

ACTA ORTHOPAEDICA SCANDINAVICA
SUPPLEMENTUM NO. 133

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LATE RESULTS
AFTER MENISCECTOMY
IN THE KNEE JOINT

A CLINICAL AND ROENTGENOLOGIC FOLLOW-UP
INVESTIGATION

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MUNKSGAARD
Copenhagen 1970

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I SBN 8716 00173 7

To Irma

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Acknowledgements

My sincere thanks are due to all those who have helped me with this investigation.

To my present chief, Professor John Sevastikoglou, M. D., Head of the Department of Orthopaedic Surgery, University Hospital, Umeå. Without his constant help in various ways this investigation would not have been possible.

To my former chief, Professor Ragnar Magnusson, M. D., Head of the Department of Orthopaedic Surgery, Regional Hospital, Linköping, who originally suggested this investigation.

To Docent Rudolf Lemperg, M. D., for his helpful criticism and advice.

To Docent Seved Ribbing, M. D., Head of the Department of Diagnostic Radiology II, Regional Hospital, Linköping for his help with the roentgenologic investigation.

To Dr. Anders Movin and Dr. Paul Junghagen for help with the examination of the radiographies.

To Sten Holmqvist, C. E. and Hans Vallberg, F. K., UMDAC, for help with the computation of the material.

To Lennart Gustavsson, F. K. and Erik Arvidsson, F. K. for help with the statistics.

This investigation was supported by grants from the University of Umeå and Östergötlands Landsting, Linköping.

Introduction

Articular injuries, including operative procedures, are generally regarded as influencing the occurrence of degenerative arthritis of the affected joint. The connection between intra-articular procedures and secondary degenerative arthritis can hardly be denied, but this experience is almost exclusively based on clinical empiricism and not on concrete facts.

Ruptures of the semilunar cartilage of the knee are the most common intra-articular injuries and consequently, their removal is the most usual intra-articular procedure. The relation between removal of the semilunar cartilage of the knee and the development of degenerative arthritic changes in the joint is a controversial subject. This applies to both the frequency of occurrence of degenerative arthritis following the operative procedure and the effect of different factors, — such as trauma, duration of the preoperative history, age at the time of operation, — on the development of degenerative arthritis.

A number of follow-up examinations of, and reports on, patients who had been subjected to meniscectomy, showed clear-cut results with regard to the occurrence of degenerative arthritis after removal of the semilunar cartilage of the knee. However, the frequency rates stated by various authors and the importance they attach to the different factors in the development of degenerative arthritis vary very widely. As a rule the results reported are based on the authors' own material, where, to a certain extent, subjective evaluation cannot be entirely excluded; the results are also often based on small series and on the analysis of only one or of a few factors which are regarded as playing a role in the development of secondary changes in the joint. Furthermore, only a few authors confirm their results on the basis of statistical analysis.

Authors who recommend partial resection of an injured semilunar cartilage, consider that its total extirpation changes the statics and dyna-

mics of the operated knee to such a high degree that the late results are less satisfactory than after partial resection (Dengler 1938, Weisbach 1942, Hübner 1943, L. Böhler 1955, Krömer 1955, Strelt 1955, Jonasch 1964). The advocates of total meniscectomy consider on the other hand that the "regenerate" after partial resection is qualitatively and functionally worse than after total extirpation. There is, therefore, a greater risk of a new rupture and of degenerative arthritis after partial resection than after total meniscectomy (Bürkle de la Camp 1936, Andreesen 1937, Magnus 1938, Mandl 1940, Schaefer 1953, Frosch 1956, Smillie 1962, Schilling 1963 and 1965, Strelec & Wozelka 1964, Zippel 1964, Herschmann 1965, Jelinek 1965, Springorum 1966).

There are also authors who state that one has to decide from case to case the type of operation to be performed (Hagemeyer 1955, Leuschner & Weickert 1964, Tapper & Hoover 1969).

Access to a large number of patients, who had been subjected to meniscectomy during almost half a century, and personal follow-up examination of the majority of the cases have made it possible to analyze objectively the results obtained, with long observation periods. The size of the material has further made it possible to treat statistically the obtained results with consideration of different factors which might influence the occurrence of degenerative arthritis. For these reasons a detailed report on this material was considered well justified in order to meet the need for concrete and clear-cut answers to the following main questions:

- to what extent is the operated knee affected by roentgenological signs of degenerative arthritis compared with the nonoperated joint; and if there are any differences in the occurrence of degenerative arthritis are these significant?
- to what extent have the patients subjective discomfort and objective symptoms after removal of the semilunar cartilage of the knee?
- which factors could possibly influence the fate of the meniscectomized knee?
- is partial resection or total extirpation to be preferred when choosing the method of operation?

Material

The basic material comprised all the patients who, during the period 1921—1960, were operated at the Regional Hospital in Linköping, Sweden, for rupture of the semilunar cartilage of the knee, in all 718 persons. Fig. 1 shows the number of operations during the different 10-year periods. Up to 1950 these patients were operated at the Department of General Surgery, but since the autumn of 1950 all injuries of the semilunar cartilage were operated on at the Department of Orthopaedic Surgery. Examination of the patients was performed during 1965 and the first half of 1966, by the author himself. Therefore, only patients who were resident in the reception area of the Regional Hospital in Linköping at the time of the follow-up could be included in this investigation. No selection was made of the material investigated.

