Acta orthop. scand. *53*, 963–974, 1982

DEFORMITIES, GONARTHROSIS AND FUNCTION AFTER DISTAL FEMORAL FRACTURES

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Sixty-two patients treated for distal femoral fractures from 1969–1976 were re-examined, after a mean follow-up period of 5 years, to study deformities, gonarthrosis and function. These fractures occur mainly in elderly persons with bone fragility due to age and disease. The deformities were analysed from precisely defined radiographic projections. An anatomical classification into supracondylar, unicondylar and bicondylar fractures, with subdivisions for undisplaced and displaced fractures was used. A special group for transcondylar fractures was included. Displaced bicondylar fractures mostly healed with varus and anterior angulation, medial unicondylar fractures with varus and lateral unicondylar fractures with valgus angulation. Most of the healed supracondylar fractures showed varus angulation. Three patients developed arthrosis in both the femoro-tibial and patellar compartments, and eleven only in the patellar area. Intercondylar or transcondylar diastasis, or difference of level in the joint surface exceeding 3 mm, caused a significant degree of gonarthrosis.

Function was assessed using the Knee Disability Sheet prepared at the Hospital for Special Surgery. The necessity of radiographic examination of the patellar joint in the axial projection on admission is stressed. Accurate reduction and adequate stabilization of intra-articular fractures seem to be important for reducing the risk of gonarthrosis and later impairment of function.

Key words: deformities; distal femoral fracture; function; gonarthrosis; osteoarthritis; radiologic examination; supracondylar fracture

Accepted 29.iii.82

Fractures of the distal third of the femur constitute 4 per cent of all femoral fractures (Kolmert & Wulff 1982). Experience with these fractures is therefore limited and only a few reports have mentioned primary displacement after fracture and deformities in the healed fractures (Neer et al. 1967, Trentz et al. 1977, Della Torre et al. 1980). The aim of this study was to describe deformities after healing, to estimate gonarthrosis (osteoarthritis) in the femoro-tibial and the patellar joints separately and to assess function and its relation to deformities and gonarthrosis.

PATIENTS AND METHODS

A total of 137 fractures of the distal third of the femur were treated from 1969–1976 in the Departments of Orthopaedic Surgery in Lund and Malmö (56 in Lund and 81 in Malmö).In another study (Kolmert & Wulff 1982) the records of these cases were reviewed for age, sex, previous disease, type of fracture, treatment and results. In 1978, 44 of the patients had died and 22 did not reply to three successive letters and could not be traced. In five cases the preoperative or postoperative radiograms had disappeared. Two of the patients were pregnant. During the period concerned, one patient was treated for two fractures of the same limb and another had a prosthetic replacement of the knee. Thus 62

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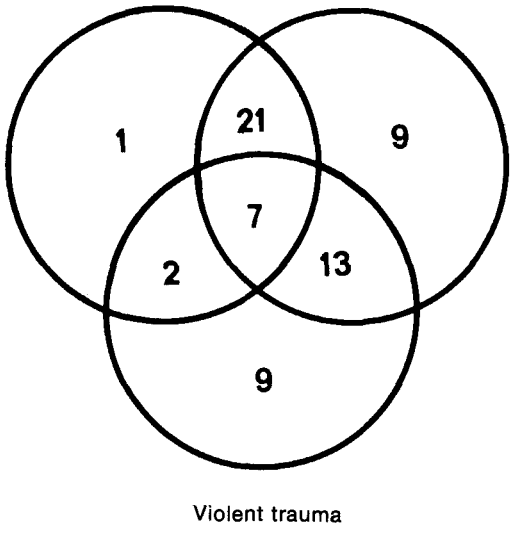

Figure 1. Relation between current diseases and previous fractures, age over 50 and violent trauma, in 62 distal femoral fractures.

fractures (in 22 males and 40 females) were available for this investigation. Thirty-five fractures had been treated non-surgically with traction and/or a cast and 27 had been treated surgically. The average age at fracture was 59 years (range 18–91) and at follow-up 64 years. The mean observation period was 5 years and 1 month (range 13–117 months). Four patients were observed for less than 2 years. Thirty-one patients had had a previous disease and/or fracture of the injured limb.

For 31 patients the trauma was considered to be severe, after traffic accidents (T) and falls from heights or on stairs (H), and for 31 moderate, mainly after falls on ground level (F) (Alffram & Bauer 1962). The interrelation of previous diseases, age over 50 and degree of trauma is shown in the Venn diagram in Figure 1.

Radiographic examination

The preoperative and postoperative radiographic examinations consisted of two perpendicular projections.

