Acta orthop. Scandinav. 42, 366–376, 1971

Surgical Department II, Århus County Hospital, Århus, Denmark.

FRACTURES OF THE TIBIAL CONDYLES

ULF LUCHT & SØREN PILGAARD

Accepted 5.viii.71

Fractures of the tibial condyles are characterized by the involvement of cancellous bone and weight-bearing articular surfaces.

The treatment of these fractures aims at obtaining a stable painless knee joint with good mobility.

It is widely accepted that non-weight-bearing for a long time is needed, but here the agreement ends, and over the years there have been heated discussions as to whether operative or conservative treatment affords better results. The advocates of operation (Bahr 1945, Fryjordet 1967, Jacobsen 1953, Palmer 1951, Rombold 1960) stress the importance of an adequate reduction in order to obtain good function and to avoid subsequent osteoarthritis. Authors who support conservative treatment (Apley 1956, Poulsen & Tophøj 1969, Reibel & Wade 1962, Slee 1955) feel that in most cases operation is unnecessary. Solonen (1963) concluded that the method of treatment had to be selected in each individual case.

In a review on tibial condylar fractures Mortensen (1969) stated, as a general rule, that non-displaced fractures and fractures showing a depression or displacement of less than 5 mm should be treated conservatively, whereas operation should be considered in others.

The reason why it has proved so difficult to arrive at an agreement in this important field is, among others, that tibial condylar fractures occur in many different types. The various materials have been analysed according to different criteria and are therefore often not comparable. There have not been reports on large, prospective materials within which patients treated by conservative measures and by operation make up entirely comparable groups.

In the present retrospective material, operative as well as conservative methods have been used, but it should be mentioned that the attitude in the Department is in favour of operation. The object of this analysis was to relate the long-term results to the therapeutic method

and thereby contribute to the discussion as to which method is preferable.

MATERIAL AND METHOD

During the 10-year-period 1959–1968, a total of 107 patients with 109 fractures of the tibial condyles were treated. Two patients had bilateral fractures. 69 fractures were left-sided and 40 right-sided.

The material does not comprise fractures involving exclusively the intercondylar eminence.

Before the treatment was decided upon, the conventional X-ray films were supplemented by tomography, and on this basis the type of fracture and the degree of displacement, if any, were ascertained. At follow-up the history and clinical findings were supplemented by X-rays, anteroposterior views of both knees on long films, and a lateral view of the fractured knee.

Sex and Age

The age distribution and sex ratio are shown in Figure 1. 55 were females and 52 males. The majority were in the age range 40–80, average age 50. Within the individual age groups there was a male preponderance up to the age of 60; thereafter females predominated.

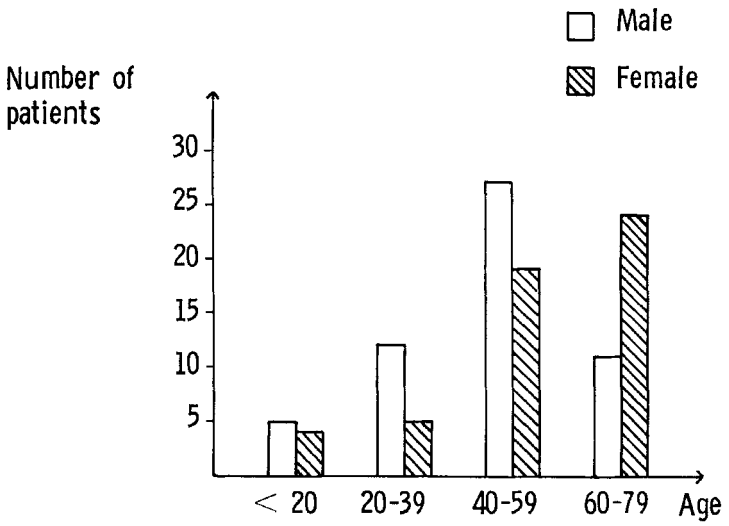

Figure 1. Age distribution and sex ratio.

Table 1. Place of accident.

