FROM ULLEVÅL HOSPITAL, 3rd SURGICAL DEPARTMENT, OSLO, NORWAY
(CHIEF SURGEON: PROFESSOR CARL SEMB, M.D.)

OPERATIVE TREATMENT OF LATERAL TIBIAL CONDYLE FRACTURES

A follow-up study of 68 cases

By

ARNT JAKOBSEN

INTRODUCTION

The treatment of tibial condyle fractures has for a long time been the subject of varying opinions. Nearly all surgeons are now agreed that these fractures should be treated by means of operation (*Foged, Palmer, v. Bahr, Barr, Cave*). Some will only operate on fractures with more serious dislocations (*Böhler, Watson-Jones, Olaussen, Bick*). Others (*Maisel* and *Cornell*) will not operate upon elderly patients with serious dislocations or general complications.

The publications containing the widest range of follow-up studies of operated patients come from Sabbatsberg Hospital (*Palmer, v. Bahr*), and from Massachusetts General Hospital (*Cave*). Both these investigations show very satisfactory results.

General Remarks.

In the 3rd Surgical Department of Ullevål Hospital, the operative treatment of the tibial condyle fracture has given rise to much interest since the year 1937. During the first years only a few cases were operated on, whilst during the last 8–10 years this was the rule in all fractures with dislocation. In the five-year period, 1946–1950, we treated 104 cases of fractures of the tibial condyle in our department, of which 58 were subjected to operative treatment. Since 1937 we have to date operated on more than 100 cases of these fractures. All fractures which fulfil the indications to be discussed below were operated upon regardless of the age of the patient.

Operative Technique and After-treatment.

Since 1937 both operative technique and after-treatment have undergone developments resulting in quite a number of changes. Basing our view on the recognised theory that sooner or later a secondary arthrosis will develop in every anatomically imperfect joint, and that the degree of this arthrosis will be in proportion to the incongruity of the joint surface, we originally aimed merely at an anatomically perfect result. As the importance of early movement after operation became clearer in our minds, we developed the internal fixation of the fracture in order to allow immediate freedom for post-operative motion. From small incisions which give limited range of view, we came to use a comparatively large incision. Likewise, from pins and screws which did not hold firmly enough, we arrived at the use of steel wire loops as the best method of internal fixation. The grafting of spongy bone tissue from the iliac crest as support for the replaced fragments is, in our opinion, an absolutely necessary step in the operation of cases with depression.

A direct result of this development has been simultaneous alteration of the after-treatment. Originally the operation terminated in the casing of the leg in plaster from the groin to the toes. Since we have been able to stabilize the internal fixation, we have allowed the patient unlimited freedom of movement after the operation, with no external fixation. Experience shows that it is immeasurably easier to bring about movement in an operated joint soon after the operation, than when the joint has been immobile–over either a long or short period of time. In the former case, the muscle will not have weakened to any great extent, and no adherences will have taken place in the operated joint.

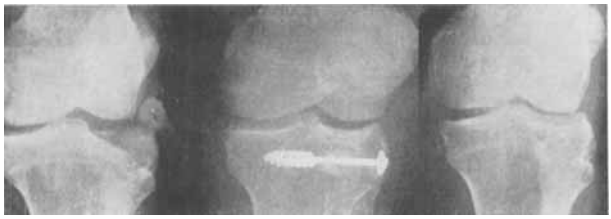
It may perhaps be asked if there is no risk of secondary displacement or dislocation of the fragments caused through unlimited movement after operation? Our experience is that this will not happen provided that the internal fixation is adequate. On the other hand, signs of weakness will sometimes appear in the fixation 3–4 weeks after the operation, caused by resorption of the bone tissue surrounding the fixation material. We have taken this into consideration, and now immobilize the limb by putting on a plaster cast as soon as the patient can fully extend and flex the leg approx. 90°. From experience this is, on an average, 14 days after the operation.

Our present operative procedure demands three factors if satisfaction is to be obtained:

1. Accurate anatomical reduction.

2. Firm internal fixation.
3. Early movement.

The 3rd Surgical Department of Ullevål Hospital now employs this procedure also in the treatment of most other joint fractures.



Case 1.

K. T., Man. 59 years old inspector. Group II. Reduction. Bone-grafting. Screw. Exercise: 5 weeks. Plaster-cast: 5 weeks. Weightbearing: 12 weeks. Back to work: 4 months.