The follow-up radiographs were obtained as follows:

1. Standing antero-posterior (A-P) films of both knees stressed in valgus and varus (Figure 2) for detection of femero-tibial gonarthrosis (Ahlbäck 1971, Norman in Hagstedt 1974).
2. Axial radiographs of both patellar joints in the standing position and at a degree of flexion suitable (Figure 3) for revealing patellar gonarthrosis (Ahlbäck 1971).
3. Whole lower limb radiographs of both knees, with the patient standing on the examined limb only, using two X-ray tubes, with the central rays perpendicular to one other. The frontal plane was seen perpendicular to the tangent of the most posterior aspects of the femoral condyles which was obtained by fluoroscopy in the lateral view. The lateral radiograph thus obtained included the knee and the distal two-thirds of the femur (Edholm 1966, Maquet 1976).

Six of the 61 patients were unable to stand during the examination.

Radiographic definitions and measurements

Displacement of the fragments was considered as translation along or rotation about three axes, perpendicular to each other: the longitudinal axis of the femoral diaphysis, the sagittal and the transversal axis. The supracondylar and intercondylar displacement of the fractures was measured as follows.

Supra-condylar fractures (including the supracondylar part of the bicondylar fractures). *Ad latus* displacement was expressed as the ratio between the area of bone contact and the cross-sectional area. Thus no contact between proximal and distal fragment = 0 and complete contact = 1*.

Rotation about the *sagittal axis* of the fracture, or the valgus or varus deformity, was described by the lateral angle between the longitudinal axis of the proximal femur and a line joining the most distal points of the femoral condyles. This angle was compared with that of the unfractured femur which was used as a reference. Rotation about the *transverse axis* was estimated using the shape of the condyles and the intercondylar fossa (the line of Blumensaat), and a comparison was made with the unfractured femur.

The *total rotation* V about the transverse as well as the sagittal axis of the *fracture* was calculated according to Bogdanov (1950).

$\tan V = (\tan^2 a + \tan^2 b) \cdot 1/2$, where a and b represent the angulation in the frontal and sagittal planes.

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* $\frac{\text{Bone contact area}}{\text{Cross-sectional area}} = \frac{2}{\pi} (\text{arc cos}G - G\sqrt{1-G^2})$

$G = \frac{h}{2r}$; where r is the radius and h is the true distance between the longitudinal axes of the proximal and the distal fragments obtained by two perpendicular projections and their respective distances a and b, $h = \sqrt{a^2 + b^2}$.

Figure 2. Standing radiographs of both knees stressed in valgus. Stage II medio-lateral gonarthrosis on the right side. Large deformity of the supracondylar fracture. The HKA angle was 192°. (Case B 32)

Intercondylar fractures. The translation was expressed as the distance between the fragments assessed from frontal, lateral and axial projections.

Translation along the longitudinal axis included shortening of the supracondylar fracture, which was measured in steps of 0.5 cm, and displacement of one condyle in comparison with the other in the proximal direction, which was measured in millimetres (diastasis and difference in joint level).

Rotation about the sagittal axis of the *knee* (valgus or varus deformity) was related to the lateral angle between the lines joining the centre of the femoral head, the tibial eminence and the centre of the ankle joint – the Hip-Knee-Ankle angle (> 180° = varus, < 180° = valgus). It is described as the HKA angle in the following (Maquet 1976).

Gonarthrosis was assessed radiographically in the standing position, as defined, and graded I–V, depending on cartilage and bone destruction, according to Ahlbäck (1971).

Clinical examination

At follow-up the patients were assessed according to Ranawat et al. (1976) using the Knee Disability Sheet prepared at the Hospital for Special Surgery. Pain-free with normal function received a score of 100. Over 84 was excellent, 70–84 good, 60–69 fair and below 60 poor.

The clinical examination included range of motion in both knee joints (for comparison) and in both hip joints in order to assess concomitant hip disease influencing post-fracture function. Angular measurements were performed with a goniometer. Differences in the length of the lower limbs were measured, in the supine position, from the superior iliac spine to the medial malleolus.

Walking capacity was classified into three groups:

A. Walking without external support;
B. Walking with one or two sticks, or crutches;
C. Walking only with a walking frame or with assistance from others, or unable to walk.

RESULTS

The 62 fractures were grouped according to the primary displacement, their course, and relation to the femoral condyles and shaft (Tables 1–3).

