

From the Surgical Department M (Head: Professor E. Hart Hansen, M.D.),
Bispebjerg Hospital, Copenhagen, Denmark.

THE LATE PROGNOSIS AFTER FRACTURE OF THE PATELLA

By

K. HARRY SØRENSEN

Until about 15 years ago the surgical treatment of patellar fractures was usually cerclage, using a steel wire or a soft suture material, or merely suture of the extensor apparatus following reduction, in some cases suture of the fragment through drill holes along the fracture. Satisfactory results from these methods are still being reported (*Bitossi* 1950, *Sabaino & Conti* 1953, *Paschold* 1958, and *Mocci & Basile* 1959), but in a number of cases the results have been unsatisfactory, especially after cerclage (*Moberg* 1944, *Marion* 1953).

Excision of one or more minor fragments combined with suture of the extensor apparatus to the largest fragment has gained some ground in suited cases (*Thomson* 1935, *McMurray* 1954, *Smillie* 1954, and *O'Donoghue* 1958), but the results have not always been good (*Duthie & Hutchinson* 1958).

After *Brooke*, in 1937, introduced patellectomy and could report satisfactory results (1946), a number of authors have recommended this procedure, particularly in comminuted fractures (*Langvad-Nielsen* 1954, *MacAusland* 1954, *McMurray* 1954, *Smillie* 1954, *von Rosen* 1954, *Trevor* 1957, *Fisk* 1962), or on more extended indications (*Dodd* 1939, *Fehr* 1951, *Goutz & Javelle* 1956), and even extremely wide indications (*O'Donoghue* 1958). Formerly, it was believed that quadriceps strength increased during the latter part of knee extension, because the patella removed the extensor tendon from the anterior aspect of the knee and therefore gave better lever action. The adherents of patellectomy consider the role of the patella in this function to be exaggerated. Moreover, deformation of the patellar joint surface following fracture is thought to increase the risk of subsequent osteoarthritis in the femoro-patellar and possibly later in the femoro-tibial articulation.

The disadvantage of patellectomy is the common occurrence of calcifications in the quadriceps tendon at the previous site of the patella (*MacAusland* 1954). The larger these calcifications, the poorer the result (*Duthie & Hutchinson* 1958). Moreover, the quadriceps does not regain its normal strength after patellectomy (*O'Donoghue et al.* 1952).

All reported series of patellar fractures include patients on whom the follow-up is far too short, viz. 6 months to 5 years. In consequence, the results are distorted by posttraumatic complaints, and the development of osteoarthritis and its clinical significance have never been properly elucidated. Before the surgical methods and their indications are changed, a series with a sufficiently long-follow-up period must be submitted. Cases treated without operation will serve as a good "control series".

PRESENT INVESTIGATIONS

During the period Jan. 1, 1930, to June 5, 1951, a total of 114 cases of patellar fracture were treated in the 3 surgical departments of Bispebjerg Hospital, Copenhagen. At follow-up in 1961, 46 of the patients had died, 3 could not be traced (living abroad), and 1 had undergone amputation.

TABLE 1
Age distribution and sex ratio of 64 patients with fracture of the patella.

Age at accident	Males	Females
11-29 years	26	3
30-44 years	16	4
45-66 years	9	6
Total	51	13
Average age	31 yrs.	42 yrs.
Age at follow-up	50 yrs.	61 yrs.
Follow-up period (10-30 years)	18.5	19.3

Accordingly, 64 patients were examined after a follow-up period ranging from 10 to 30 years. Their age distribution and sex ratio are given in Table 1. The fracture is most common in the younger age groups, and four-fifths of the victims were males. Six were under 14 years of age and two over 60 at the time of the accident. On an average,

the males were 11 years younger than the females. At follow-up the average age was 50 and 61 years respectively (30-87).

TABLE 2
Types of fracture—degree of displacement—place of accident.

