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From the Orthopaedic Clinic, Sahlgrenska Sjukhuset, Gothenburg, Sweden, (Head: Professor Carl Hirsch), and the Department of Surgery, University Hospital, Umeå, Sweden, (Head: Professor Stig Borgström).

OSTEOSYNTHESIS OF MEDIAL COLLUM FRACTURES WITH THE "SPRING-LOADED NAIL"

By

NILS RYDELL

A new method of osteosynthesis in fractures of the femoral neck has been developed in order to prevent nail slipping, to produce compression between fracture surfaces and to maintain better fracture healing. In an earlier work: "A new apparatus for the measurement of the compression between two bony surfaces and a construction for compression in fractures of the femoral neck", Acta Orthopaedica Scandinavica, Vol. XXXI, Fasc. 1, 1961, the author has given an account of this method. For references the reader is referred to this article. The results of the first two years' experience are now given.

NAIL SLIPPING

There is still much discussion going on regarding the technique of osteosynthesis in medial collum fractures and the causes of numerous complications are the object of various forms of analyses. Nail slipping is an usual complication of ostesynthesis of medial collum fractures. This can be due to a number of reasons. In most of the cases the nail slips because of resorption in the area of the fracture. Such a resorption leads to a shortening of the neck. When the nail lies sequestrated and surrounded by connective tissue membrane it soon loses its hold and slips out. By sinking the lower part of the nail's head under the cortical shell, theoretically the nail slipping should be made more difficult. This is what happens when a callus forms around the head of the nail, but this can hardly be expected within the first few months. Some authors warn against this technique, believing it will decrease the holding strength of the osteosynthesis. In order to determine to what

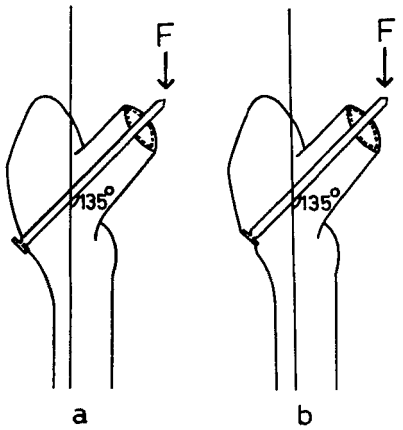

Fig. 1.

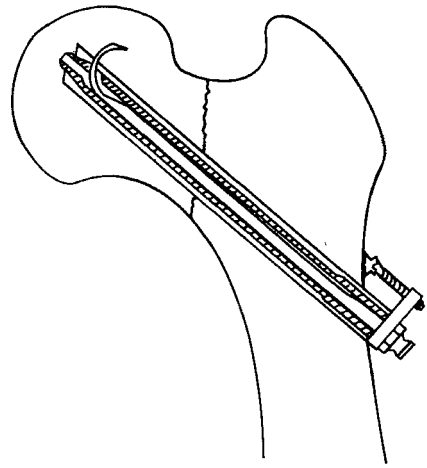

Fig. 2.

Fig. 1. Loading test. a) the head of the nail outside the cortical shell, b) the head of the nail sunk under the cortical shell.
Fig. 2. The spring loaded nail in position.

extent the efficiency of the osteosynthesis in neck fractures is influenced by sinking the head of the nail, leading tests were performed on 20 autopsy specimens. Bilateral autopsy specimens were used, choosing right or left legs at random for the experiments. The head was excised by a subcapital sawcut perpendicular to the long axis of the neck, so that the length of the neck fragment was about the same in all specimens. A Smith-Petersen nail was then inserted into the femur at about 135°. In ten cases the nail was driven in so far that the lower part of its head came to lie just inside the lateral cortex of the femur. In the remaining ten cases it was inserted so that the head reached right to the outside of the lateral corticalis. As the nails, whose heads were sunk under the corticalis, came to lie about half a centimetre longer medially, these nails were chosen half a centimetre shorter. In this way the same leverage was maintained during the loading tests. The femoral specimens were then placed in an Amsler testing machine and the point of the nails loaded (Fig. 1). Under fairly light loading the nails obtained a varus position in all cases and started to slip out. In only one case was the load that started the moving of the nail over 75 kp., the smallest force being 30 kp. No difference between the two groups could be recorded either regarding the strength of the fixation or the tendency to slip out.

Fig. 3.
X-ray showing the nail in position.

Nail slipping is prevented in many clinics by fastening the lateral part of the nail to the femur with a plate or a screw. The disadvantage of this method is that resorption at the neck will either result in a diastasis between the fracture surfaces or the nail will penetrate into the joint.