There was no marked difference, on the primary films, in the reduction of the displacement after conservative or operative treatment with regard to the total angle for all groups. This was true both for the total angle and if displacements

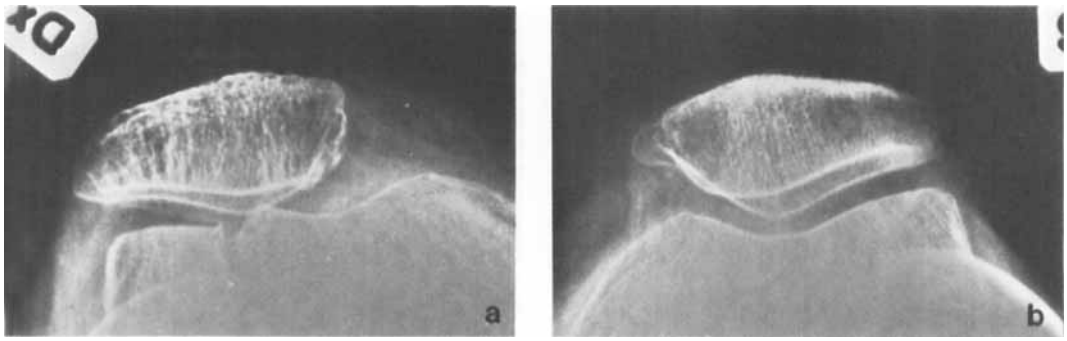
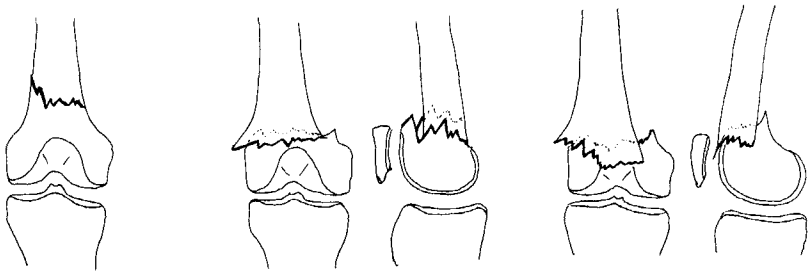


Figure 3. a. Axial projection of the patellar joint with an intra-articular fracture on the right side treated with a screw. There is still separation and difference in joint level in the lateral condyle after surgery. The patella has shifted laterally. b. Left side for comparison. (Case U 12)

Table 1. Supracondylar femoral fractures



a. No displacement

b. Supracondylar displacement

c. Supracondylar displacement +comminution

Fracture	Patient				Trauma				Follow-up						
Classification	No. (S.....)	Age	Sex	Prev. disease	Degree	Contact area	Total angle	Operation	Obs. time (years/months)	Walking ability	HSS points	Contact area	Total angle	Development of arthrosis FT	P
a. No displacement	1	81	M	Amp	F	1.0	4	–	5/7	B	100	1.0	4	–	–
	2	70	F	–	F	1.0	4	–	3/4	B	61	1.0	3	–	–
	3	43	F	Po	F	1.0	5	–	3/3	C	100	1.0	7	–	–
b. Supracondylar displacement	4	58	F	CVD	F	0.5	9	–	4/5	C	51	0.6	3	–	–
	5	56	M	HF	F	0.7	14	+	9/6	B	51	1.0	0	–	–
	6	57	F	GA	F	0.0	29	+	2/6	A	94	1.0	35	–	–
	7	57	M	–	H	1.0	32	+	6/0	A	98	1.0	2	–	–
c. Supracondylar displacement + comminution	8	65	F	MS	F	1.0	3	–	6/1	C	90	1.0	4	–	–
	9	62	F	RA	F	0.8	17	–	2/9	B	84	0.7	10	–	–
	10	52	M	TF	F	0.5	11	–	5/11	A	100	0.8	8	–	–
	11	64	F	Ep	T	0.6	20	–	4/6	C	100	0.6	26	–	ML2
	12	70	F	–	T	0.2	13	+	1/5	B	89	0.4	15	–	–

Abbreviations: Sex: M = male; F = female

Previous diseases: fractured leg

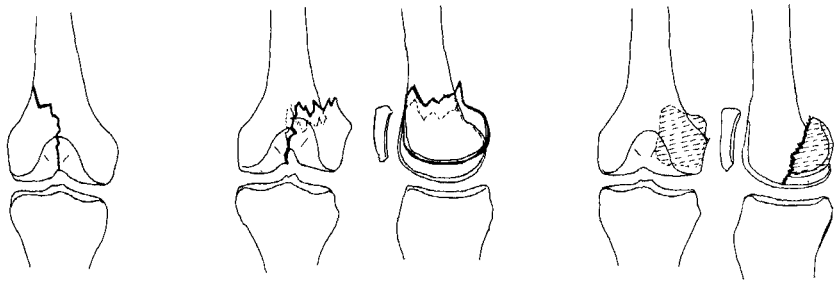
Amp: Amputated lower leg.
CA: Osteoarthritis (coxarthrosis)
GA: Osteoarthritis (gonarthrosis)
FF: Femoral fracture
HF: Hip fracture
KF: Knee (eminence) fracture
MF: Malleolar fracture
TF: Tibial condylar fracture

