominate, as was done at the second operation, than to secure it outside the jugular vein, as was done at the first operation.

At the bottom of the neck on the right side the jugular vein diverges outward from the carotid, leaving a small triangular space, crossing the base of which the subclavian artery will be found.

The upper end of the innominate artery and the root of the subclavian artery often lie well below the level of the manubrium sterni (they did in our case), but access to the latter can be attained by strong traction on the carotid and to the former by additional traction on the subclavian after this is found and isolated.

So resistant to trauma are large arteries that even strong traction on a considerable length of vessel stripped of its sheath and entirely isolated does not result in any harm.

REFERENCES.

¹ *Surgical Experiences in South Africa*, p. 142. ² *British Journal of Surgery*, vol. iii, No. 10.

would permit of. At 2 p.m. the pallor increased, he became more cyanosed, and his breathing more difficult. His temperature rose to 102° F., pulse 130, respiration 45. At 6 p.m. morphine $\frac{1}{2}$ gr. was given hypodermically to relieve the distress caused by the shortness of breath. He was semi-conscious all the time he was in this hospital. He knew his name, regiment, and home address; but kept on trying to get out of bed, and was often delirious. He never complained of any pain either in the chest or arm, but suffered considerably from thirst. The heart sounds were normal. There were signs of fluid in both pleural cavities, more on the right than on the left side. There was neither cough nor expectoration. The cyanosis deepened, the pallor and dyspnoea increased, and he died at 11.45 a.m. on March 25th, having lived 59½ hours after receiving the injury, and having during that time been conveyed from the regiment to the field ambulance, and from that unit to this clearing station.

Necropsy.

The body, which was examined four hours after death, before the onset of rigor mortis, was that of a well-built man of medium height and good muscular development. The skin was pale, but cyanosed, and there were no wounds other than the three already mentioned. The wounds of the left elbow and right arm were of no pathological interest, and could not have been factors of any importance in causing death. A small external wound, situated just above and internal to the left nipple, was traced transversely inwards for about two inches through the subcutaneous tissue and chest muscle; its subsequent course was through the sternum, leaving the internal mammary artery intact; then through the edge of the left lung, the pericardium, the right ventricle, and the pericardium; finally the missile was found imbedded in the right lung. It was

A. Probe through wound in left lung. B. Probe through two wounds in pericardium. C. Probe through entrance wound in right ventricle. D. Probe through exit wound in right ventricle. E. Piece of metal in right lung. F. Wad of cotton-wool to evert margin of right lung to show piece of rifle grenade.

not removed for examination, but its small size could be judged from an x-ray photograph.

The left pleural cavity contained a considerable quantity of blood, but the lung was of nearly the normal size; the right pleural cavity was almost full of blood, and the lung was found to be collapsed. The blood was fluid except for a single clot on the right side. The left lung had a slit like wound of entrance, detected with difficulty, half an inch from the margin, at the inner and lower part of the anterior surface of the upper lobe, and a larger wound of exit through the margin of the inferior surface; about half an inch of the lung tissue had been passed through. There was a patch of recent fibrinous pleurisy between the upper and lower lobes, extending for about 2 in. on to the anterior surface of the lower lobe. On the under surface of the middle lobe of the right lung, about half an inch from the inner margin, a small piece of metal could be seen lying in the lung substance. There was no recent pleurisy, but the upper and middle lobes were almost completely fused by dense old adhesions.