		Number	%
Traffic			
Moped or motor-bike	25		
Car (motorist)	18		
Pedestrians	20	69	65
Bicycle (cyclist)	6		
Home		24	22
Working-place		10	9
Sport		4	4
		107	100

Our age distribution corresponds largely to that reported previously, but several authors have had a male preponderance – Hohl & Luck (1956), for instance, 444 males and 282 females.

Place of Accident

Fractures of the tibial condyles occur as a result of direct injury to the outer or inner aspect of an extended or flexed knee, or of indirect injury, i. e. in the longitudinal direction of the leg. It is not surprising, therefore, to learn from Table 1 that 65 per cent of the fractures were road accidents. On the other hand, it is remarkable that 22 per cent occurred at home and only 9 per cent during work or 4 per cent during games.

This distribution is in fair conformity with that reported by Dovey & Heerfordt (1970).

Classification of Tibial Condylar Fractures

Like a number of others before us, we felt that it was most expedient to use the classification of Hohl & Luck (1956), and Figure 2 illustrates the material thus classified.

Fractures classified as undisplaced (28 per cent) involve the joint surface, but may show a displacement of less than 3 mm on the X-ray film. The other displaced fractures comprise fractures with depression of the joint surface as well as fractures without depression. The depression may be local or total. Local depression fractures may be subdivided into fractures with a central depression (23 per cent) and split fractures with depression (17 per cent). Total depression fractures, in

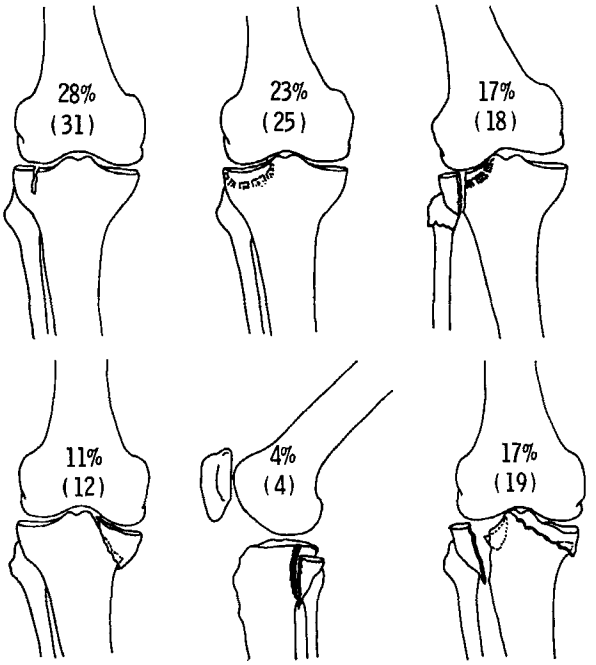

Figure 2. Classification by type of fracture.

which the entire condyle is pressed down, made up 11 per cent. Split fractures which were displaced, but not depressed, made up 4 per cent. Lastly, there is a group of bicondylar fractures that may be more or less comminuted; depression may be present. This group, which includes also pure "T" fractures, made up 17 per cent.

This distribution of the fractures into the various types corresponds to that reported by Hohl (1967). In Dovey & Heerfordt's series (1970) more than one-third of the fractures were of the split type with depression.

In our material 79 fractures affected the lateral condyle, 11 the medial condyle, and 19 were bicondylar.

Associated Fractures

At the time of the tibial condylar fracture 36 patients sustained 58 associated fractures, 29 of the arms and the other leg. The remaining 29 fractures, affecting the same leg as the tibial condylar fracture, are distributed as follows: 3 of the femur, 3 of the patella, 5 of the tibial shaft, 5 of the fibular shaft, and 13 of the head or neck of the fibula.

Table 2. Method of treatment.

		Number	%
Operation			
Without bone transplantation	21	51	47
With bone transplantation	30		
Not operated			
Only non-weight-bearing	30	58	53
Only plaster-bandage	26		
Reposition + plaster	1		
Extension followed by Plaster-bandage	1		
		109	100

Method of Treatment

Table 2 gives the method of treatment. 51 or 47 per cent of the 109 fractures were treated by operation, whereas 58 or 53 per cent were treated conservatively.