CD: Congenital deformity of the leg
Ep: Epilepsy
MS: Sclerosis disseminata
Par: Parkinson
PD: Perthes Disease
Po: Polio
RA: Rheumatoid arthritis
HSS: Hospital for Special Surgery

Trauma:
F: Low energy
H: High energy
T: High energy from traffic
Amp: Below knee amputation
CVD: Cerebrovascular disease

Arthrosis:
FT: Femoro-tibial joint
P: Patellar joint
M: Medial
L: Lateral
ML: Medial + Lateral

Table 2. Unicondylar femoral fractures



a. No displacement b. Unicondylar displacement c. Transcondylar displacement

Fracture	Patient				Trauma				Follow-up							
Classification	No. (U.....)	Age	Sex	Prev. disease	Degree	Condyle M/L	Total angle	Operation	Obs. time (years/months)	Walking ability	HSS points	Total angle	Diast. IC † mm	Diff. joint level	Development of arthrosis FT	Development of arthrosis P
a. No displacement	1	75	F	GA	F	M	0	–	3/9	C	80	0	0	0	–	–
	2	69	F	KF	F	M	2	–	2/11	B	89	0	0	0	–	–
	3	59	M	Po	F	M	0	–	6/1	B	95	0	0	0	–	–
	4	61	M	–	F	L	0	+	7/0	A	95	0	0	0	–	–
	5	64	F	–	F	ML*	0	–	1/6	C	95	0	0	0	–	–
b. Unicondylar displacement	6	70	F	–	F	L	5	–	7/7	B	90	7	3	2	–	–
	7	75	F	KF	F	L	0	+	9/10	B	100	0	10	0	–	–
	8	68	F	–	F	L	1	–	5/1	A	91	5	4	2	–	–
	9	75	F	–	F	L	3	+	4/1	A	91	5	3	4	–	MLI
	10	60	F	Ep	F	L	11	+	3/6	A	93	5	5	8	–	LI
	11	75	M	Ep	F	L	5	+	2/6	C	100	5	0	0	–	–
	12	71	F	–	T	L	3	+	8/7	A	100	5	10	4	–	–
	13	63	F	GA	T	L	14	–	7/6	A	98	15	11	11	–	–
c. Transcondylar displacement	14	61	M	GA	H	M	6	+	2/11	A	100	6	0	0	–	–
	15	25	M	–	H	L	2	+	6/3	A	84	2	0	0	–	–

† IC = Intercondylar
* Intercondylar with unidentifiable course
For other abbreviations see Table 1.

in the antero-posterior and lateral direction were considered separately. However, in most cases there had been an improvement in the contact area of the bone.

Evaluation of the healed *supracondylar femoral fractures* (Table 1) showed that only 1/9 of the displaced fractures had gonarthrosis and that three had 15° or more of total angular deformity.

Evaluation of the healed *unicondylar femoral fractures* (Table 2) showed that 2/10 of the displaced fractures had developed gonarthrosis in the patellar compartment and none of them in the femoro-tibial area. One had a total angular de-

Skin damage and secondary infection caused by high energy trauma are important factors involved in the poor results of tibial shaft fractures (Edwards 1965). High energy trauma was an important causative factor in the poor results observed in the comminuted intra-articular fractures of the distal tibia, but with this type of fracture the reason seemed to be articular damage rather than skin damage.

The conclusion drawn from this study was that the results of the majority of the comminuted intra-articular fractures were clinically not acceptable when initial displacement and comminution were severe and the accuracy of reduction was poor. The incidence of osteoarthritis was high in this group. The extra-articular comminuted fractures, on the other hand, seemed to have a different and better prognosis as determined by the final clinical results, including the occurrence of osteoarthritis.

The initial X-ray could not be used to predict the final result except for the intra-articular comminuted fractures. These fractures should, according to the present observations, obviously not be treated by primary operation. We cannot answer the question of whether comminuted intra-articular fractures should be treated by non-operative methods or by primary arthrodesis, but we feel that arthrodesis should be used only as a salvage procedure.