Follow-up ex.: 4 years. Full time work. Hunting and fishing. No pain. No instability. Except for 5 flexion-contracture full function. Excellent result.

Indications for Operation.

The following types of tibial condyle fractures are treated by operation:

a. Fractures without ostensible roentgenographic increase in depression or width, but with lateral instability.
b. Fractures with increase in width. (Splitting fractures.)
c. All fractures with depressed fragments, with or without simultaneous increase in width.

Date of operation.

We do not operate before the swelling has gone down, usually about 8 days after the injury. Aspiration of the joint with subsequent pressure bandages will sometimes be of assistance.

Pre-operative roentgenographic examination.

The fracture must be accurately plotted by roentgenograms before the operation, with radiographs taken in four planes. Oblique views are especially important, as without these, important dislocations may go unnoticed.

Operative Technique in detail.

a. *Fracture without dislocation but with lateral instability.*

Through a short incision over the lateral tibial condyle, the fracture is fixed by a 1 mm. thick steel wire loop passing through it. As a wire guide, a thick puncture cannula is employed, and to bring the wire back again a small auxiliary incision is made over the medial tibial condyle.

b. *Fracture with increase in width.* (Splitting fracture.)

This fracture is pressed together by hand, or with the aid of a Böhler Clamp. Fixation is carried out as described in the preceding paragraph (a).

c. *Fracture with depressed fragments, with or without simultaneous increase in width.*

This fracture is reduced and fixed by arthrotomy (Fig. 1–4).

Incision: A Bayonet-shaped incision is employed, above the line of the knee joint parallel with and a little in front of the lateral side ligament. Corresponding to the joint line it swings forward approximately 3 cm. and continues parallel to the upper portion of the incision until arriving slightly below the tibial tubercle. The fascia and joint capsule which to a certain extent go together, are cut according to the skin incision. In most cases the semilunar cartilage is removed, whether it is ruptured or not. In a certain number of cases it is only the anterior portion of the semilunar cartilage which is loosened and sewn in place at the end of the operation. A triangular fragment, varying in size from almost the entire articular surface down to the lateral condyle's cortex itself, is in practically all cases connected with the joint capsule and dislocated outwards. In the cases where there is a fracture of the fibula head at the same time, this lateral fragment will also be dislocated downwards. Inside this laterally dislocated fragment various pieces of the joint surface are fractured and depressed. (In a few cases the entire cortex circumference is found intact, with a centrally depressed joint surface.) The fracture fissure of this lateral fragment is identified and the fragment pulled outwards. Sometimes it will be necessary to carry out careful subperiosteal loosening of the outside edge of the fragment in order to make it sufficiently mobile. Small, quite loose fragments of the joint surface are removed, whilst larger pieces are replaced by means of an elevator inserted through the fracture fissure. In cases where there is only central depression, a small hole is chiselled in the front of the cortex, and the elevator is inserted through this hole. Sometimes considerable strength is needed in reduction in order to loosen the depressed fragments. Necessary counter-pressure must be applied on the joint sides in order to prevent sudden complete loosening from the surroundings. Very occasionally it is necessary to chisel out a depressed piece, especially in the case of the fragments in the medial region of the condyle.

The hollow now remaining in the tibial metaphysis after the depressed fragments have been replaced is accordingly packed tight, using spongy pieces of bone with cortical wall taken from the iliac crest. The lateral triangular fragment is now pressed into place, and two thick puncture cannulas are inserted through this fragment, parallel with and approx. 1–2 cm. under the articular surface, and then proceeding out again through the cortex on the medial condyle. A small auxiliary

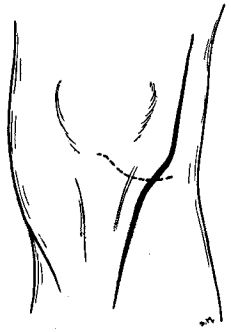


Fig. 1.

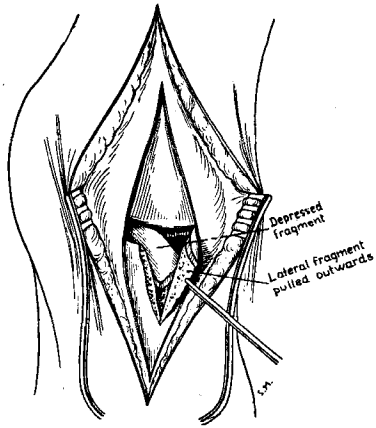


Fig. 2.