The method adopted when trying to trace the patients was based partly on the county register and partly on inquiries to the parish registrar's offices. No information could be obtained regarding 49 persons. Seven patients were resident abroad. The parish registrar's offices furnished information on 42 deceased patients. Seventeen of these had been operated during the period 1921—1940 and 25 during the period 1941—1960. Moreover, 123 patients were traced, who at the time of the follow-up examination were living outside the reception area of the Regional Hospital in Linköping. In all, 497 persons were found who could be considered for follow-up investigation. On receiving an invitation 480 of them answered by attending for a follow-up examination. This represents 66.8 per cent of the total number of operated patients and 96.5 per cent of those who were known to be living in the reception area.

Table 1 shows the number of persons from the entire material who were investigated, as well as the distribution of total or partial meniscectomies and so-called "double-operations", i. e. cases where more than

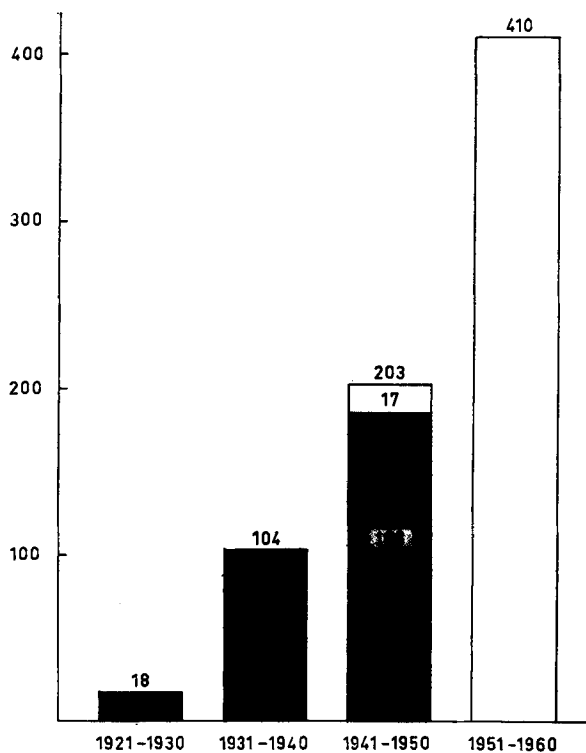


FIG. 1 Total number of meniscectomies performed at the Regional Hospital in Linköping, Sweden during the years 1921—1960.

Black columns: Operations performed in the Department of General Surgery.

White columns: Operations performed in the Department of Orthopaedic Surgery.

TABLE 1. *The distribution of the whole material. Patients available and those not available for follow-up examination are included. M = males, F = females. % = M + F.*

Patients	Total number		%	Total meniscectomy		Partial		"Double-operated"	
	M	F		M	F	M	F	M	F
Followed-up	422	58	66.8	384	56	19	2	19	0
Not „	212	26	33.2	198	25	8	0	6	1
Total	634	84	100.0	582	81	27	2	25	1

one semilunar cartilage was operated on in the same patient. In 6 cases among the "double-operated" both semilunar cartilages in the same knee were removed. In 13 patients one semilunar cartilage had been operated on in both knees. In the remaining 461 patients only one semilunar cartilage had been operated on. Twenty-one patients underwent partial resection and 440 total extirpation of the meniscus. It is these last-mentioned 440 patients who underwent total meniscectomy that will be reported on as the main material in what follows. Furthermore, a brief account will be given of the patients subjected to partial resection and those who underwent a "double-operation". Very shortly, the problem of re-operation on the same semilunar cartilage will also be dealt with.

Comments on the material

Previous reports on large materials, as for instance Zippel's series (1964), with 1,360 operated patients, usually give data only on sex and age distribution as well as, among other information, the side of the semilunar cartilage operated on, but they are not based on a follow-up examination. In table 2 follow-up investigations reported by different authors are summarized. Some of these follow-ups are based wholly or partially on questionnaires sent to the patients, and are thus, a report only on the patient's conception of his complaint. With regard to the number of re-examined persons, the present material is comparable with other follow-up series.

TABLE 2. *Materials, period of observation and method of judging the results, according to different authors.*

Authors	Number of cases	Followed up	Time of observation	Remarks
Strahlman & White (1921)	*	50	*	All by questionnaire
Birgfeld (1928)	85	59	*	*
Raess (1930)	27	25	1—7 years	Some by questionnaire
Key & Strömberg (1930)	48	44	2—16 "	All personally
Frising (1930)	36	35	— 9 "	Some by questionnaire
MacAusland (1931)	388	287	—25 "	All by questionnaire
Spira (1933)	82	76	*	Some by questionnaire
Andersson (1934)	28	23	1—14 "	All personally
Aleman & Friberg (1934)	186	176	*	Some by questionnaire
Dengler (1938)	122	74	—11 "	" " "

*) No information available

Table 2 (continued)