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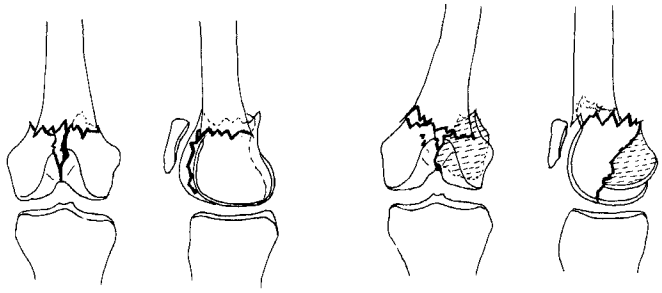
Table 3c, d. Bicondylar femoral fractures



c. Supracondylar and intercondylar displacement

d. Transcondylar displacement

Fracture	Patient				Trauma				Follow-up								
Classification	No. (B . . . .)	Age	Sex	Prev. disease	Degree	Contact area	Total angle	Operation	Obs. time (years/months)	Walking ability	HSS points	Contact area	Total angle	Diast. IC. mm	Diff. joint level	Development of arthrosis FT	P
c. Supracondylar and intercondylar displacement	18	65	F	CD	F	0.0	20	–	1/1	C	57	1.0	19	5	4	–	–
	19	70	F	GA	F	0.8	10	+	1/6	B	100	0.8	12	5	0	–	–
	20	23	M	–	H	0.6	26	+	4/0	A	100	1.0	3	5	0	–	–
	21	54	M	–	T	0.3	21	–	5/0	B	62	0.2	22	10	10	–	MI
	22	51	M	–	T	0.5	6	–	4/2	A	95	0.5	31	10	0	–	–
	23	57	F	–	T	1.0	15	–	6/11	B	91	1.0	15	6	3	–	LI
	24	57	F	–	T	0.0	24	–	6/11	B	91	1.0	15	5	4	–	–
	25	22	M	–	T	1.0	6	–	6/11	A	100	1.0	6	5	5	–	LI
	26	39	F	–	T	0.6	7	–	5/0	A	94	0.6	12	7	5	–	ML2
	27	58	F	HF	T	1.0	12	–	8/4	A	99	1.0	10	5	0	–	MLi
	28	75	F	–	T	1.0	18	–	3/11	B	36	1.0	35	8	5	–	–
	29	46	F	–	T	1.0	3	–	8/9	A	91	1.0	7	6	4	–	–
	30	50	M	PF	T	0.7	30	–	3/7	B	75	0.7	30	5	5	MLI	MLI
	31	24	F	–	T	0.0	12	+	5/2	A	93	0.2	1	7	5	–	L2
d. Supracondylar, intercondylar and transcondylar displacement	32	59	M	–	H	0.2	36	+	6/6	B	49	0.5	15	4	4	ML2	MLI
	33	45	M	Po	T	0.4	17	–	7/0	B	44	0.4	19	10	0	–	ML2
	34	40	M	–	T	0.5	5	–	2/2	A	22	0.9	22	5	0	–	MIL2
	35	26	M	–	T	0.3	8	+	5/2	A	88	1.0	1	0	0	–	–

For abbreviations see Table 1.

tients with gonarthrosis at the trauma, those with gonarthrosis in the other knee at follow-up and those observed less than 2 years, 3/51 developed femoro-tibial and 14/51 patellar arthrosis. All three patients with femoro-tibial and seven of those with patellar arthrosis complained of discomfort in the knee (10/14) and four did not (4/14).

The severity of the gonarthrosis in the *femoro-tibial joint* in the three patients with bicondylar fractures varied between stages I and II. Case B 30 had an anterior angulation of 30°. Case B 32 (Figure 2) had a varus deformity of 12° and an anterior angulation of 15° as well as a lateral transcondylar fracture (Figure 7). Cases B 30 and B 6 both had subchondral fractures but no varus

Figure 4. Distribution of varus/valgus angular deformities in the healed unicondylar *fractures.*

or valgus deformity. Despite severe angular deformities no other patients developed femorotibial arthrosis.

The gonarthrosis in the *patellar joint* varied between stages I and II (e.g. Figure 8). In case S 11 the patellar joint had been crushed by distal displacement of the femoral shaft (Figure 9).

Three of the 11 patients with patellar arthrosis only were given scores of 62, 44 and 22. These three also had the most distinct total angular deviations, intercondylar diastasis and joint level differences of all the patients with gonarthrosis. However, equally high values were found in patients who did not develop gonarthrosis during the observation period.