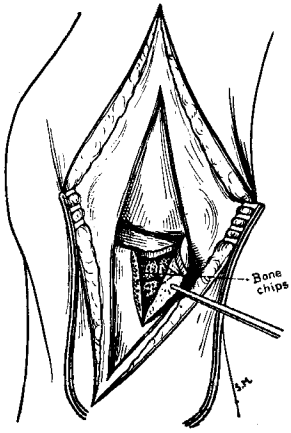


Fig. 3.

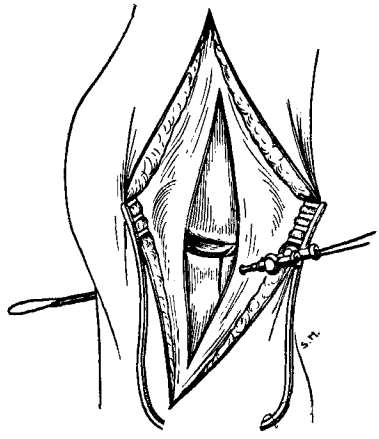


Fig. 4.

incision is then made on the medial condyle, corresponding to the spot where the cannulas protrude. At this point of the operation a roentgenographic check is made, and any necessary correction of the position effected accordingly. A 1 mm. thick steel wire is passed through the one cannula, bent on the medial side and brought back through the other cannula. The cannulas are extracted whilst an assistant exerts hard lateral pressure on the condyles and the surgeon subsequently tightens the wire. If the lateral fragment tips, it may be necessary to stabilize it by means of a lag screw or an extra steel wire loop. A further radiological check is now made. Before the soft parts are closed, layer by layer, the joint is washed with saline solution. *Special attention must be given* not to loosen too much of the lateral periosteum and capsule fragments, in order that their blood supply will not be blocked. In addition the packing of the spongy bone under the reduced fragments must be firm, so as to avoid the risk of redisplacement and valgus deformity.

In the cases where there has been fracture and dislocation of the tibial spine at the same time, we used a Textors curved incision, chiselling out the root of

the inferior patellar ligament of the tibia. The condyle fracture is treated as described above, and the tibial spine is reduced and fixed with a silk suture or a steel wire brought out through two holes drilled in the front of the tibia. Post-operative roentgenographic examination sometimes shows a reduction which is not as exact as imagined. The fragments at the back especially, have a tendency to tip backwards, and the medial fragment is not sufficiently elevated. One must, therefore, pay attention to this. After-examination of operated cases seems to prove that as a rule this will not produce any particularly unfavourable effects on an otherwise satisfactory result.

After-treatment.

In the first years it was a matter of routine that the patient should wear a plaster cast during the entire treatment until weight-bearing was permitted–or for a shorter period of 4–6 weeks. Later free movement was allowed without weight-bearing.

During the last 5–6 years we have utilised the following procedure. After the operation the leg is placed on a large pillow, and the day after the operation the patient begins quadriceps exercises under the care of a physiotherapist. For some days careful active and passive flexion and extension of the knee is practised. In same cases we have put the leg in a Thomas splint incorporating a hinged knee joint immediately after the operation, and allowed the patient to promote movement in this. When the leg can be fully extended and the joint flexed to approximately 90°–which occurs generally 2–3 weeks after the operation–a plaster cast is applied which extends from the toes to the groin, and the patient is allowed up on crutches. 10–12 weeks post-operatively weights are allowed on the plaster cast; these are subsequently taken off after a period of 12–16 weeks, depending on the severity of the fracture.

The reason why the leg is put in plaster *after* satisfactory post-operative motion, as described previously, is mainly to prevent secondary displacement and following valgus deformity. This can occur through muscle pull only as long as the fracture is not consolidated. When the patient has a plaster cast he can be up on crutches and does not need to be detained in hospital.

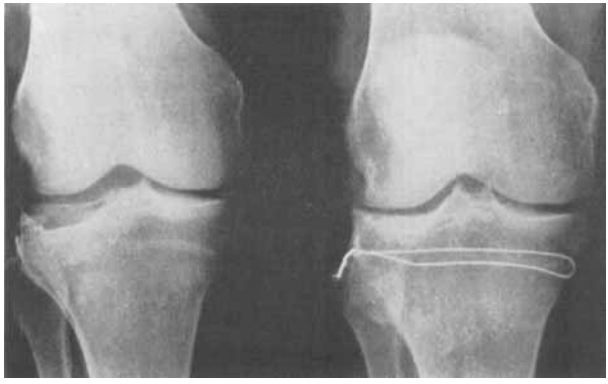
When there is also a transverse fracture of the tibial metaphysis which cannot be fixed internally, we apply a heel traction at the close of the operation. These patients also commence gentle, early active and passive movements of the knee joint under the care of a physiotherapist. One must control the position of the metaphysis frequently, and correct immediately any potentially wrong metaphysis positions. As a rule sufficient movement is not obtained in the operated knee joint of these patients before the fracture of the metaphysis is consolidated. Further treatment is individualised according to the principles outlined above.

