FRACTURE OF THE FEMUR : A METHOD OF HOLDING THE FRAGMENTS IN DIFFICULT CASES.*

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SOME fractures of the femur resist all attempts to maintain reduction by ordinary means. Lane's plates, screws, wiring, medullary pegs, and bone grafting, all have the disadvantage of introducing a foreign body into a septic or potentially septic wound, and this renders them inapplicable to most compound fractures. Hey Groves' apparatus has several disadvantages: its application involves a complicated operation in the depths of the limb; it may involve opening the marrow cavity; and it does not give absolute immobility to the fragments. The apparatus here described was designed to meet the requirements of these difficult cases, and may be applied in any case in which the great trochanter and condyles are intact, regardless of the site of fracture or degree of comminution. It is an attempt to procure absolute fixation by external means. The one possibility of failure is that of sepsis developing in the cancellous tissue of the great trochanter, which possibility should be negligible with careful asepsis.

The apparatus is made of steel throughout, and the principle which makes it possible is that of a locking universal joint. A peg (1, *Figs. 395, 396*), rectangular in cross-section is designed to be driven into the great trochanter until it meets the firm resistance of the *calcar femorale* (*Figs. 397, 398*). No preliminary drilling should be done, thus ensuring the least possible destruction of bone, and preventing the possibility of contamination by several different instruments. The two narrow surfaces of the peg taper slightly towards the chisel-shaped point, the cutting edge of which is made by bevelling the two broad surfaces. This shape is an adaptation of the principle of the square nail which joiners use to avoid splitting. In driving a square nail, the parallel sides are in the plane of the grain of the wood—the taper crosses the grain—and in this way the peg should be driven into the bone. This will not split even a dry bone. The chisel point prevents the possibility of driving bits of cortex ahead of the peg into the cancellous bone, while the taper ensures its being firmly seated. The butt end which protrudes beyond the skin is a ball.

The condyles are grasped by double-pointed calipers (9, *Figs. 395, 396*), made firm by a transverse screw (8), which approximates the points when tightened. There is abundant room in a longitudinal direction on the condyles for these double-pointed calipers, which have the advantage of absolute control over the lower fragment, as against the partial control of the single-pointed instrument. They can be used without the rest of the apparatus for extension and elevation of the lower fragment in supracondylar fractures (*Fig. 395*). A ball (7) is fixed to the arch of the caliper body.

The two balls, one fixed to the trochanter (1) and one to the condyles (7), are connected by a telescoping steel bar, on either end of which a socket receives the respective balls. Each of these sockets is fitted with a locking screw (2, 6), which, when set, converts the ball-and-socket joint into a fixed angle. The length between the two ends of the telescoping rod is increased or diminished by a screw which runs through

* Messrs. Allen & Hanburys, 48, Wigmore Street, London, have a model of this apparatus, and can supply it to order. Also the American Red Cross (Splint Department), Paris, have a model, which may be obtained by applying to them at 4, Place de la Concorde.

it (4). The outer tube is slotted and fitted with a locking collar (3). Thus, the bar can be twisted on itself to any degree, and locked. Every possible relation can then be produced between the great trochanter and the condyles.

FIGS. 395 and 396.—Illustrating the parts of the apparatus. (The apparatus has been simplified since this case was treated.) (1) Peg and its socket. (2) Lock-nut for trochanteric socket. It is in an easily accessible position. (3) Locking collar and length screw (4). (5) Nut for length screw. Note easily accessible position. (6) Nut for condylar socket. (7) Ball attached to condylar calipers. (8) Transverse condylar screw for gripping condyles. This is not needed on the later model. (9) Double caliper points. (10) Wrench which fits all nuts.

Case Report.—L.-Cpl. C., wounded April 5, 1918, by bullet driving contents of pocket into thigh.

OPERATION on April 6, at C.C.S.; wound excised, bullet removed. April 8. Admitted to general hospital on Thomas splint, general condition poor. Abduction 30°, 15 lb. weight and pulley extension. April 16. X ray shows over-abduction of lower fragment. April 22. Abduction 15°; 20 lb. extension; splint changed from large to small ring Thomas. On April 25, x ray shows

upper fragment persists in adduction (*Fig. 399*). Adduction 10° . May 5. Genuflexion 20° ; adduction 20° ; 20 lb. extension. May 10, despite all attempts to hold the fracture in position, malposition recurs. Skin over great trochanter dressed with alcohol for forty-eight hours.

FIG. 397.—Apparatus with dressings removed. The entire thigh is free for inspection and dressing. Note the dependent posterior drainage incision (made May 18); the normal outline of thigh; the absence of inflammation about trochanter and condyles; and also the preservation of the musculature of calf, due to active exercise of ankle and knee.