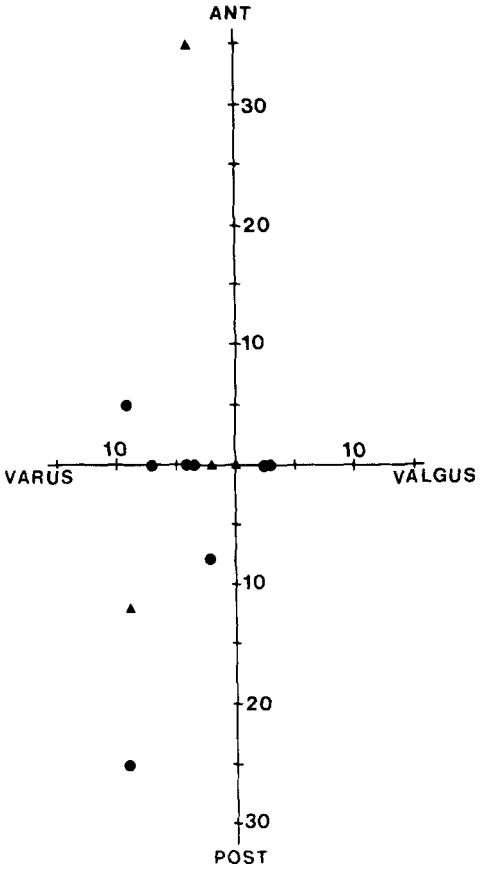


Figure 5. Distribution of varus/valgus and antero-posterior angular deformities in the healed supracondylar *fractures.*

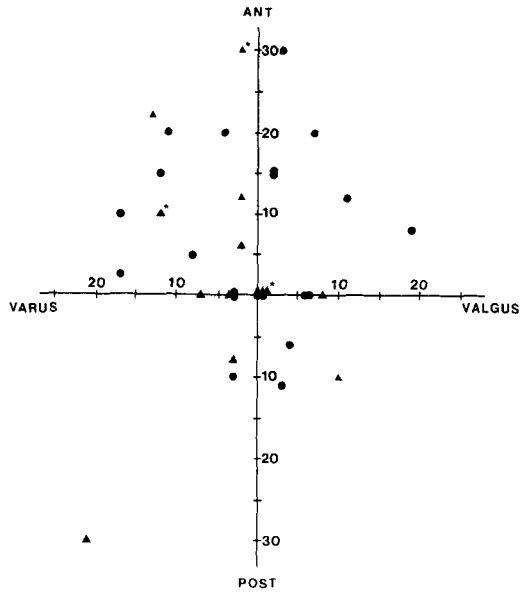


Figure 6. Distribution of varus/valgus and antero-posterior angular deformities in the healed bicondylar *fractures.*

The two transcondylar, unicondylar fractures were surgically stabilized in an exact position and gonarthrosis did not develop. Two patients in the bicondylar group without gonarthrosis had intercondylar diastasis and scores of below 60. The HSS score for the bicondylar groups averaged 81, 77, 85 and 51.

The relation between intercondylar diastasis as well as difference of level in the joint surface and gonarthrosis (Table 4) showed statistically significant values* for gonarthrosis when the values exceeded 3 mm in the intra-articular fractures. Contact area and total angulation in supracondylar and bicondylar fractures did not have a significant influence on gonarthrosis.

* Statistical analysis by Chi-square test with Yates' correction ($0.001 < P < 0.01$).

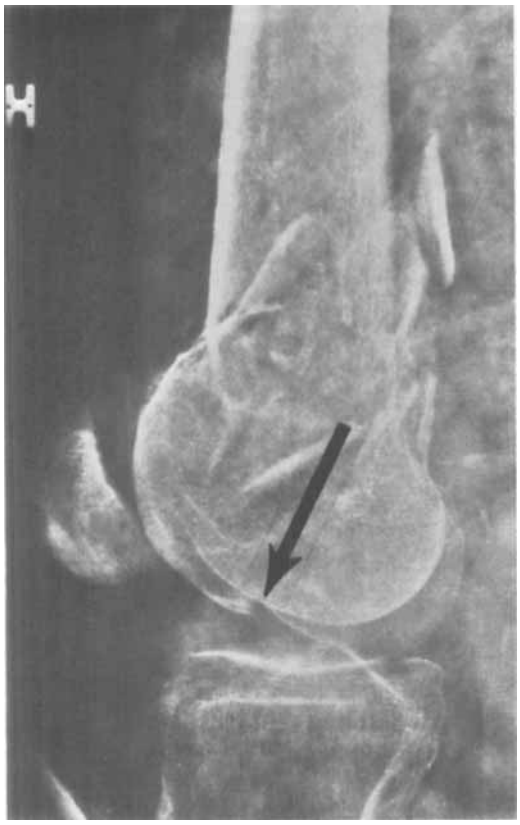


Figure 7. Bicondylar fracture combined with transcondylar (in plaster). The arrow indicates the difference in level caused by the transcondylar fracture. (Case B 32)

DISCUSSION

The best point of reference when assessing results of leg fracture treatment is the prefracture condition of the individual patient. As this is rarely known, a comparison with the other knee was made and previous fractures and concurrent diseases were taken into consideration. Thus a paretic or bedridden patient with contractures was not expected to gain full range of motion, but was expected to be pain-free after fracture and if so was given the maximum score.