Type of fracture	Displacement			Total No. of pts.	Right
	severe	slight	none		
Transverse	9	4	15	28	
Comminuted	12	3	1	16	
Marginal	—	4	5	9	
Polar	1	1	9	11	
Total	22	12	30	64	30
Operated	19	2	1	22	
Accident: Place of work				15	
Sport				10	
At home (2), brisement (1)				3	
Traffic (females: 10)				36	14
Fracture complicated (traffic: 16)				21	

Table 2 gives the *type of fracture* and the *degree of displacement*. The distribution corresponds approximately to that in other series. More than half the patients sustained the accident in the *traffic*, an almost equal number being pedestrians (11), cyclists (11), and motorists (14). There was no difference in the side involved, but if excoriations are included left-sided fractures were twice as often complicated as the right-sided. This is due to the traffic injuries, in which 12 out of 22 left-sided and 4 out of 14 right-sided were complicated.

Twenty-two patients underwent operation, 11 by metal cerclage, 9 by suture of the extensor apparatus, and 2 by excision of minor fragments. 12 of the operated and 20 of the conservatively treated patients carried a plaster cast for an average of 6½ weeks (2-11). Thirteen had evacuation of effusion by puncture. *Complications* occurred in 10 cases (including 4 operated) and consisted in pulmonary infarction in 2, patellar osteitis in 1, arthritis in 1, broken cerclage in 1 (re-operation on the 10th day), and re-fracture in 5. All the re-fractures occurred after a repeated trauma, in 2 patients having severe pareses 7 and 2 years after the first fracture, in one case by brisement 6 weeks after cerclage, and in 3 non-operated patients with marked displacement

(severe comminuted complicated fracture: 1, severe fractures of the same leg: 2, including fracture by brisement in 1).

At follow-up 41 patients had been totally symptom free since the end of the primary complaints, viz. 65 per cent of the males and 62 per cent of the females. The follow-up period and the age at follow-up was in both sexes the same for the symptom free and the non-symptom free group. Freedom from symptoms was obtained with approximately the same frequency in the various types of fracture. In particular, there was no significant difference between comminuted and other fractures. Nor did the degree of displacement definitely influence the frequency of freedom from symptoms (Table 3). There was no significant difference between the frequency of freedom from symptoms for the operated (55 per cent) and non-operated (69 per cent) patients. No relation was found between the age at fracture and the frequency of freedom from symptoms. The most marked difference was found between the groups under and over 30 years of age, 72 per cent and 57 per cent respectively being symptom free, but this difference is not significant.

TABLE 3
Patients without symptoms.

Type of fracture	Displacement			Total No. of pts.	Per cent of total series
	severe	slight	none		
Transverse	6	2	12	20	71
Comminuted	6	2	—	8	50
Marginal	—	1	5	6	(67)
Polar	—	1	6	7	(64)
Total symptom-free	12	6	23	41	64
in per cent	55	50	73	64	
<i>Operated</i> and symptom-free	10	1	1	12	55
Sutured: 6 out of 9. Cerclage: 5 out of 11. Partial excision: 1 out of 2.					

23 patients had suffered from *subjective complaints* from the knee, invariably mild, for brief periods in recent years:

Stiffness in getting started	10 patients
Unrest or pain upon changes in the wheather	8 "
Pain after working or walking	10 "
Pain on walking stairs	8 "
Periodically pain at rest	2 "
Periodical swelling	2 "
Periodical limping	3 "

A total of 19 had experienced pain suggesting osteoarthritis, and one had periodically suffered from symptoms caused by slight lateral instability following injury to the ligaments. Nine patients had had osteoarthritic symptoms of exactly the same kind and degree from the contralateral knee.

According to whether the patients' work had been predominantly *sedentary*, *standing*, or *walking*, during the follow-up period, 9 out of 26, 4 out of 8, and 10 out of 30 had experienced subjective complaints. If the work is classified with a particular view to its strain on the knees, 20 out of 48 with *light* and 3 out of 16 with *heavy work* had had subjective complaints. In other words, there is no connection between occupation and subjective complaints.

Secondary incapacity due to patellar fracture after the end of the primary complaints was reported by only 3 patients, of a total duration of 1 and 6 weeks and in one case for a week or two a year in association with another disease. In 6 cases the sequelae of the fracture had influenced the occupation: Two years after the fracture a navy changed to other heavy work, another navy still has complaints and special work, 3 independent tradesmen spare themselves from the heaviest work, and one woman had lighter work for a year before returning to her former employment. Furthermore, 4 stated that they had been unable to work kneeling, but this was of no practical importance. The earning capacity had not been reduced in any case.