Personal material.

The series consists of all the fractures of the lateral tibial condyle operated on in the 3rd Department of Ullevål Hospital during the years 1937 to 1948. During these years the operative technique itself as well as the after-treatment progressed and altered considerably, so that the series is not entirely homogeneous.

In the meantime I have found it correct to include all operated fractures in this period despite the differences in technique, and will show the results accordingly.

In all, 69 fractures of the lateral tibial condyle were operated on from 66 patients during the period 1937–1948, of which 3 were second operations.



Case 2.
F. E., man. 60 years old stevedore. Group II. Reduction. Bone-grafting. Wire-loop. Exercices for 4 weeks. Plaster-cast: 6 weeks. Weightbearing: 10 weeks. Back to work: 4 months. Follow-up ex.: 3 years. Full time heavy work. No pain. No instability. Full function. Excellent result.

Age and Sex classification is shown in Table 1. As will be seen, 22 patients were aged over 60 years on operation.

Average age for the entire series is 54 years, the youngest patient being 26 years and the eldest 79 years.

Men: 31 *Women:* 35

Post-operative complications:

Infection with stiff knee	1 case
Thromboembolism	7 cases
Transient peroneal palsy	1 case

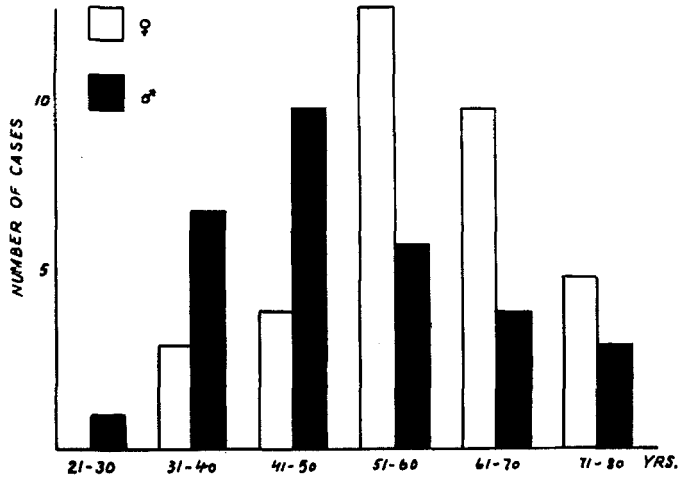
No post-operative deaths.

Post-operative examinations.

61 of the patients have either been followed up in the department or have been examined privately. All of them have been examined by the writer.

TABLE 1

SEX- AND AGEDISTRIBUTION



1 man is in the overseas marine service. He was last examined in the department 6 months after the operation.

3 patients died several years after the operation, but were checked up on until shortly before their decease.

The above-mentioned 65 patients are included in the series.

1 man died 14 days after the operation (suicide). He is not included in the series.

Observation period 2–13 years.

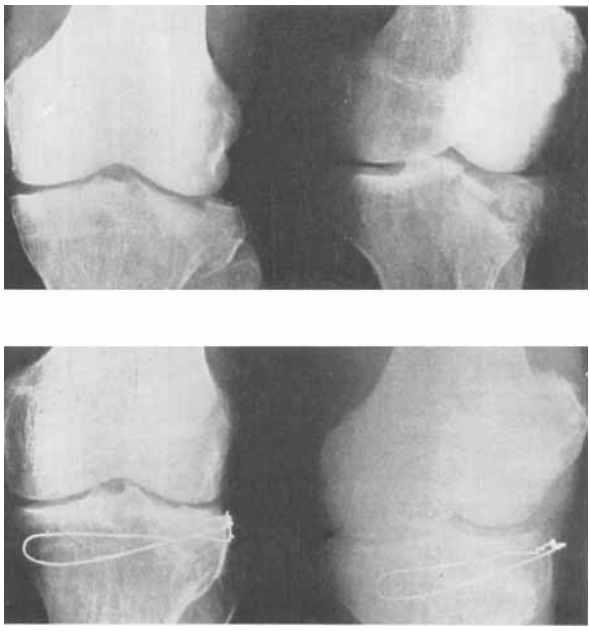
All the operated patients have thus been examined and are included in the following arrangement of the results.