Authors	Number of cases	Follo- wed up	Time of observa- tion	Remarks
Efskind (1939)	33	32	1—14 years	All personally
Uebermuth (1941)	92	55	3—15 "	" "
Brechling (1942)	57	45	1—15 "	" "
Sjövall (1942)	144	143	3—12 "	All by questionnaire
Hübner (1943)	*	35	1—15 "	All personally
Nitter (1946)	42	35	1—19 "	" "
Fairbank (1948)	*	107	1/4—14 "	" "
Fuss (1951)	279	100	2—16 "	" "
Lagergren (1953)	120	97	2—25 "	Some by questionnaire
Aarstrand (1954)	56	48	*	" " "
Streli (1955)	111	82	18—25 "	All personally
Barfod & Bierring (1956)	112	110	1—18 "	" "
Rothascher (1960)	404	353	8—14 "	" "
Scheibe (1963)	*	127	2—12 "	Some by questionnaire
Saugmann-Jensen (1963)	*	351	1/2— 4 "	
Saugmann-Jensen (1963)	*	73	10—15 "	
Leuschner & Weickert (1964)	148	91	3—10 "	All personally
Kühnel (1964)	452	326	*	Some personally
Monn (1964)	60	52	2—17 "	All by questionnaire
Allegreni & Dell 'Orto (1965)	*	92	3—11 "	All personally
Huckell (1965)	462	134	11—21 "	Some by questionnaire
Herschmann (1965)	*	163	2—12 "	All personally
Barta & Perjés (1965)	94	71	1/2— "	" "
Springorum (1966)	*	150	18—35 "	" "
Franke (1966)	*	98	1/2— 5 "	" "
Mohing (1966)	*	110	—30 "	*
Gear (1967)	150	40	10— "	Some by questionnaire
Jackson (1968)	640	577	4—40 "	All personally
Tapper & Hoover (1969)	*	213	Average 18,9	Some by questionnaire
Appel (1970)	718	480	4—41 years	All personally

*) No information available

1. AGE DISTRIBUTION

This refers to the age of the patients at the time of operation. Fig. 2 and 3 show the age distribution both for the entire material comprising 718 persons and for all the 480 patients who were followed up. For the "double-operated" the age at the time of the first operation is given. The mean age for the entire material was 31.9 ± 0.46 years, and for the patients who were followed-up 33.5 ± 0.53 years. Thus there was no appreciable difference in age distribution between the entire material and the patients who were followed-up.

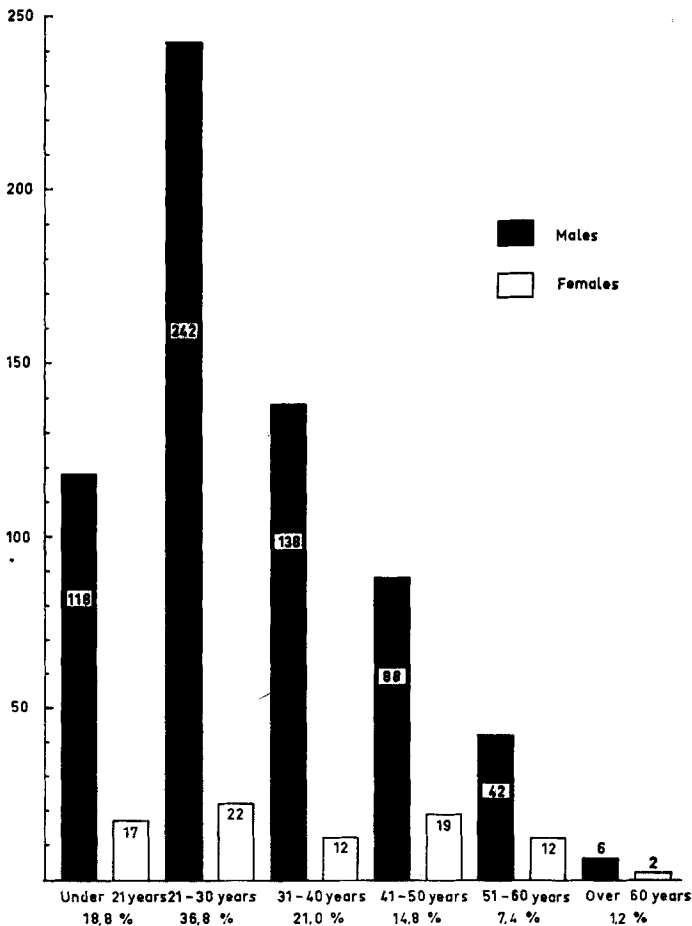


FIG. 2 Age distribution of the total number of meniscectomies.