Apart from the re-fractures, only 5 patients had applied for treatment owing to possible late sequelae of the fractures. Three had received physical therapy and X-ray therapy, one only physical therapy, and 1 had been treated by bed rest for a week.

Physical examination revealed the following abnormalities which could not be explained on the basis of other diseases:

Flexion defect in the knee ...	4 pts.	(180/35-40-70-110°)
Extension defect in the knee	1 pt.	(less than 5°).
Wasting of thigh	17 pts.	(1-4, average 2 cm.).
Wasting of calf	10 pts.	(1-2½, average 1½ cm.) (including 9 who also had wasting of the thigh).
Tenderness of lateral margins		
of patella	13 pts.	(6 + tenderness on direct pressure)
Fixation of patella.....	9 pts.	(6 treated by metal cerclage)
Reduced quadriceps strength	9 pts.	(7 with wasting of thigh)
Pain on strength test	5 pts.	
Thickening of joint capsule	5 pts.	(3 bilaterally)

		Contralateral knee		
		chafing	slight grating	severe grating
No chafing or grating	21 pts.	0	0	0
Chafing below patella	11 pts.	4	0	0
Slight grating	21 pts.	3	5	0
Severe grating	11 pts.	0	3	4

Thus, the objective changes were moderate. Chafing and grating had a tendency to be bilateral. In 6 cases the objective findings were distorted by other diseases and left out of the analysis (sequelae to multiple fractures: 2, severe paresis and wasting: 2, sequelae to gunshot injury: 1, patellar dislocation and meniscectomy 1 year previously: 1).

X-rays in 2 views and tangential views of the patella of both knees were obtained in all cases at follow-up.

TABLE 4

Osteoarthritic changes in the knees and their relation to symptoms. Bilateral changes are included in the unilateral group (P: patella, F: femur, T: tibia).

Changes	Fractured side		Opposite side		Bilateral pts.
	pts.	+ symptoms	pts.	+symptoms	
<i>Femoro-patellar</i>					
Narrowed joint space	40	18	15	6	15
Osteophytes (P)	24	9	12	3	10
Sclerosis (P)	20	11	3	2	2
<i>F-P: total</i>	45	21 = 47%	20	6 = 30%	
<i>Femoro-tibial</i>					
Narrowed joint space (F-T, usually medi- ally only)	17	8	8	2	7
Osteophytes (F or T)	11	5	6	4	2
Sclerosis (subchond.)	8	3	3	2	2
Pointed intercondy- loid eminence	8	3	8	3	6
<i>F-T: total</i>	23	10 = 43%	16	5 = 31%	

In 8 there was *non-union* of the fracture, and this corresponds to the usual frequency (*Järvinen* 1942, *Paschold* 1958). Four were symptom free, and the remaining 4 did not require treatment.

Table 4 gives the radiographic frequency of *osteoarthritic changes* in both knees in the total series of 64 patients and relates the individual

changes to subjective symptoms. Mild changes are also recorded. The individual changes were more common on the fractured side except for a pointed intercondyloid eminence.

A total of 45 had osteoarthritic changes in the femoro-patellar articulation on the fractured side. This is significantly more common than on the contralateral side which showed such changes in 20 cases. On the other hand, only 23 had femoro-tibial changes on the fractured side as compared with 16 on the opposite side, *i.e.* no significant difference. Thus, at long sight, patellar fracture entails the development of femoro-patellar, but not definitely of femoro-tibial osteoarthritis.

The frequency of symptoms attending the listed individual changes was approximately the same on both sides, but for the total number of femoro-patellar changes symptoms were somewhat more common on the fractured side.

In Table 5 the osteoarthritic changes are graded and related to age at follow-up. An age factor is distinctly evident, the degree of the osteoarthritis on both sides increasing significantly with advancing age. There is a significant age difference when comparing the groups with no changes with the groups having femoro-patellar osteoarthritis as well as with the groups with osteoarthritis of both the femoro-patellar and femoro-tibial articulations. The average age for the fractured side is in all groups only negligibly below the average age for the opposite side. Only a few X-ray films from the time of the fracture had been preserved, so it is impossible to ascertain how many had osteoarthritic changes then.