Procedure in after-examination.

The patients are examined for pain, stability and strength in the operated limb. Enquiries are also made to ascertain that their economic status is in proportion to what it was preceding the injury. A good many patients were too old to have been at work when the injury was sustained. For these the economical status is counted as unchanged as long as the patient has been able to continue the same kind of life as before the injury.

The examination has included the calculation of active movement, possible lateral instability, anteroposterior movement and axis-deviation in the knee joint (valgus, varus). The strength is tested in comparison with the able limb, and possible limping or the use of a stick taken into account.

For the patients who come to be re-examined in the department, we make a roentgenographic examination of the operated knee joint in comparison with the able joint.



Case 3.

K. A., man. 72 years old salesman. Group III. Reduction. Bone-grafting. Wire-loop. Plaster-cast for 4 weeks. Weightbearing: 12 weeks.

Follow-up ex.: 6 years. No work (78 years old). 10 % compensation. No pain. Full function. "Do every morning half-an-hour's gymnastics including deep knee-bending, and take one hour fast's walk before breakfast". Excellent result.

Classification of the series.

Group	I: Patients treated without arthrotomy ...	9	cases
„ II and III:	„ „ with „ ...	56	„
	II) Fractures with depression, with or without simultaneous increase in width	36	„
	III) Fractures with depression combined with fracture of the metaphysis, and/or fracture of the head of the fibula	20	„

The treatment technique, after-treatment methods and results of the follow-up examination are indicated by grouping in the following Tables 2–7.

TABLE 2

	Group I	Group II	Group III	Total
Number	9	36	20	65
Sex Men	4	18	8	30
Women	5	18	12	35
Average age in years	52	51	57	54
Internal fixation with screw	8	6	4	18
„ „ „ wire-loop	1	27	15	43
No internal fixation	0	3	1	4
Bone grafting	0	24	8	32

The division of the material into three groups, and the method of internal fixation employed is shown in Table 2. The lag screw was used, in all, 18 times–most frequently in Group I. In later years the lag screw was not used at all in Groups II and III. The wire-loop was used in all 43 times, and there was no internal fixation in 4 cases. Excepting 1 case this has resulted in more or less important redisplacement. Bone grafting was utilized in 32 cases. The cases in which bone grafting was not used are nearly all found amongst the earliest operated cases.

TABLE 3

	Group I	Group II	Group III	Total
Plaster of Paris cast	2	6	6	14
Exercises 2–6 weeks	0	16	5	21
Traction	0	4	5	9
No external fixation	7	10	4	21
Average weight-bearing time in weeks	8	11	13	

Table 3 classifies the after-treatment. Plaster of Paris cast signifies that the leg is encased in plaster from toe to groin. This was used in 14 instances either during the entire treatment or in any case during a good part of it. Exercises demand physical therapy for 2–5 weeks, followed by a cast. Traction is applicable to cases with a simultaneous unstable fracture of the metaphysis, or when the internal fixation is not reliable. The period of traction has varied from 2–5 weeks and was sometimes followed by a cast. At other times all external fixation was omitted. "No external fixation" applies to the cases where the patient has neither had a plaster cast nor splints, and has exercised

until weight-bearing was permitted. The last line of Table 3 indicates the time allowed for weight-bearing.

TABLE 4

	Group I	Group II	Group III	Total
Average observation time in years	7	5	5	
Pains 0	7	27	14	48
slight	2	8	3	13
disabling	0	1	3	4
Ankylosis	0	0	1	1
Limping	0	5	5	10
Support (cane)	0	7	6	13

Table 4 shows the average observation period in years, together with the results of the after-examination, taking pain into account. 1 patient developed ankylosis in a good position after deep infection. 10 patients limp to varying extents and 13 use sticks. Of the latter, 8 only utilise a stick out-of-doors as a safety precaution. All are elderly patients.

TABLE 5

		Group I	Group II	Group III	Total
Extension	normal	7	32	15	54
	—5°	0	3	2	5
	—10°	2	0	2	4
	—20°	0	0	1	1
Flexion	>100°	8	28	13	49
	80°–100°	1	7	3	11
	65°	0	0	1	1
	45°	0	1	2	3
Valgus deformity	<5°	0	4	2	6
	6°–10°	0	1	1	2
Varus deformity		0	1	1	2
Lateral instability		0	4	3	7

Table 5 indicates the results of the after-examination taking into consideration extension, flexion, valgus and varus deformities and lateral instability. Nearly all those who suffer from valgus deformity have some degree of pain, whilst the 2 patients with varus are free from suffering.