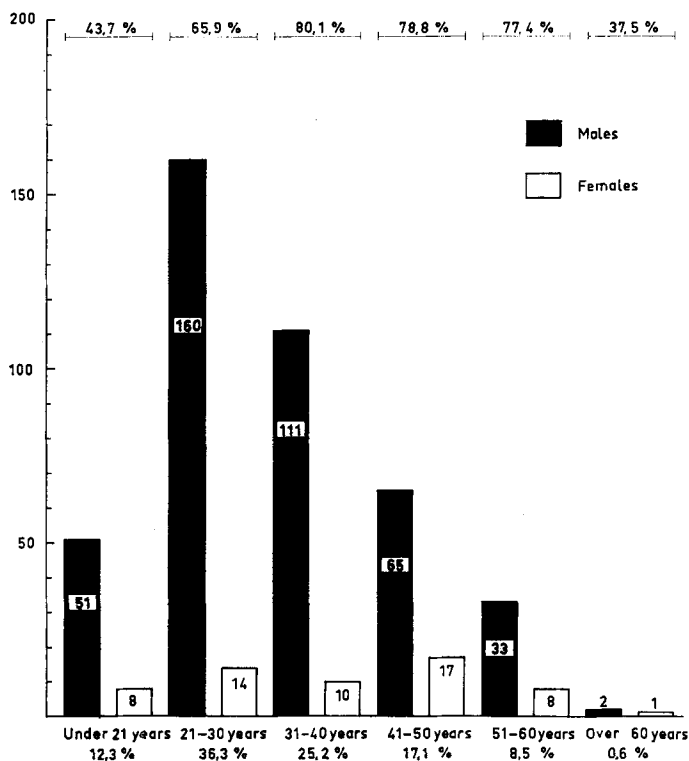


FIG. 3 Age distribution of the follow-up cases. Percentages at the top refer to the relation between the followed-up patients and the total number of patients belonging to each 10-year period.

Comments

The age distribution in the material of some authors is shown in table 3. It will be observed that most authors have a peak in their material during the third decade, which agrees with the condition in the present series. The mean ages stated correspond also with those given in this material. The comparatively low percentage of followed-up persons younger than 20 years at the time of the operation is probably due to the fact that in the entire material a large number of military servicemen were included, who at the time of the investigation were living outside the reception area.

TABLE 3. *Age distribution at operation, according to different authors.*

Authors	Ave- rage age	Under 21 %	years				Over 60 %	
			21 - 30 %	31 - 40 %	41 - 50 %	51 - 60 %		
Key & Strömberg (1930)	48		29.2	35.4	22.9	12.5	0	0
MacAusland (1931)	349		23.8	32.1	17.8	14.0	10.0	2.3
Spira (1933)	82		12.2	48.9	26.8	10.9		1.2
Rostock & Runge (1937)	238	28.8	21.4	44.4	19.3	9.7		5.2
Sjövall (1942)	144	29.3	22.9	41.0	21.5	9.7	4.9	0
Brechling (1942)	57		14.0	42.1	29.8	10.5		3.5
Nitter (1946)	35		17.1	54.3	17.1	8.6	2.9	0
Lagergren (1953)	97		16.5	43.3	18.6	16.5	4.1	1.0
Aarstrand (1954)	56		28.6	37.5	25.0	5.4	3.5	0
Streli (1955)	82		6.1	46.3	34.2	13.4	0	0
Barfod & Bierring (1946)	108		17.6	38.9	22.2	14.8	5.6	0.9
Scheibe (1963)	127		12.6	42.5	15.7	21.3	7.9	0
Kühnel (1964)	452		9.8	52.9	20.6	11.7	4.6	0.4
Monn (1964)	52		34.6		30.8	34.6		
Zippel (1964)	1360		18.8	49.6	17.1	9.3	5.1	0.1
Barta & Perjés (1965)	94		9.6	47.9	27.6	9.6		5.3
Herschmann (1965)	165		16.3	32.7	21.2	15.1	12.1	2.6
Mohing (1966)	110		6.5	53.6	23.6	15.4	0.9	0
Springorum (1966)	150		90 per cent between 29—39 years					
Jackson (1968)	577		8.0	25.0	29.0	25.0	11.0	2.0
Hübner (1943)	35	30						
Huckell (1965)	134	30						
Tapper & Hoover (1969)	213	32						

2. SEX

As shown in table 1 the entire material consisted of 84 women and 634 men, giving a ratio of females to males of 1 : 7.54. Among the followed-up persons 58 were women and 422 men, and here the ratio women to men was 1 : 7.27.

Comments

In other series the ratio females to males varied widely, as demonstrated in table 4. It is difficult to find any explanation for this. The ratio reported in many other materials corresponds with the ratio in the present series.

TABLE 4. *Ratio females to males according to different authors.*

Authors	Ratio	Authors	Ratio
Frising (1930)	1:3.5	Aarstrand (1954)	1:7
Key & Strömberg (1930)	1:7	Sevastikoglou (1954)	1:7.7
MacAusland (1931)	1:1.85	Scheibe (1963)	1:3.1
Abrahamsen (1933)	1:1.3	Strelec & Wozelka (1963)	1:3.9
Andersson (1934)	1:22	Kühnel (1964)	1:9.76
Rostock & Runge (1937)	1:2	Zippel (1964)	1:5.5
Efskind (1939)	1:1.2	Day (1966)	1:5.1
Brechling (1942)	1:4	Jackson (1968)	1:8.4
Sjövall (1942)	1:5	Tapper & Hoover (1969)	1:4

3. OPERATED MENISCUS

Among the 718 patients who were operated on in the entire material, 607 underwent medial and 137 lateral meniscectomy, which represents a ratio lateral to medial 1 : 4.43. Among the 480 persons who were followed-up 417 had had medial and 82 lateral meniscectomy, or lateral to medial 1 : 5.08.

Comments

Table 5 shows a wide variation as to the ratio lateral to medial meniscectomies in different materials with higher frequency of medial. No explanation for these variations could be advanced. Hashimoto (1958) reported a higher incidence of lateral than medial and he explains this

divergent relation in the Japanese by their manner of living. The relation in the present material, however, is in good agreement with most of the other reports.