PRESENTATION OF THE METHOD

With a view to preventing the nail slipping from the proximal fragment without the risk of diastasis at the fracture surfaces or penetration of the nail into the joint, a new nail-construction has been developed, earlier presented in Acta Orthopaedica. The principle of the construction is that a spring pin is inserted in a 4-flanged Smith-Petersen nail and this pin is directed out in a bow at the side of the nail. The nail is in this way securely fastened in the head. Despite its small dimensions the pin resists a pulling force of 40–50 kp. The nail has also been furnished with a plate, the function of which is to produce compression between the fracture surfaces (Fig. 2). The plate is not fixed to the femur's lateral surface, in order to prevent a diastasis arising between the fracture surfaces during neck resorption. Fig. 3 shows X-ray of a 78 years old patient with the nail in position.

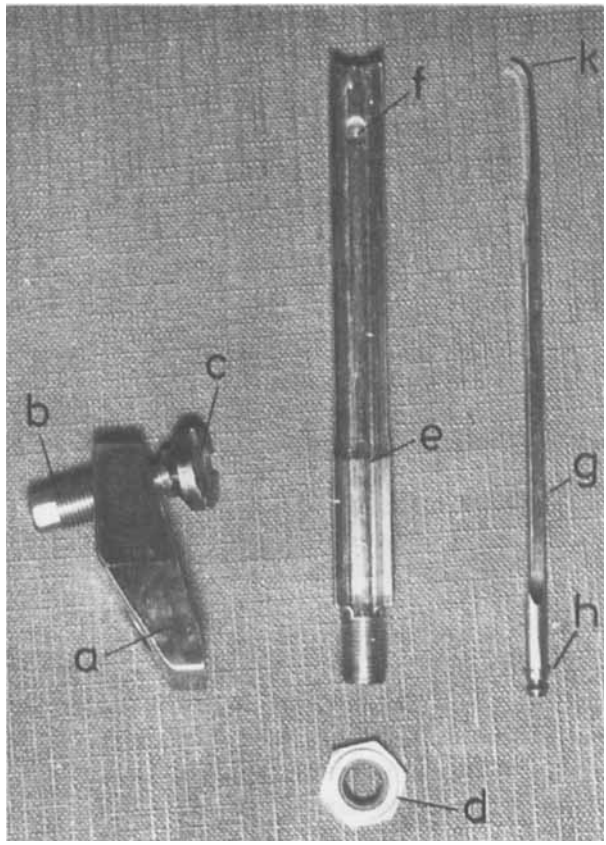

Fig. 4.
Instrument for osteosynthesis of fractures of the medial femoral neck.
a = plate, b = compression screw, c = supporting plate against the trochanteric area, d = nut with nylon lock washer, e = 4-flanged nail, f = hole for spring pin, g = spring pin, h = lock ring, k = the curve of the pin.

MATERIAL

The material presented here is made up of twenty-six dislocated medial collum fractures. The cases were selected at random. Only fractures with varus dislocation were included and each was closed reduced and nailed with this particular appliance. Even patients in a very poor general condition were operated upon. The average age of the subjects was 67 years. Of these 19 were women with an average of 72 and 7 men with an average age of 52. 7 of the 26 patients, 6 women and one man died. The average age of the dead was 74 years. The cause

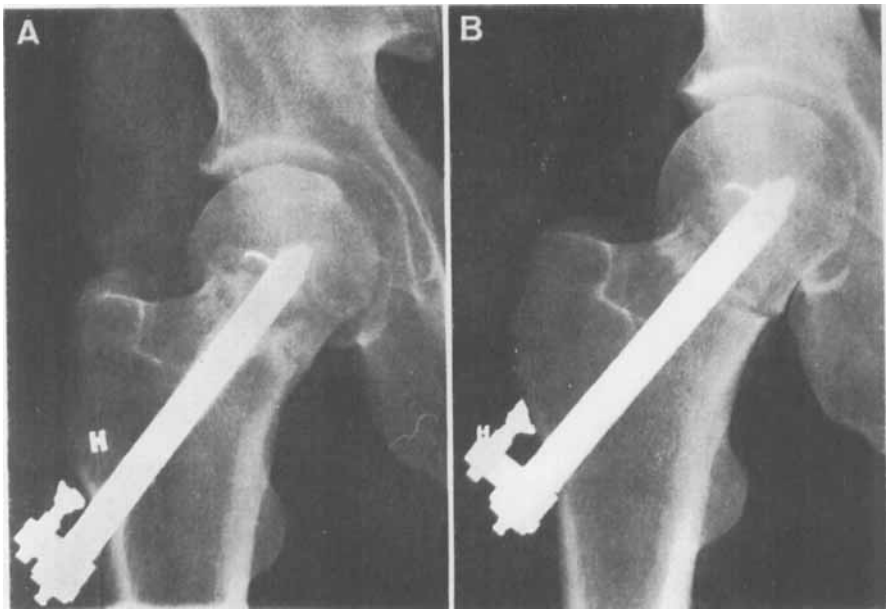

Fig. 5.
X-rays from a nailed hip fracture.
a. soon after the operation, b. some months later.

of death in every case was cardio-vascular disease. Only one of the patients died while still in hospital, the other 6 at home before the follow up was finished. The difference in the average age between the male and female patients is of interest. Even if the material is small, the tendency is clear and by examining the kind of accident it was shown that adequate force is the cause of fracture in the male clientele, whilst in the female group falling on the floor or similar slight traumata had sufficed to produce the fracture.