In 30 operations bone grafting was done, the defects left by elevation of the joint surface being filled with a graft from the iliac bone, fixed by cerclage or screw. In 21 cases the fracture was merely reduced and fixed by osteosynthesis material. After the operation 36 knees were placed in plaster casts. During the operation 13 semilunar cartilages were removed, whereas in others a detached semilunar cartilage was sutured. Secondarily, two patients had a semilunar cartilage removed.

Among the conservatively treated cases 30 knees were treated merely by non-weight-bearing, while 28 were treated in plaster casts.

Table 3. Time for start of knee exercise and weight-bearing.

	Knee exercise	Weight-bearing
$\leq$ 4 weeks	51	10
5– 8 weeks	39	13
9–12 weeks	16	74
13–16 weeks	0	6
$>$ 16 weeks	0	3
Not informed	3	3
	109	109

Table 4. Absent from work.

	Number of patients
< 3 months	15
3– 6 months	48
7–12 months	7
13–24 months	2
Work not resumed	4
Unemployed before accident	16
	92

In the entire series, then, external fixation by plaster was used on 64 knees. The cast was worn for less than four weeks in 11 cases, from five to eight weeks in 38 cases, and from nine to twelve weeks in 15 cases. No patient wore a plaster cast for more than 12 weeks.

The patients did exercises to train the knee (Table 3). In the majority of those who did not have plaster casts these exercises were instituted shortly after the accident, while the others were started on exercises as soon as the cast had been removed. The mean time of starting exercises was 4½ weeks after the accident.

A relatively long period of non-weight-bearing was needed because of the characteristics of tibial condylar fractures (Table 3). Weight-bearing was allowed on an average 12 weeks after the accident.

Complications

Five patients developed paresis of the peroneal nerve, transient in four. Two of these patients also had fracture of the fibular head. In five cases re-operation was performed because of re-displacement. Two patients developed thrombophlebitis, one after operation and the other one after conservative treatment. Three patients had infection in the scar after the operation, but none developed infective arthritis or osteomyelitis.

FOLLOW-UP

At the time of follow-up 12 patients had died. Three surviving patients were not seen, as one could not be traced and two refused. Thus, the follow-up material comprises 94 fractures of the tibial condyles in 92 patients, or 94 fractures on 97 "living knees" (91 per cent). The follow-

up period ranged from 18 months to 11 years, averaging 5 years 8 months.

Time Off Work

In analysing the time off work, we also included housewives, etc. The majority (68 per cent) were disabled for less than 6 months (Table 4). This period depends, *inter alia,* upon how heavy the work was, the period being longer the heavier physical work the patient had.

Four patients were obliged to give up their work completely. This includes both patients with bilateral tibial condylar fractures. Three patients had changed to lighter work after the accident.

Jensenius et al. (1961) reported that 58 per cent of their patients had returned to work within 6 months.

Subjective Complaints

31 patients had pain on exertion, as a rule only mild. Only 9 patients had constant pain on exertion, and 5 of them occasionally had pain at rest.

Among other complaints, it should be mentioned that 9 patients had "restless knee" due to weather changes, 14 complained of instability, 7 of restricted mobility, and 16 had occasional swelling of the knee. 10 patients had complaints of osteoarthritic nature.

The complaints were distributed on 42 patients or 44 knees, 20 treated conservatively and 24 by operation.

Clinical Findings

In 7 knees there was an extension defect, in 3 cases less than 5°, in another 3 between 5° and 10°, and in only one more than 10°.

The mobility was more than 120° in 85 knees, while in five it was 90°–120° and in four less than 90°.

There was lateral instability in five patients and distinct forward mobility in five.

Out of the five patients with lateral instability, four complained of instability and all of pain. Out of the five patients with forward mobility one complained of instability and four of pain.

Measurement of the thigh 10 cm proximal to the patella showed in 10 cases muscular wasting of 3–4 cm, and in 21 cases of 1–2 cm.