TABLE 5. *Ratio lateral to medial according to different authors.*

Authors	Ratio	Authors	Ratio
Frising (1930)	1:6.2	Hashimoto & al. (1958)	3.2:1
Key & Strömberg (1930)	1:15	Wynn Parry & al. (1958)	1:2.2
MacAusland (1931)	1:3.8	Scheibe (1963)	1:13.6
Abrahamsen (1933)	1:7	Strelec & Wozelka (1963)	1:7
Andersson (1934)	0:23	Kühnel (1964)	1:10.9
Aleman & Friberg (1934)	1:6.1	Zippel (1964)	1:3.8
Efskind (1939)	1:5	Leuschner & Weickert (1964)	1:4
Brechling (1942)	1:8.5	Herschmann (1965)	1:5
Sjövall (1942)	1:3.5	Barta & Perjés (1965)	1:14
Aarstrand (1954)	1:4.7	Day (1966)	1:3.3
Streli (1955)	1:7.1	Ritchie (1966) children	1:2.9
Barfod & Bierring (1956) males	1:5	Jackson (1968)	1:3.7
females	1:2	Tapper & Hoover (1969)	1:5.1

4. SIDE

In the entire material the ratio left to right knee was 1 : 1.20 and among the persons followed-up 1 : 1.26.

Comments

No large differences between left and right operated knee were found in the material of other authors (table 6). Also in the present material both knees were affected to almost the same extent by injuries of the semilunar cartilage.

TABLE 6. *Ratio left to right according to different authors.*

Authors	Ratio	Authors	Ratio
Sjövall (1942)	1:1.38	Wynn Parry & al. (1958)	1:1.2
Fuss (1951)	1.09:1	Zippel (1964)	1:1.13
Streli (1955)	1:1.13	Day (1966)	2:1

5. TRAUMA

Rupture of the semilunar cartilage may occur without the injured person being able to state any definite trauma. It has, therefore, been assumed that nontraumatic ruptures are due to a high degree to degenerative changes in the semilunar cartilage. In this material it was found that the injury of the semilunar cartilage was clearly associated with trauma in 80 per cent of the cases both in the entire material and in the subjects who were followed-up. Information on several traumata in the same patient has not been specially noted, despite the fact that in a number of cases several injuries were mentioned. In athletes, on the other hand, there may have been information on only one injury, although it is known that, repeated traumata of the knees are usual, e. g. in footballers.

Comments

The frequency of traumatic ruptures of the semilunar cartilage reported earlier (table 7) and that reported in the present investigation were about the same.

TABLE 7. *Percentage traumatic ruptures of the semilunar cartilage according to different authors.*

Authors	Per cent	Authors	Per cent
Key & Strömberg (1930)	93.7	Barfod & Bierring (1956)	85.7
Brechling (1942)	75.0	Scheibe (1963)	77.9
Sjövall (1942)	91.6	Barta & Perjés (1965)	79.8
Nitter (1946)	97.6	McLaughlin (1966)	92.8
Aarstrand (1954)	73.2		

6. INJURIES IN ATHLETES

Twenty-eight per cent of all operated patients related the rupture of the semilunar cartilage directly to injury occurring in the course of athletics. The majority of these patients were men.

Comments

Other authors had an appreciably higher percentage of injuries connected with athletics (table 8) than that shown in this material. The number of patients stated in another Swedish investigation (Sjövall, 1942) agrees

best with the percentage for the present material. It is difficult to decide, however, whether this is due to special Swedish conditions or to a certain selection in the material of other authors. One explanation of the differences may be, that other authors have apparently calculated the percentage of injuries occurring in the course of athletics on the basis of meniscotomies performed on patients with a clear trauma in the history and not, as in this material, as a percentage of the entire number of cases.

TABLE 8. *Frequency of lesions of the semilunar cartilage due to sport trauma according to different authors.*

Authors	Per cent	Authors	Per cent
Raess (1930)	60.7	Aarstrand (1954)	48.2
Spira (1933)	50.0	Bestle (1955)	40.5
Rostock & Runge (1937)	47.1	Wynn Parry & al. (1958)	69.0
Sjövall (1942)	33.0	Zippel (1964)	58.8
Nitter (1946)	57.1		

7. LATENCY PERIOD

The time that elapsed between the injury or the first appearance of the symptoms respectively and the time of operation — termed in this investigation the latency period — is shown in table 9 with regard to the number of cases in each time group. If data on several injuries were available

TABLE 9. *Distribution of the whole material and the followed-up cases with regard to the latency period. M = males, F = females. % = M + F.*

Latency period	Number of cases		%	Followed-up		%
	M	F		M	F	
1 week	59	4	8.6	37	3	8.1
8—14 days	27	3	4.1	14	1	3.1
15 days—1 month	60	7	9.1	42	3	9.1
Total within 1 month	146	14	21.8	93	7	20.3
1—6 months	208	34	32.9	138	24	32.9
Over 6 months	296	37	45.3	203	27	46.8
Total	650	85	¹⁾	434	58	²⁾

¹⁾ 17 cases operated on twice

²⁾ 12 " " " "

then the latency period was calculated from the first injury reported. Six months have been taken as the limit between a short and a long latency period. Many other authors have used the same limit. The number of patients in the group with a latency period exceeding 6 months was larger than the number of patients in groups 0—1 and 1—6 months. On the other hand, if all the patients operated during the first half year were taken together, it was found that these formed a somewhat larger group compared with the patients who were operated on after a latency period of half a year.