TABLE 6

	Group I	Group II	Group III	Total
Returned to former work	9	30	15	54
„ „ lighter work	0	3	2	5
Not returned to work	0	3	3	6

Table 6 indicates the results with regard to fitness for work. Elderly patients who had no work before the injury and can do as much as they did before, are included in the group "returned to former work". All heavy workers, 18 in all, are included in this group. The ages of the patients counted as "not returned to work" are respectively 47, 67, 69, 73, 73 and 74 years. The youngest of these was reoperated on with excellent results.

TABLE 7

	Group I	Group II	Group III	Total
Patients' opinion on result:				
Most satisfied	7	27	12	46
Satisfied	2	5	2	9
Not satisfied	0	4	6	10
Authors' opinion on result:				
Excellent	7	19	9	35
Good	0	12	4	16
Fair	2	1	1	4
Poor	0	4	6	10

Table 7 shows the patients' and the author's classification of results. Provided they had not already stated their opinion, as they mostly had, the patients were asked directly on after-examination whether they were "most satisfied", "satisfied" or "not satisfied".

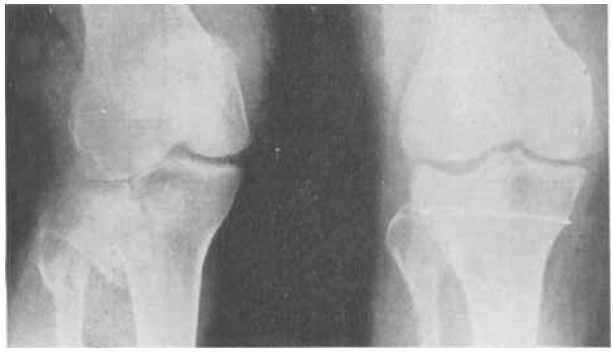
The writer's evaluation is based on the following criteria:

Excellent results.

No pain. Practically full movement of the joint. No lateral instability or valgus position. Good strength.

Good results.

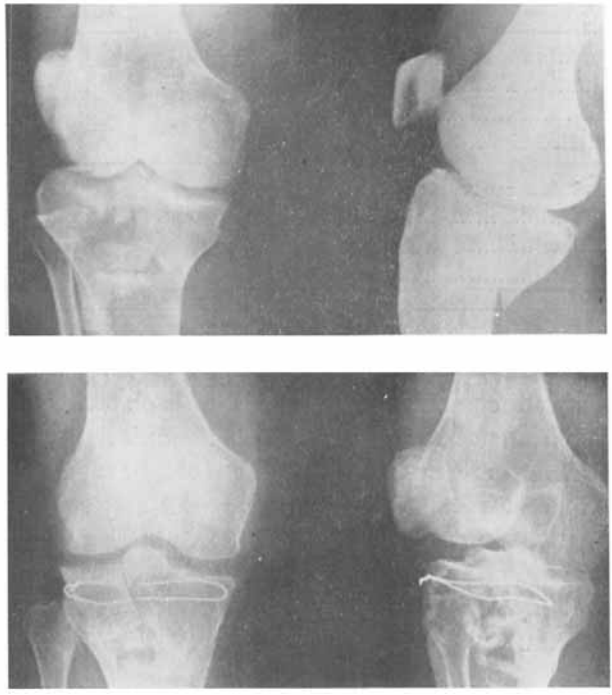
A little pain, but not enough to affect the ability to work. Unimportant limitations of movement. No lateral instability. No valgus position.



Case 4.

K. T., Woman. 59 years old housewife. Group III. Reduction. Bone-grafting. Wire-loop. Traction and exercices for 8 weeks. Weightbearing: 8 months! (Did not show up for check-up before!)

Follow-up ex.: 4 years. Full time housework. No pain. No instability. Full function. Did not remember which knee was treated! Excellent result.



Case 5.

D. J., woman. 55 years old housewife. Group III. Reduction. Bone-grafting. Wire-loop. Traction for 3 weeks. (Simultaneous transverse fracture of same tibial metaphysis). Weightbearing: 14 weeks. Back to work: 5 months.