FIG. 398.—Apparatus with dressings in place and rope suspension of thigh and foot. The ropes are carried over pulleys with counterweights attached, thus permitting each rope to be moved independently. The dressings over the peg and the caliper points were changed only three times in 24 days.

SECOND OPERATION.—May 12. Ether anaesthesia. Thomas splint removed. Incision one inch long made longitudinally over great trochanter, carried to the bone, and packed with dry gauze until oozing ceased. It was then dried with alcohol, and a small amount of B.I.P.P. rubbed into the incised skin and subcutaneous tissues. The steel peg was now driven directly into the bone by blows from a steel hammer until the point seemed firmly embedded in the

calcar femorale. A dry dressing was applied, leaving the ball of the peg protruding. Incisions one inch long were made over the condyles in a longitudinal direction. They were packed with gauze until all oozing ceased, dried with alcohol, and rubbed with B.I.P.P. The double-pointed calipers were affixed to the cortex of the condyles, and dry dressings applied. This technique provides for the driving of the peg and the application of the calipers to be made through an anti-

septic—B.I.P.P.—a small amount of which the peg carries with it into the medulla of the trochanter, where it acts as a barrier to possible infection.

The connecting telescopic bar was now put in place. The ball-and-socket joints were not yet set. The fracture was then reduced while an assistant set the locking-screws. The length of the femur can be controlled either at once (which I did), or subsequently in stages, by simply screwing the telescopic arrangement. The patient was put in bed, and counter-weights were arranged to support the weight of the leg (*Fig. 398*).

A discharge from the anterior wound, which had been about a drachm of thick pus daily,

FIG. 399.—Radiogram taken April 25 on Thomas splint shows upper fragment in adduction. There is shortening of $1\frac{1}{2}$ in. This is practically the same as the radiograms taken on April 16 and early in May.

ceased from May 12, only appearing on May 17, and therefore indicating pocketing posteriorly due to the absence of the supporting bands.

THIRD OPERATION.—May 18. Chloroform. Posterior drainage established. Correction of position of bones with fingers in the wounds while an assistant tightened up the screws.

June 4. Position good (*Fig. 400*): $1\frac{1}{2}$ cm. over-length, no fever, pulse normal. Active motion knee 35° . Ankle normal. Hip slightly limited. Patient has been able to sleep on his side and to move about actively in bed. Up in chair to-day with apparatus in position. June 5. Plaster cast applied. Splint removed. Considerable force was required to loosen peg in great trochanter. No evidence of rarefaction about peg. Cultures taken from peg in bouillon and on agar were sterile. June 9. Discharged to England, soft union, good position, general condition good. Wounds over condyles and great trochanter sealed with dried serum.

This apparatus makes the patient *comfortable*, produces and maintains accurate reduction of his fracture, eliminates support bandages which obstruct dressing and free drainage, and leaves the hip, knee, and ankle-joints free for early passive motion. The bed can be left in its flat position rather than elevated at the foot, so that there is no tracking

FIG. 400.—Radiogram taken June 2 shows final antero-posterior position.

upwards of pus. It allows active motion so soon as infection clears up. The patient reported above was able to extend his knee *actively* two weeks after the appliance was put on. These advantages are the result of the absolutely rigid fixation which is obtained. There is no transfixion of bone ; there are no parts buried deeply in muscular substance ; the points of application are at the limits of the bone and are subcutaneous ; the peg in the trochanter, being rectangular in section, gives a purchase for flexion or extension of the upper fragment ; there is no danger of involving the knee-joint by piercing the intercondylar notch ; all parts can be locked ; and finally, it produces rigid immobility, and it can be applied to the fracture in its unreduced position, and reduction accomplished as well as maintained by the instrument. Its application is simple and easy.

It is applicable to any case where plating and wiring would be indicated, and does not have the disadvantage of introducing a foreign body into the wound or its neighbourhood.

I hesitate to publish this report based on only one case, but since the war promises to be over soon, and since the apparatus was so satisfactory in its performance, it seems advisable to bring it to the attention of those who may have difficult cases of fractures of the femur. It has been applied to more cases recently, and promises to give equally satisfactory results, which I may report at a later date.

I desire to acknowledge my indebtedness to the work done by Lieutenant-Colonel Beasley, M.C.N.A., U.S.A., in demonstrating the utility of the caliper which has made this instrument possible. I am indebted to Major E. Granville Crabtree, R.A.M.C., Harvard Unit, and to Mr. G. A. Mower, of the Sturtevant Engineering Company, for valuable mechanical suggestions. Through the kindness of Lieutenant-Colonel Hugh Cabot, R.A.M.C., Harvard Unit, and Lieutenant-Colonel Spencer-Mort, R.A.M.C., I am permitted to publish this paper.