Comments

In several reports no distribution with regard to the latency period is given. Table 10 shows the distribution reported by some authors. In a number of series a contrary relation is reported, e. g. a larger number of patients operated after a latency period of 6 months. The differences, however, are relatively small and the observations are based on materials of different size. Early diagnosis and, consequently, early operation in recent years, as well as longer expectancy prior to operation adopted by some surgeons, can also account for these differences.

TABLE 10. *Distribution of the materials of different authors with regard to the latency period.*

Authors	Under 6 months		Over 6 months	
	Number	%	Number	%
Key & Strömberg (1930)	19	43.2	25	56.8
Dengler (1938)	48	64.8	26	35.2
Sjövall (1942)	66	46.2	77	53.8
Barfod & Bierring (1956)	51	46	59	54
Herschmann (1965)	91	55.2	74	44.8
Jackson (1968)	210	36.4	367	63.6

8. OBSERVATION PERIOD

In view of the fact that the follow-up investigation was begun in 1965 and all the patients operated in 1960 were included in the material, the shortest observation period was somewhat longer than 4 years. The ma-

terial was, therefore, divided, in respect of the observation period, into the following decades:

4—13 years, 14—23 years, 24—33 years, and 34—43 years. Table 11 shows the distribution of all the subjects followed up in the different observation-period groups. It was found that in 199 cases, or 41.1 per cent, the observation period was at least 14 years. In 73 cases, or 15.2 per cent, the observation period was at least 24 years.

TABLE 11. *Distribution of followed-up patients with regard to observation period (in decades). M = males, F = females. % = M + F.*

	Total		4—13 years		14—23 years		24—33 years		34—43 years	
	M	F	M	F	M	F	M	F	M	F
Number of cases	422	58	236	45	118	8	61	5	7	0
%	100.0		58.5		26.3		13.8		1.4	

Comments

On account of the differences in the classification of observation periods in other reports it was not possible to compare, in tabular form, frequencies of subjects followed up in the different observation-period groups with the corresponding frequency in the present material. If, however, the frequency figures in the different observation periods given above are compared with earlier investigations (table 2), it will be found that this material is comparable with other materials with regard to the length of the observation period and to the number of cases in the different observation-period groups.

CHAPTER III

Methods

The material was collected by studying the hospital register for the patients admitted during the years 1921—1960. A double control was obtained also by checking the operation register for the same period. All the patient records were produced, and from these summaries were made of the most important details of the case histories, of the entire operation reports and of the postoperative data, and transferred to punched cards. At the follow-up a scheme number 1 (p. 26) was used for the recording of subjective complaints, objective clinical findings, and information on the type of occupation as well as athletic activities after operation. Information whether the patient had had to change to lighter work after the operation, and the reasons for this were also noted. A roentgenologic examination was also made at the follow-up investigation.

1. DATA FROM HOSPITAL RECORDS

Lockings were recorded only if data on these occurred in the hospital records; the frequency of the lockings was not noted.

Effusion was recorded only if the case records contained the relevant data or if exudate was established and recorded by the examining physician or the surgeon.

Haemarthrosis was noted only provided the data were connected with puncture or when operation was performed in close association with trauma.

Because in this hospital the roentgen films are usually discarded after 10 years it was only possible to record the data on *preoperative roentgenologic osteoarthritis* in those cases where information on such changes

was given in radiological reports, for example, in connection with arthrography.

Injuries of the collateral ligaments, injuries of the cruciate ligaments, chondromalacia patellae, osteochondritis dissecans or osteoarthritis in the knee joint in connection with the operation were recorded only in such cases where these were mentioned in the operation report.

Postoperative complications in the form of *haemarthrosis* or *persisting effusion* were noted if the hospital records contained definite information in this respect. *Signs of infection* were recorded only if, in connection with a rise in temperature, information was also given, e.g. concerning increased local temperature and/or redness in the operating area. No case of extensive supuration was recorded in the whole material.

Postoperative fixation with some kind of splint or circular plaster cast was only noted if this had been recorded. Similarly, the time when the patient was first allowed to bear weight, and the *duration of the post-operative hospitalization* were also recorded.

If definite information was available for *postoperative muscular training*, this was recorded as well.

The type of surgical procedure, such as partial or total extirpation of the semilunar cartilage was also noted.

2. FOLLOW-UP INVESTIGATION

a. Clinical examination

Subjective complaints were recorded on a standardized form in accordance with scheme 1 with + if the patient stated any. Each question was recorded separately. If a patient stated in answer to a question that he had considerable trouble, this was recorded by ++, and if the trouble was very pronounced with +++.

Objective findings were tested by inspection and palpation. The range of movement was measured from the maximal extended position (0°) to the maximal actively flexed position. Signs of cruciate ligament instability was tested with the knee at about 90° flexion position and the foot fixed. Lateral instability was tested with the knee in the extended position. To test the muscular strength of the knee the patient was asked to stand on one leg and from the maximal extended position to bend the knee to a squatting position from which he could rise without supporting himself with his hands or with the other leg. The angle between the initial posi-

tion and the squatting position was measured and noted. The test was performed on both the operated and the nonoperated leg. The thigh girth was measured 15 cm above the upper margin of the patella.

Besides these subjective complaints and objective findings, it was recorded whether the patient practised any kind of sport after the operation, and whether, on account of his articular trouble, he had been compelled to change his occupation for work that required less knee strain. When estimating the degree to which the work affected the knee, one had to depend to a great extent on the statements made by the patient himself.