Follow-up ex.: 4 years. Full time housework. Walk for hours. No pain. 8° lateral instability. 5° flexion-contracture, flexion to 110. Good result.

Fair results.

More intense pain, but still not enough to prevent work. More limited movement and in some few cases slight lateral instability or valgus position.

Poor results.

Pain which prevents work. Stiff knee or extremely limited movement. More severe lateral instability or valgus position.

It is evident that such an evaluation must be subjective to a certain extent. When, in the meanwhile, one compares the patient's own opinion with that of the writer, this corresponds very well in so far as "most satisfied" will answer to "excellent" plus "good". 10 patients were "not satisfied", and the writer has rubricated 10 as poor results.

Secondary Arthrosis.

It is an acknowledged fact that joint fractures are liable to secondary arthrosis, and that the degree of arthrosis increases with the irregularity which develops in the joint as the outcome of the injury (*v. Bahr*). An existing arthrosis, whether of severe or moderate degree, in no way necessitates a painful joint.

In this series, all who have been followed up in the department have undergone roentgenographic examination for purposes of comparison with the able joint. That is to say–56 patients.

In Group I: 5 have no arthrosis. 3 have a moderate or more severe arthrosis; 2 of these suffer pain.

In Group II: 11 have no arthrosis. 19 have arthrosis of a moderate or more severe degree, of whom only 3 suffer any pain.

In Group III: 3 have no arthrosis. 15 have arthrosis of a moderate or more severe degree, of whom 4 suffer pain.

In these three groups 16 of the 56 patients radiologically examined have no arthrosis. 40 have arthrosis of a moderate or more severe degree, and 9 of these suffer pain.

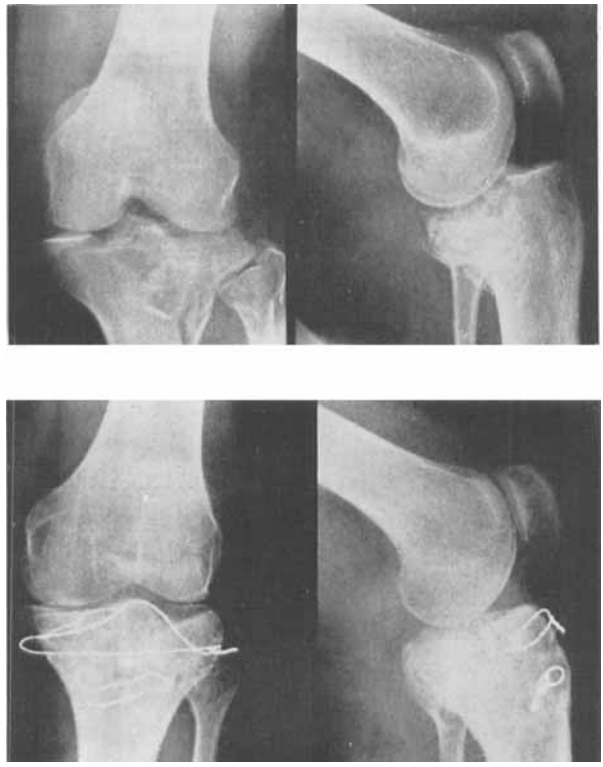
Analysis of the results grouped as "poor".

1 case due to infection with stiff knee.

1 case due to a simultaneous, overlooked injury to the crucial ligaments.

1 case due to simultaneous, overlooked fracture of the collum femoris.

2 cases due to deficient or absent reduction.



Case 6.

A. K. J., woman. 50 years old factory worker. Group III. (Simultaneous fracture and dislocation of the tibial spine). Reduction. Bone-grafting. Wire-loop. Reduction and fixation of the tibial spine. (Textor incision). Plaster-cast for 3 weeks. Exercises for 4 weeks and then plaster-cast for another 6 weeks. Weightbearing: 16 weeks. Back to work: 6 months.
Follow-up ex.: 2 years. Full time factory work. Walks with a slight limp. No support. No pain. No instability. Flexion to 90. Good result.

5 cases due to insufficient internal or external fixation, which caused secondary displacements.

One notices that out of 10 patients showing poor results, 6 have at the same time suffered from severe pain, valgus deformity and secondary arthrosis.

Reoperation.

We have reoperated on 3 patients after healing following the first operation. In all instances we were compelled to chisel out the lateral condyle according to the depression. The results of these operations are:

1 patient operated on elsewhere the first time is a good deal better and now considered as belonging to the group "fair".