By measuring the distance arising between the surface of the screw (Fig. 4c) and the surface of the femur's lateral cortex it was in all cases possible to measure the arising collum resorption with the subsequent shortening. It was seen that in most cases a collum resorption with shortening arose at an early stage and then became constant. Fig. 5 shows X-rays soon after operation (a) and some months later (b). Notice the gap between the screw and the bone in b. The extent of shortening was found to be between 5 and 10 mm. In two cases the collum resorption did not appear until one year after the operation, one of these represents the only case of aseptic necrosis of the caput. In

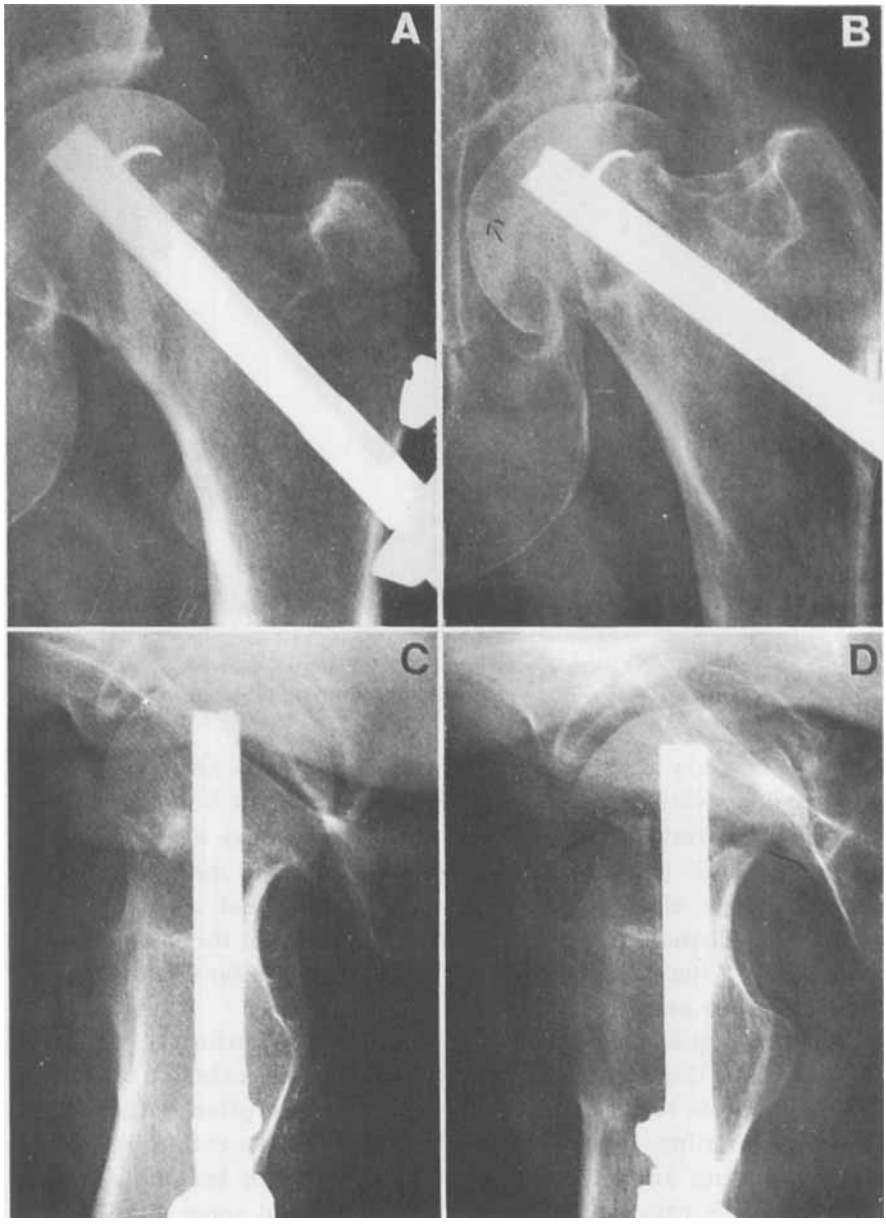

Fig. 6.
X-rays from the case with necrosis of the femoral head. A and C taken shortly after the operation. B and D one year later.

some cases during the healing process a slight varus position was met with, but in no case did the tip of the nail loose its grip in the caput, but remained all the time in an unchanged position in the caput fragment. This was so even in the case of the necrosis, where finally a small fragment of caput was left hanging on the tip of the nail (Fig. 6).