Laros (1979) discussed and compared 10 recent reports of distal femoral fractures and found that there were a great variety of opinions regarding assessment of the results. Because of this, he stressed the prognostic importance of comminution, articular damage, ipsilateral fractures, soft tissue damage and osteoporosis. Our anatomical classification is based on displacement, comminution, and soft tissue and articular damage. Only one ipsilateral and four open fractures were seen. The osteoporosis, as estimated from the radiographic films taken at the time of the trauma, did not influence the results in this material in any way.

Schatzker & Lambert (1979) stated that the type of trauma had little bearing on the quality of the result. For patients who had been treated with rigid internal fixation, they found that failures occurred most frequently in those aged over 50 (9/19 compared to only 1/17 in those aged under 50). They concluded that the use of this technique for elderly, osteoporotic patients was "clearly beyond the surgeon's ability" and drew attention to the importance of accurate reduction in preventing rapid development of gonarthrosis. Chiron et al. in 1974 found that intra-articular fractures gave poorer results than simple or comminuted extra-articular fractures. This is confirmed in our material which showed signific-

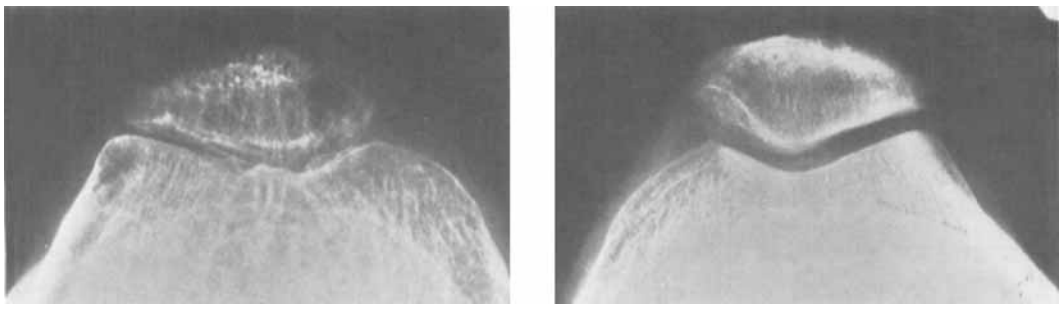


Figure 8. Left patellar joint with stage II gonarthrosis. Callus formation is seen in the fracture gap. (Case B 26)

Figure 9. Healed supracondylar fracture involving the patellar joint. (Case S 11)

antly more gonarthrosis when differences in joint level and diastasis between condyles exceeded 3 mm. These authors, however, did not consider the patellar joint. No reports included comparable radiographic measurements concerning angles, contact between fragments, difference in joint level and diastasis.

Varus/valgus deformity of distal femoral fractures can be described either as a displacement of fragments in comparison with the unfractured side, or as deformities of the knee, in relation to normal values of the femoro-tibial angle. The HKA angle is a valuable expression of the biomechanical forces on the knee joint in valgus or varus deformities (Maquet 1976, Johnsson et al. 1980); however, it has often failed to reveal deformities in the fracture, owing to anatomical variations of the femur, rotation, about its longitudinal axis and translation displacements. The angle between the distal condylar plane and the anatomical axis of the distal femur was preferred as a means of showing valgus/varus displacement of the fracture, in comparison with the unfractured side. In most cases, however, the HKA angle reflected the valgus/varus deformity of the fracture, but only after comparison with the "normal" side.

The direction of the deformities could be determined at the follow-up examination because of pecisely defined radiographic projections (Edholm 1966). In the less precise preoperative and postoperative radiograms without exact definition the total angular deviation had to be roughly estimated.

In previous reports of distal femoral fractures the patellar joint has been considered only in antero-posterior and lateral projections. The axial radiographs used in the present study contributed to the differentiation of intra-articular fractures from supracondylar fractures with unaffected joint surfaces. The distinction between displaced and undisplaced fractures, including those in the patellar joint, also improved the classification.