1 patient assigned to the group "poor" shows no improvement.

1 patient described as "poor" is much better and now considered as "good". Is in full time work in the hospital's laundry.

SUMMARY

1. The operative technique for the treatment of fractures of the lateral tibial condyle as employed by the 3rd Department of Ullevål Hospital is described in detail. The importance of exact reduction and firm internal fixation with steel wire loops, together with bone grafting in order to prevent secondary displacement is underlined.

2. The after-treatment is described in detail. The firm internal fixation allows immediate treatment with exercises. When the knee can be fully extended and flexed to approximately 90°, the plaster cast is applied. Weight-bearing is commenced from 12–16 weeks after the operation according to the type of fracture.

3. Results of the after-examination of all operated patients in the period 1937 to 1948, including an analysis of the bad results. Of 65 patients operated on and re-examined 35 show excellent results, 16 good results, 4 fairly good results and 10 bad results.

CONCLUSIONS

The writer believes that he has proved that operative treatment of the tibial condyle fractures by reduction and firm internal fixation with steel wire loops, together with immediate exercise is a very satisfactory method to employ. The patient's age does not appear to have any particular affect on the results of the treatment.

This method is simple, but demands a certain experience in operative fracture technique.

RESUME

1. La technique opératoire pour le traitement des fractures du condyle tibial latéral telle qu'elle est utilisée par le 3ème Service de l'Hôpital d'Ullevål est décrite en détail. Il est souligné l'importance d'obtenir une réduction exacte et une fixation interne ferme au moyen de boucles de fil d'acier avec la greffe osseuse, de manière à prévenir un déplacement secondaire.

2. Les soins à donner après l'opération sont décrits en détail. La ferme fixation interne permet de procéder immédiatement à des exercices. Lorsque le genou peut être entièrement tendu et fléchi à env. 90°, le bandage plâtré est appliqué. Il doit être porté pendant 12 à 16 semaines après l'opération suivant le type de fracture.

3. Résultats de la réexamination de tous les malades opérés pendant la période entre 1937 et 1948, y compris une analyse des mauvais résultats. Sur 65 malades opérés et réexaminés, il y a eu d'excellents résultats chez 35, bons chez 16, relativement bons chez 4 et mauvais chez 10.

ZUSAMMENFASSUNG

1. Die Operationstechnik für die Behandlung der Brüche des lateralen Tibiacondyls, wie sie an der III Abteilung des Ullevål Krankenhauses ausgeführt wird, wird eingehend beschrieben. Die Wichtigkeit einer genauen Einrenkung und sicheren Fixierung mit Stahldrahtschlingen, kombiniert mit Knochenspahnverpflanzung zur Verhinderung sekundärer Verschiebung, wird hervorgehoben.

2. Die Nachbehandlung wird in ihren Einzelheiten beschrieben. Die feste innere Fixierung gestattet unmittelbare Übungsbehandlung. Sobald das Knie vollständig gestreckt und bis einem Winkel von ungefähr 90° gebeugt werden kann, wird ein Gipsverband angelegt. Das Bein wird 12–16 Wochen nach der Operation, abhängig von der Art des Bruches, belastet.

3. Die Ergebnisse der Nachuntersuchung aller im Zeitraume 1937–1948 operierten Patienten werden, zusammen mit einer Analyse der schlechten Resultate, vorgelegt. Von den 65 operierten und nachuntersuchten Patienten wiesen 35 ein ausgezeichnetes, 16 ein gutes, 4 ein mittelgutes und 10 ein schlechtes Ergebnis auf.

REFERENCES

Bahr, V. von: Acta Chir. Scand. 1945: 92: 139.
Barr, J. S.: J.A.M.A. 1940: 115: 1683.
Bick, E. M.: J. Bone and Joint Surg. 1941: 23: 102.
Böhler, L.: Technik der Knochenbruchbehandlung. Vienna 1941.
Cave, E. F.: Surg. Gyn. and Obstr. 1948: 86: 289.
Foged, J.: Acta Chir. Scand. 1944: 91: 143.
Hulthen, O.: Acta Chir. Scand. 1946: 66, Suppl. 15.
Maisel, B. and *Cornell, N. W.:* Surgery. 1948: 23: 591.
Olaussen, T.: Acta Chir. Scand. 1946: 94: 407.
Palmer, I.: J. Bone and Joint Surg. 1939: 21: 674.
Watson-Jones, R.: Fractures and other Bone and Joint Injuries. Edinburgh 1940.