Table 5. Comparison of results of patients treated with operation and those treated conservatively.

Fracture	Functional acceptable results as %	Anatomic acceptable results as %
Without depression		
Operated	88	63
Non-operated	94	94
Depression 3–10 mm		
Operated	78	61
Non-operated	94	59
Depression > 10 mm		
Operated	79	58
Non-operated		

Radiographic Findings

In one patient, who was suffering from Lévi's syndrome, the fracture was still very distinct and must be classified as ununited. All the other fractures had united.

In 24 patients there was still depression at the site of the fracture, but often only a few mm. 16 of these patients had been treated by operation.

Valgus deformity was found in 22 patients, of less than 5° in two patients and from 5° to 10° in 20. Two patients exhibited a varus deformity of 5°–10°.

Osteoarthritis was found in 39 knees, but in 30 of these cases it was mild. Halisteresis was observed in eight cases.

Assessment of the Therapeutic Results

To sum up the results, we felt that it must be expedient to use the classification of Hohl & Luck (1956). This classification is based upon an anatomic and a functional assessment, the results being graded as excellent, good, fair, and poor. To simplify the classification, we have combined the groups excellent and good as acceptable and the groups fair and poor as unacceptable. The anatomical assessment includes the position of the fracture, valgus deformity and degenerative articular changes, if any. The functional assessment includes mobility, extension defect, lateral instability, strength, working ability, and pain.

This classification shows that an acceptable functional result was

obtained for 82 knees (87 per cent) and an acceptable anatomical result for 67 (72 per cent).

To compare the conservatively and surgically treated fractures we divided the fractures by degree of depression (Table 5). However, the groups are not entirely comparable, as no regard was paid to an increase in width of the tibial condylar plateau.

When considering the functional outcome, we found better results in the conservative group if the fractures were non-depressed or only depressed 3–10 mm. If the depression exceeds 10 mm, we cannot tell, as all such fractures were treated by operation. As for the anatomical outcome, the results were better after conservative treatment of non-depressed fractures, but if there was a depression of 3–10 mm the results were the same after conservative and operative treatment.

To ascertain whether the time of instituting knee exercises influenced the results, these two factors were plotted against each other. A distinct difference was found to occur around the eighth week, the functional result being acceptable in 90 per cent of the patients who had started knee exercise within eight weeks, while it was acceptable in only 71 per cent of those who had started knee exercise later than eight weeks after the accident.

Finally, it should be mentioned that the result was somewhat poorer if the patients had associated fractures of the same leg. The length of the follow-up period was of no importance. The results were no poorer in patients with over 5 years' follow-up than in patients followed for less than 5 years.

DISCUSSION

The purpose of operating on patients with fractures of the tibial condyles must of course be to obtain results superior to those obtainable without operation. In our material this was not attained in non-depressed and slightly depressed fractures. As already mentioned, however, we did not pay regard to a possible increase in width of the tibial condylar plateau in performing this classification. For this reason the groups treated by operation and by conservative measures are probably not entirely comparable.

Dovey & Heerfordt (1970), in a followed series of tibial condylar fractures, had 36 per cent operated cases. They found an acceptable functional result in 75 per cent and an acceptable anatomical result in 40 per cent. This is somewhat poorer than in our series (87 and 72

per cent respectively), but the explanation is presumably that their material was selected, comprising the most serious tibial condylar fractures, transferred from other departments. The same authors analysed the result by degree of depression. In cases with fairly mild as well as more severe depression they found that operation meant no improvement of the functional result.

Jensenius et al. (1961), in a somewhat older material, with an operation rate of 40 per cent, found an acceptable functional result in 71 per cent and an acceptable anatomical result in 48 per cent. These authors also found better functional results after conservative treatment in cases with fairly mild as well as with more marked depression.

Poulsen & Tophøj (1969), analysing a series of 47 knees treated conservatively, found an acceptable functional result in 85 per cent.