TABLE 5

Osteoarthritic changes in relation to patient's age at follow-up. (Bilateral changes included in unilateral groups. Age: average age in years).

Changes	Fractured side			Opposite side			Bilateral pts.
	pts.	+ sympt.	age	pts.	+ sympt.	age	
No changes	19	2	43	38	3	45	19
F-P only	22	11	52	10	1	56	8
F-T only				6	—	63	
F-P and F-T ...	23	10	59	10	5	66	9
Total	45	21	56	26	6	62	17

Osteoarthritic changes were least common and mildest following polar fractures not involving the joint surface (Table 6), while they

were most common and most severe after comminuted fracture. Even in the latter cases the subjective discomfort was slight. The only difference between conservatively and surgically treated cases was that 18 of the former had no osteoarthritis. The average age of these 18 patients and one operated is 43 years (Table 5).

TABLE 6
Osteoarthritic changes and their relation to type of fracture, treatment, break in contour of joint surface and to enlargement of patella.

	Pts.	Osteoarthritic changes		
		None	F-P	F-P and FT
<i>Type of fracture</i>				
Transverse	28	9	11	8
Comminuted	16	1	6	9
Marginal	9	3	1	5
Polar	11	6	4	1
<i>Treatment</i>				
Conservative	42	18	11	13
Operation	22	1	11	10
Cerclage	11	1	6	4
Suture	9	—	4	5
Part. excis.	2	—	1	1
<i>Break in contour of joint surface</i>				
1-2 mm.	16	3	5	8
3-9 mm.	13	—	5	8
<i>Enlarged patella</i>	39	4	16	19

A radiographic break in the contour of the joint surface on a level with the fracture was found at follow-up in 29 patients. Out of these patients 16 or 55 per cent were symptom free, 9 having a 1-2 mm. break in the contour, while 7 had 3-9 mm. Out of 35 patients without such a break in the contour of the joint surface 25 or 71 per cent were symptom free. There is no significant difference between this frequency and the frequency of freedom from symptoms in patients with a break in the contour (55 per cent). Wasting of the thigh was found in 12 of 29 patients with a break in the contour as compared with 5 of 35 without, or 41 per cent and 14 per cent respectively, *i.e.* a significant difference. The break in the contour probably contributes to eliciting the symptoms, but not decisively, and its significance is presumably less

than generally assumed. As may be seen from Table 6, the size of the break in the contour does not influence the severity of the osteoarthritis.

Clinically the fractured *patella was enlarged* in 31, radiologically in 39, its height, width or both being at least 5 mm. greater than on the contralateral side. In 32 cases the height was increased by 12 mm. and in 26 the width—also by an average of 12 mm. (5–27). The maximum increase was 27×26 mm. (Fig. 1). A radiologically enlarged patella was found in 15 out of 16 comminuted and in about half the other types of fracture. When the patella is enlarged, osteoarthritis is nearly always present (Table 6), viz. in 90 per cent, and half the patients have femoro-patellar as well as femoro-tibial osteoarthritis. 19 of the 39, or 49 per cent, had subjective complaints as compared with 4 of 25, or 16 per cent, without enlargement of the patella.

Peripatellar calcifications, large in most cases, were found in 15, 6 of whom had subjective complaints. Ten of these patients had been treated by cerclage.

Comparison of the severity and frequency of osteoarthritis with that reported in other series is impossible, both because of the difference in the length of the follow-up period and because previous authors have given only the total frequency of osteoarthritis in per cent, without specifying its nature or severity. *Madlener & Paas* (1930) reported the same frequency for conservatively and surgically treated patients, viz. 55 per cent with bilateral changes in 22 per cent and 32 per cent respectively. *Paschold* (1958) also found no difference between conservatively and surgically treated patients, viz. 31 per cent and 27 per cent, whereas *Järvinen* (1942) observed osteoarthritis in 28 per cent and 55 per cent respectively, *i.e.* the frequency was twice as high after operation. *Langvad-Nielsen* (1951) reported a total frequency of 14 per cent. In other words, the frequency has been extremely varied. The methods of treatment in these series correspond approximately to those in mine.