FINAL RESULT

All 19 surviving cases could be followed up of which 13 were women with an average age of 70, and six were men with an average age of 50 years.

In one case, a 55 years old woman, caput necrosis developed. The fracture was nailed after exact reduction. Only some months later the patient complained of severe pain in the hip joint, but no X-ray evidence of necrosis could be seen until ten months had elapsed. One month after the operation the patient walked very well and had almost normal hip movements. After a further couple of months the movements were limited by pain and she was unable to walk more than a short distance. Later on a Moore prosthesis was put in.

In the remaining 18 cases healing progressed normally. Partial weight-bearing was allowed after six weeks and full weight-bearing after ten weeks. In no case was there any pain from the operated hip joint, either at rest or after weight-bearing. The postoperative mobility of the hip joint was not less than before injury. All patients were satisfied with the final result and were able to resume their previous activities.

In all cases the nail remained in the caput in an unchanged position, but due to the shortening in the collum, the plate and the lateral part of the nail protruded into the soft parts more than immediately following the operation. Many of the patients experienced some discomfort and tenderness over the lateral part of the nail. In two cases a secretion arose from the wound, although without any other effects on the patient. All nails were removed after the fractures were healed. The purpose was to see if there were any corrosion in different parts of the nail. No corrosion was found.

The compression applied to the fracture surfaces at the time of the operation could not be maintained more than a few months.

SUMMARY

A material consisting of twenty-six femoral neck fractures which were nailed with a new fixation device—a "spring-loaded nail" is reported. 7 patients died and the 19 surviving patients were followed up. Two years was the shortest time between the operation and the follow up. In one case caput necrosis arose and in the other 18 cases the final result was satisfactory.

The device is so constructed that it primarily provides compression between the fracture surfaces and makes it impossible for the nail to slip out of the proximal caput fragment. Therefore the nail does not lose its hold in the caput and the contact in the fracture area is thus maintained. The result achieved up to now shows that the method offers certain advantages. Whether the fixation in the caput is of sole importance to the good results or whether the applied compression at the time of the operation is of value, cannot so far be judged.

RESUME

Rapport sur un matériel d'observation comprenant vingt-sis fractures du col fémoral clouées par une nouvelle forme de fixation, le « clou avec charge à ressort ».

7 malades moururent. Les 19 malades survivants ont été suivis. Deux ans représentent la plus courte période d'observation depuis l'operation. Dans un cas, il a été observé une nécrose de la tête et dans les autres 18 cas le résultat final fut satisfaisant.

Le clou est construit de manière à assurer primairement la sompression entre les surfaces de la fracture et empêcher le clou de sortir du fragment proximal de la tête. Le clou ne lâche donc pas sa prise dans la tête et le contact de la surface de la fracture est maintenu. Le résultat obtenu jusqu'ici montre que cette méthode offre certains avantages. On ne peut pas encore juger si la fixation dans la tête est le seul élément important par rapport aux bons résultats ou si la compression appliquée au moment de l'opération présente une valeur.

ZUSAMMENFASSUNG

Über ein Material von sechsundzwanzig Schenkelhalsbrüchen, die mittels einer neuen Fixationsvorrichtung – einem mit einer Sprungfeder versehenen Nagel – behandelt wurden, wird berichtet. 7 Patienten starben und die 19 überlebenden Patienten wurden nachuntersucht.

Zwei Jahre ist die kürzeste Zeit zwischen der Operation und der Nachuntersuchung. In einem Falle entstand eine Kopfnekrose und in den anderen 18 Fällen war das Ergebnis zufriedenstellend.

Die Vorrichtung ist so konstruiert, dass sie unmittelbar eine Kompression zwischen den Bruchoberflächen herstellt und das Herausgleiten des Nagels aus dem proximalen Kopffragment unmöglich macht. Daher verliert der Nagel seinen Griff am Kopfe nicht und der Kontakt in der Bruchregion bleibt auf diese Weise erhalten. Die bisher erhaltenen Ergebnisse zeigen, dass die Methode gewisse Vorteile darbietet. Ob die Ruhigstellung im Caput allein für die guten Resultate verantwortlich ist oder ob die anlässlich der Operation angewandte Kompression das Wertvolle ist, kann zur Zeit nicht festgestellt werden.

REFERENCE

Rydell, Nils: A new apparatus for the measurement of the compression between two bony surfaces and a construction for compression in fractures of the femoral neck. Acta orthop. Scandinav. *31*: 1–17, 1961.