The data on the subjective complaints and the objective findings and on sport and occupation after operation were transferred to a new scheme number 2 (p. 27). In this connection, with regard to the objective findings, the differences between the operated and the nonoperated knee were taken into account. These differences were recorded. Thus, for example, obtained differences in extension-flexion range between the 2 knees were divided into two groups: differences below or at most 10° , and differences exceeding 10° . The muscular strength of the knee was considered to be reduced if the difference in the ability to rise from the squatting position was greater than 10° . Muscular atrophy was regarded as present in the operated leg, and was recorded, if the difference between the thigh girth of the operated and of the nonoperated leg was 2 cm or more. These data were transferred to both punched cards and computer cards.

b. Roentgenologic examination

At the time of the follow-up investigation both knees were radiologically examined in the Department of Diagnostic Radiology II at the Regional Hospital in Linköping. This examination was made with the patient in both the lying and the standing position with weight bearing on both knees. The importance of radiological examination in the standing position was previously emphasized by Fairbank (1948), and later by Ahlbäck (1968), Bauer (1968) and Bauer & al. (1969) among other authors.

All radiographies were assessed by one and the same senior radiologist, with regard to the reduction of joint space, marginal osteophytes, sclerosis, flattening of the femoral condyle and subluxation. The results were tabulated in accordance with scheme number 3 (p. 27).

In order to exclude any subjective influence on the assessments the radiologist did not know which knee and which semilunar cartilage had been operated on.

When assessing the osteoarthritic signs on the radiographies, the degree of osteoarthritis was indicated by 0, +, ++, or +++, according to the following principles:

Marginal osteophytes:

0 = no signs of accentuation of the condylar margins, on the eminentia, in the fossa intercondyloidea or on the margins of the patella.

1 + = slight accentuation at the above-mentioned places of "Raubert's sign" type.

2 + = a distinct prolongation of the condylar margins or eminentia, in the fossa intercondyloidea or on the margins of the patella.

3 + = advanced osteophytes at the above-mentioned places.

Narrowing of the joint space was assessed by comparing radiographies with and without weight bearing on the knee, and was recorded as 0, if no difference could be demonstrated for certain. If a distinct narrowing of the joint space could be seen when weight bearing, but this was less than half the height of the joint space with the knee unloaded, this was indicated by 1 +. If the difference in the height of the joint space on weight bearing amounted to more than half of that with the knee at rest, but a joint space still existed, this was recorded by 2 +. A complete obliteration of the joint space when standing was recorded by 3 +. A distinct lateral subluxation of the femur in relation to the tibia was specially noted.

The occurrence of flattening of the surface of the femoral condyles was recorded, without any special grading, by +.

The occurrence of sclerosis, especially in the condyles of the tibia, as well as of cystic formations, was recorded, also without any grading, by +.

The roentgenologic findings were transferred only to computer cards.

It must be mentioned here that, in general, when classifying the data obtained from the study of the various parameters examined in this investigation, special care was taken to use classification criteria corresponding as much as possible to those used by the majority of earlier authors.

3. STATISTICAL METHODS

For the statistical treatment of obtained differences between 2 or more comparisons the chi-square (X^2) method was used for testing the probability of differences in frequency of occurrence or non occurrence of the

$p > 0.05$ == non significant
 $p < 0.05$ == almost significant = *
 $p < 0.01$ == significant = **
 $p < 0.001$ == highly significant = ***

Scheme No. 1 for registration of the subjective complaints and objective findings.

Increased skin temperature
 Soft tissue swelling
 Hypertrophied "Hoffa"
 Capsule thickening
 Effusion
 Tenderness medially (operated knee)
 Tenderness laterally (" ")
 Other localisation of tenderness (operated knee)
 Moderate crepitation
 Pronounced "
 Lateral instability
 Cruciate ligament instability
 Quadriceps atrophy (more than 2 cm)
 Decreased range of active extension (up to 10°)
 " " " " " (more than 10°)
 " " " " flexion (up to 10°)
 " " " " " (more than 10°)
 " muscular strength (more than 10°)

Scheme No. 2 for registration of the objective findings when the operated knee is compared with the nonoperated knee.

	Operated knee	Nonoperated knee
Osteophytes	medial femur condyle	
"	" tibia "	
"	lateral femur "	
"	" tibia "	
"	fossa intercond. medially	
"	" " laterally	
"	eminentia tibiae medially	
"	" " laterally	
Sclerosis	medial femur condyle	
"	lateral " "	
"	medial tibia "	
"	lateral " "	
Planning	medial femur condyle	
"	lateral " "	
Narrowing	medial joint space	
"	lateral " "	
Osteophytes	patella	

Scheme No. 3 for registration of the roentgenologic findings.

CHAPTER IV

Results of follow-up examination of patients with total extirpation of the semilunar cartilage

1. ROENTGENOLOGIC RESULTS

Previous investigations

As shown in table 12 the variation in the frequency of degenerative arthritis after meniscectomy reported by earlier investigators is considerable. These differences may to some extent be due to varying bases of assessment and partly to unequal observation periods in the various materials.

Besides those referred to in table 12 a number of authors have reported frequencies, varying between 8 and 25 per cent without grading the observed signs of degenerative arthritis in detail (Key & Strömberg 1930, Brechling 1942, Lagergren 1953, Saugmann-Jensen 1963, Pelzl & Rueff 1969).