Several authors (Apley 1956, Badgley & O'Connor 1952, Poulsen & Tophøj 1969) use traction on the limb during the first weeks of conservative treatment.

Apart from the problem operative *versus* conservative treatment, the time of starting exercises also appears to influence the result. In Rhesus monkeys Hohl & Luck (1956) demonstrated the importance of allowing mobility soon, finding that it was thereby possible to avoid adhesions and to obtain a more favourable process of union with less synovial reaction. The importance of early exercise has also been stressed by others (Reibel & Wade 1962, Roberts 1968, Weisman & Herold 1964), and our findings indicate the same.

CONCLUSION

In the present material of tibial condylar fractures operation does not appear to afford advantages in cases of non-depressed fractures and fractures in which the joint surface is less than 10 mm depressed. All fractures with more marked depressions were treated by operation, but according to recent literature some of these cases may also be treated conservatively. Like previous authors, we also found early exercises to be extremely beneficial.

SUMMARY

In a surgical department 107 patients with 109 fractures of the tibial condyles were treated during a 10-year period. The fractures have been classified and the material analysed according to the principles of

Hohl & Luck (1956). 47 per cent of the patients were treated by operation.

An acceptable functional result was obtained in 87 per cent and an acceptable anatomical result in 72 per cent.

The analysis indicates that operative treatment offers no advantages in patients in whom the joint surface is depressed by less than 10 mm. Early institution of knee exercise proved to influence the result favourably.

REFERENCES

Apley, A. G. (1956) Fractures of the lateral tibial condyle treated by skeletal traction and early mobilisation. *J. Bone Jt Surg.* **38**-B, 699–708.

Badgley, E. C. & O'Connor, S. J. (1952) Conservative treatment of fractures of the tibial plateau. *Arch. Surg.* **64**, 506–515.

Bahr, V. von (1945) Depressed and comminuted fractures of the lateral tibial tuberosity. *Acta chir. scand.* **92**, 139–149.

Dovey, H. & Heerfordt, J. (1970) Tibial condyle fractures. *Nord. Med.* **83**, 830–831.

Dovey, H. Heerfordt, J. (1970) Personal comments.

Fryjordet, A. (1967) Operative treatment of tibial condyle fractures. *Acta chir. scand.* **133**, 17–24.

Hohl, M. (1967) Tibial condylar fractures. *J. Bone Jt Surg.* **49**-A, 1455–1467.

Hohl, M. & Luck, J. V. (1956) Fractures of the tibial condyles. *J. Bone Jt Surg.* **38**-A, 1001–1017.

Jacobsen, A. (1953) Operative treatment of lateral tibial condyle fractures. *Acta orthop. scand.* **23**, 34–50.

Jensenius, H., Jensen, I. & Nielsen, F. K. (1961) Fractures of the tibial condyle with special reference to operative treatment. *Nord. Med.* **66**, 1573–1579.

Mortensen, T. (1969) Treatment of fractures of the condyles of the tibia. *Ugeskr. Laeg.* **131**, 1976–1980.

Palmer, I. (1951) Fractures of the upper end of the tibia. *J. Bone Jt Surg.* **33**, 160–166.

Poulsen, J. O. & Tophøj, K. (1969) Conservative treatment of fractures of the tibial condyles. *Nord. Med.* **82**, 1243–1246.

Reibel, D. B. & Wade, P. A. (1962) Fractures of the tibial plateau. *J. Trauma* **2**, 337–352.

Roberts, J. M. (1968) Fractures of the condyles of the tibia. *J. Bone Jt Surg.* **50**-A, 1505–1521.

Rombold, C. (1960) Depressed fractures of the tibial plateau. *J. Bone Jt Surg.* **42**-A, 783–797.

Slee, G. C. (1955) Fractures of the tibial condyles. *J. Bone Jt Surg.* **37**-B, 427–437.

Solonen, K. A. (1963) Fractures of the tibial condyles. *Acta orthop. scand.* Suppl. 63.

Weisman, S. L. & Herold, Z. H. (1964) Fractures of the tibial plateau. *Clin. Orthop.* **33**, 194–200.