At follow-up I advised two patients to have a minor, non-united fragment removed because of localized osteoarthritis and complaints from the knee. In one of these cases the fragment plus a small remnant of the cerclage were removed. It was only in this case plus yet another case that the cerclage was removed after the fracture had united. At follow-up the metal wire was found to have broken in 5, 2 of whom had mild complaints.

Even at follow-up I did not find any indication for patellectomy. The 23 patients who had complaints had only had mild, periodical and short-lasting symptoms of non-disabling nature. The function of the

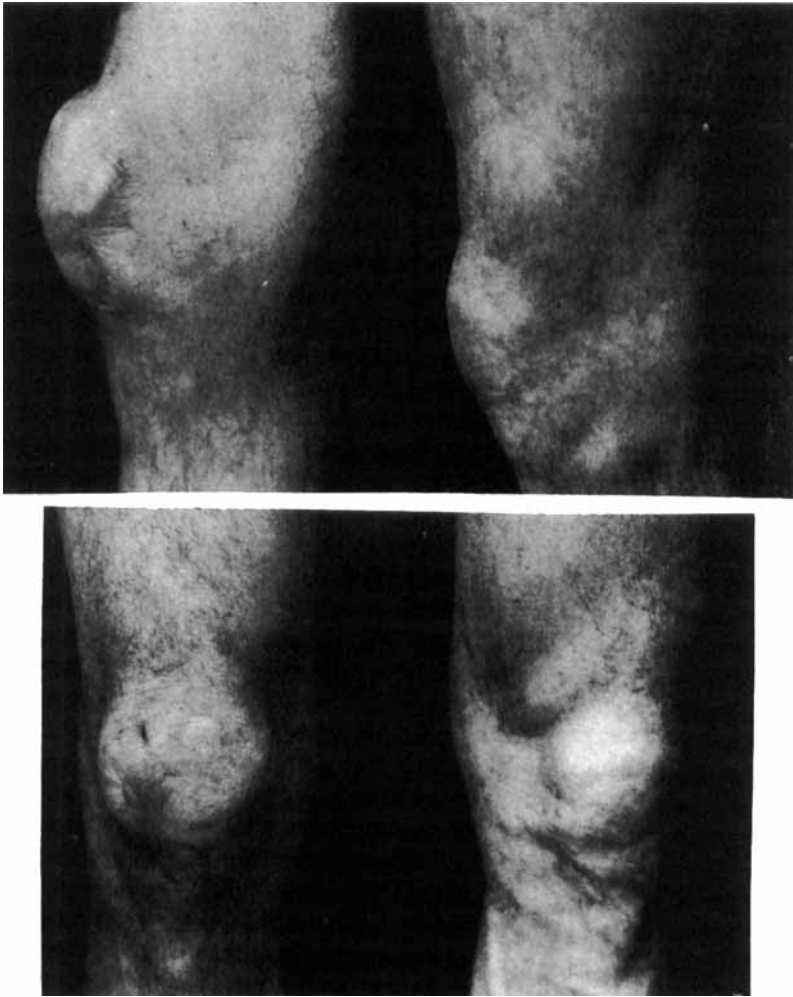


Fig. 1.

Greatly enlarged patella in a 33-year-old man who had sustained a patellar fracture, complicated by osteitis, at the age of 12. The patient has had to ride a bicycle, 20 km. daily, for many years and has been an active football player. No subjective complaints except some difficulty in kneeling.

knee was sufficient, practically no one had needed treatment, and the X-ray changes alone of course did not indicate the procedure, not even in the most severe cases, neither on the basis of subjective complaints nor of objective and radiological findings, cf. Fig. 2:

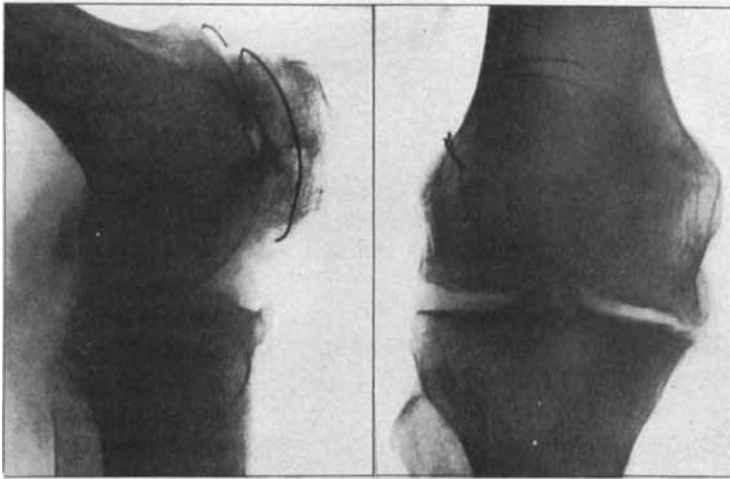


Fig. 2.

A 64-year-old woman with severe osteoarthritis (cf. text). A 2 mm. break in the contour at the site of the fracture, a greatly narrowed femoro-patellar joint space, 2-3 mm. marginal osteophytes on the patella and femur, and sclerosis of the patella. The femoro-tibial joint space is narrowed medially where there are osteophytes and subchondral sclerosis. Slight pointing of the eminence. Metal wire broken. The fracture is united.

This patient was a woman who was operated on for a transverse fracture with an 8 cm. wide diastasis at the age of 37, 7 months after conservative treatment elsewhere. The fragments were highly fibrous and adherent to the underlying bone, the cartilage on the femur showed severe erosions, and the knee was stiff. Following mobilization cerclage was performed. The fracture united. At follow-up 27 years later the patient had been working full-time as a clerk, she rode a bicycle every day and danced a lot. She had suffered from stiffness in getting started for 2 years and pain for 3 months two years before the follow-up examination. The pain yielded to X-ray therapy. The knee moved 180/110° during marked grating, and there was a 2 cm. wasting of the thigh. X-ray films showed the most severe osteoarthritic changes in the entire series (Fig. 2). On comparison with X-ray films taken 7 years previously, there had been a marked progression of the osteoarthritic changes which were thus partially age-conditioned. There was no indication and no desire for treatment.

CONCLUSION

There was no significant difference between the long-term results following conservative and surgical treatment of the patellar fractures. Thus, operation according to the classical methods leaves the most severe cases just as fit as those which require no operation. The frequency of osteoarthritis is approximately the same in displaced and non-displaced cases, and there is no difference in the severity of the changes. The size of a break in contour, if any, does not influence the severity of osteoarthritis, but is of some slight importance to the development of symptoms and signs. Radiography often shows enlargement of the patella after a fracture. In such cases osteoarthritis is common, and frequently the patients suffer moderate complaints. This group of cases always includes comminuted fractures, but the changes and complaints are not severe enough to indicate patellectomy.

Although metal cerclage does not yield strikingly poor results, this form of treatment is considered unnecessary, as the complaints involved by it may be avoided by another type of surgery.

Subjective complaints are fairly seldom present 10–30 years after the fracture, and like the objective changes they are of no major clinical and no occupational significance. Treatment was only exceptionally needed, and if so only in the form of minor procedures.

Only femoro-patellar osteoarthritis is significantly more common on the fractured than on the contralateral side, while no such difference was found in the femoro-tibial articulation. The severity of the osteoarthritis increased significantly and uniformly with age, on the fractured as well as on the contralateral side.

In estimating the prognosis of a fracture involving a joint surface, especially in compensation cases, a reservation is usually made regarding the risk of developing osteoarthritis. In the case of patellar fractures, the practical significance of such osteoarthritis was found to be slight. Generally, there is a certain tendency to overestimate the clinical significance of the X-ray findings, but in the great majority of cases they bear no relation to the clinical condition.