The time taken for the development of arthrosis is unknown and probably varies between those cases with angular deviation only in an extra-articular fracture and those with incongruence after an intra-articular fracture. In the 204 tibial condylar fractures re-examined by Rasmussen (1971) varus angulation of over 10° and instability showed a significant correlation with gonarthrosis. Those cases developing arthrosis usually experienced symptoms in the knee joint from the beginning and only occasionally had a

Table 4. Number of patients with gonarthrosis related to the number of patients with the various types of fractures and fracture displacements

Type of fracture	Diastasis, mm		Diff. joint level, mm	
	0–3	Above 3	0–3	Above 3
Unicondylar fractures	1/10	1/5	0/11	2/4
Bicondylar fractures	1/17	10/18	5/25	6/10

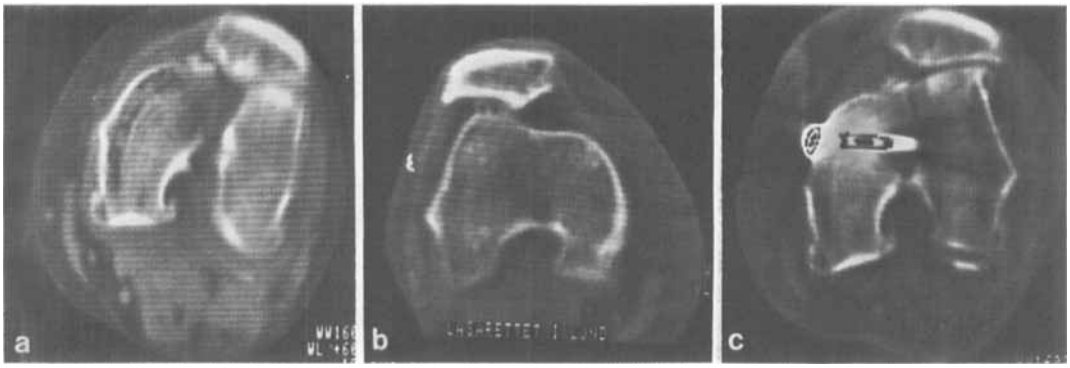


Figure 10. Computerized tomography (slice thickness 6 mm) of the femoral condyles and the patella about 2.5 cm above the knee joint space in an intra-articular, condylar fracture a. Fracture through the patellar joint and the intracondylar fossa with diastasis and difference in joint level b. Right side comparison c. After surgery with screw fixation. The displacement has decreased.

"free interval". The influence on arthrosis of angular deviation in distal femoral fractures was not confirmed in this material but the observation period (2–10 years) was probably too short to exclude the possibility of gonarthrosis occurring later. Tjörnstrand (1981) in his thesis on high tibial osteotomy for gonarthrosis found ten tibial condylar, four tibial shaft, one femoral shaft and one supracondylar femoral fracture in 212 consecutive patients. For the *tibial shaft fractures,* 15–44 years had passed since corrective osteotomy for secondary arthrosis and for the femoral shaft and supracondylar fractures respectively, 20 and 15 years had passed. In contrast, eight *tibial condylar fractures* had been osteotomized 0–3 years after fracture.

The patients with displaced bicondylar fractures (Table 3c, d) and gonarthrosis had been observed for as long as those in the same group without gonarthrosis, if the patients who had been observed for less than 2 years were excluded; their age and walking ability were comparable. The patients with gonarthrosis were all less than 60 years of age and had violent trauma. Those with transcondylar fractures showed the poorest results in the final assessment of function according to the HSS Knee Disability Sheet (Ranawat et al. 1976). This is constructed as a means of assessing disability in the knee before and after operation for rheumatoid arthritis and osteoarthritis and emphasizes range of motion, which is important after fracture, but the value seemed to be limited. This was probably due to both the small number of fractures in most of our groups and the different types of patients with frequent concurrent diseases and previous fractures.

The findings in this material underline the importance of careful radiographic examination of the patellar compartment. This is obtained by axial projection (or computerized tomography, Figure 10) of the knee joint which improves the classification and contributes to the treatment and final outcome.

CONCLUSIONS

1. An anatomical classification into supracondylar, unicondylar and bicondylar fractures is proposed with subdivisions based on supracondylar, intercondylar and transcondylar displacement.
2. The most common deformity after bicondylar fracture was varus and anterior angulation. Unicondylar medial fracture caused varus, and lateral, valgus deformity.
3. The patellar joint should be examined radiographically with axial projections in the emergency clinic. Additional information of this type is also obtained by computerized tomography.

4. Early gonarthrosis mostly developed after bicondylar fractures with displacement in both the supracondylar and intercondylar areas, especially if there was transcondylar involvement and a diastasis of planar difference in the articular surfaces exceeding 3 mm. There seemed to be less connection between angular deformity and gonarthrosis.
5. Gonarthrosis was mostly confined to the femoro-patellar articulation. Arthrosis of the tibio-femoral articulation was only rarely seen.

ACKNOWLEDGEMENT

The statistical analysis was performed by Karl Göran Thorngren, M.D., Department of Orthopaedic Surgery, University Hospital, Lund.

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