SUMMARY

After a follow-up period of 10–30 years 64 patients with patellar fracture were seen. Twenty-two had been treated surgically (by cerclage or by suture of the extensor apparatus). 41 or 64 per cent had remained completely symptom free throughout the follow-up period, and 23 had

lately suffered from mild, periodical, and non-disabling, osteoarthritic complaints which did not require treatment. Nine had had similar complaints from the contralateral knee. The objective changes left by the fracture were fairly slight and of no major practical significance. There was no significant difference between the results of conservative and surgical treatment. Femoro-patellar osteoarthritis was significantly more common on the fractured side (45 as compared with 20), and femoro-tibial osteoarthritis was found in 23 on the fractured side as compared with 16 on the opposite side, *i.e.* with no significant difference. The severity of the osteoarthritis increased significantly and uniformly with age on both sides. Breaks in the contour of the joint surface were of no importance to the development of osteoarthritis and of little clinical importance. The patella was enlarged in 61 per cent. This enlargement very often co-existed with femoro-patellar osteoarthritis, and half the patients of this group had symptoms. All the comminuted fractures belonged to this group. But even in this category there was no evident indication for primary patellectomy compared with the old methods.

RESUME

Après une période d'observation entre 10 et 30 ans, on a réexaminé 64 malades ayant eu des fractures de la rotule, parmi lesquels 22 avaient été opérés (cerclage, suture et appareil d'extension). 41, soit 64 pour cent, n'avaient eu aucun symptôme pendant la période d'observation. 23 avaient dans les dernières années éprouvé périodiquement de légers symptômes du caractère de l'arthrose qui ne les avaient cependant pas empêchés de travailler et qui exceptionnellement avaient exigé un traitement. 9 malades avaient éprouvé des malaises similaires dans l'autre genou. Les modifications objectives consécutives à la fracture étaient assez peu importantes et sans grande importance pratique. Il n'y avait aucune différence sensible dans les résultats entre les cas soumis à un traitement conservateur et ceux traités chirurgicalement. Une arthrose fémoro-patellaire a été observée plus fréquemment du côté de la fracture (45 contre 20), alors qu'une arthrose fémoro-tibiale a été constatée chez 23 malades du côté de la fracture contre 16 du côté opposé, c'est-à-dire sans différence significative de fréquence. Le degré de l'arthrose s'est accru uniformément avec l'âge des deux côtés. Les saillies du contour de la surface articulaire n'ont présenté aucune importance pour l'évolution de l'arthrose et une faible importance clinique. La rotule était agrandie chez 61 pour cent. Simultanément, on

constata fréquemment une arthrose fémoro-patellaire et environ la moitié des sujets présentaient des symptômes. Toutes les fractures à fragments multiples se trouvaient dans ce groupe. Mais même là l'indication d'une patellectomie primaire ne faisait pas évidence par comparaison avec les vieilles méthodes.

ZUSAMMENFASSUNG

Mit einer Beobachtungszeit von 10–30 Jahren wurden 64 Patienten mit Patellarfraktur, von denen 22 operativ behandelt worden waren (Cercelage, Suture des Streckapparates), nachuntersucht. 41 oder 64 Prozent waren vollständig symptomfrei unter der ganzen Beobachtungszeit, und 23 hatten in den späteren Jahren leichte, nicht arbeitsbehindernde und nur ausnahmsweise behandlungserfordernde Symptome von Arthrosecharakter gehabt. 9 von diesen hatten ähnliche Beschwerden in dem anderen Knie. Die objektiven Veränderungen als Folge des Bruches waren recht gering und ohne grössere praktische Bedeutung. Kein ausschlaggebender Unterschied der Ergebnisse bei den konservativ oder operativ Behandelten war vorhanden. Femoropatellar Arthrose kam in bezeichnender Weise häufiger auf der Bruchseite vor (45 gegen 20), und femoro-tibial Arthrose kam bei 23 auf der Bruchseite gegen 16 auf der entgegengesetzten Seite vor, d.h. ohne bezeichnenden Unterschied der Häufigkeit. Der Grad der Arthrose nahm bezeichnenderweise mit dem Alter auf beiden Seiten zu. Konturunregelmässigkeiten der Gelenksflächen waren ohne Bedeutung für die Entwicklung der Arthrose und auch von geringer klinischer Bedeutung. Die Patella war in 61 Prozent vergrössert und gleichzeitig fand man sehr oft femoro-patellar Arthrose, ebenso wie die Hälfte Symptome hatte. Alle Berstungsbrüche waren in dieser Gruppe. Aber selbst hier war die Anzeige einer primären Patellectomie nicht gegeben im Vergleich mit den älteren Methoden.

Statistical calculation by E. Dessau, actuary (significance level 97.5 per cent throughout).

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