Franke (1966) stated that he was able to show a higher frequency of osteoarthritis in females than in males.

Own observations

Tables 13 and 14 show the frequency of different signs of osteoarthritis. In classifying the results in these tables, patients operated for a medial

TABLE 12. *The frequency of roentgenologic signs of degenerative arthritis according to different authors.*

Authors	Total number of cases	Group 0 %	Group I %	Group II %	Group III %
Nitter (1946)	35		65.7	22.9	11.4
Fuss (1951)	100	44.0	43.0	13.0	0
Streli (1955)	82	69.5	15.9	14.6	0
Rothascher (1960)	353	64.3	28.9	5.1	1.7
Scheibe (1963)	110	53.6	19.1	22.7	4.6
Leuschner & Weickert (1964)	85	31.3	49.4		19.3
Franke (1966)	103	21.4	39.8	19.4	19.4
Jackson (1968)	577		77.0		23.0



FIG. 4 Characteristic radiographies of cases allocated to *group 0: normal knees* (medially meniscectomized knee at the left). A. Frontal projection of both knees with the patient in the lying position. B. Frontal projection with the patient in standing position with weight bearing on both knees. C. Side projection of both knees in lying position.



FIG. 5 Characteristic radiographies of cases allocated to *group I*: knees with *initial osteoarthritic* (medially meniscectomized knee at the right). A. Frontal projection of both knees with the patient in the lying position. B. Frontal projection with the patient in standing position with weight bearing on both knees. C. Side projection of both knees

TABLE 13. *Distribution of the frequency and grade of the roentgenologic signs of osteoarthritis in medially meniscectomized as compared with nonoperated knees. M = males, F = females.*

Operated knee				0		0		0		1+		1+		1+		2+		2+		2+		2+		3+		3+		3+	
Non	„	„		0		1+		2+		0		1+		2+		0		1+		2+		3+		0		2+		3+	
				M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Osteophytes	medial	femur	condyle	134	7	8	0	0	0	137	22	24	2	1	1	16	9	4	1	3	0	0	0	0	0	0	1	0	1
„	„	tibia	„	85	11	16	0	0	0	138	17	61	4	1	0	18	6	5	3	2	2	0	0	1	0	0	1	0	0
„	lateral	femur	„	291	31	3	1	1	1	23	4	3	1	0	0	4	4	0	1	2	0	0	1	0	0	0	0	0	0
„	„	tibia	„	253	31	11	2	0	0	41	2	18	5	0	1	3	2	0	1	1	0	0	0	0	0	0	0	0	0
„	fossa interc.		medially	277	30	5	0	0	0	39	9	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
„	„	„	laterally	303	38	4	0	0	0	16	4	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
„	eminent. tibiae		medially	156	19	12	1	0	0	73	12	86	11	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
„	„	„	laterally	141	29	14	1	0	0	77	9	93	5	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Sclerosis	medial	femur	condyle	327	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
„	lateral	„	„	327	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
„	medial	tibia	„	306	39	0	0	0	0	18	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
„	lateral	„	„	325	43	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planning	medial	femur	condyle	248	36	2	1	0	0	69	5	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
„	lateral	„	„	319	40	1	0	0	0	7	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Narrowing	medial	joint	space	222	25	5	0	0	0	88	15	9	1	0	0	3	2	0	1	0	0	0	0	0	0	0	0	0	0
„	lateral	„	„	320	42	1	1	0	0	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osteophytes	patella			184	17	8	1	0	0	65	9	61	11	0	0	7	0	2	2	0	2	0	0	0	0	0	0	0	2

TABLE 14. *Distribution of the frequency and grade of the roentgenologic signs of osteoarthritis in laterally meniscectomized as compared with nonoperated knees. M = males, F = females.*

Operated knee				0		0		1+		1+		2+		2+	
Non	„	„		0		1+		0		1+		0		2+	
				M	F	M	F	M	F	M	F	M	F	M	F
Osteophytes	medial	femur	condyle	42	7	0	0	9	3	4	1	2	1	0	0
„	„	tibia	„	33	10	0	0	15	1	9	1	0	0	0	0
„	lateral	femur	„	42	8	1	0	11	3	0	0	3	1	0	0
„	„	tibia	„	18	4	2	0	29	6	1	0	6	2	1	0
„	fossa interc.		medially	51	11	1	0	5	0	0	1	0	0	0	0
„	„	„	laterally	53	9	0	0	3	2	1	1	0	0	0	0
„	eminent. tibiae		medially	27	9	1	0	17	2	11	1	1	0	0	0
„	„	„	laterally	21	6	0	0	30	5	5	1	1	0	0	0
Sclerosis	medial	femur	condyle	57	12	0	0	0	0	0	0	0	0	0	0
„	lateral	„	„	57	12	0	0	0	0	0	0	0	0	0	0
„	medial	tibia	„	57	12	0	0	0	0	0	0	0	0	0	0
„	lateral	„	„	52	10	0	0	5	2	0	0	0	0	0	0
Planning	medial	femur	condyle	55	12	0	0	2	0	0	0	0	0	0	0
„	lateral	„	„	42	11	0	0	14	1	1	0	0	0	0	0
Narrowing	medial	joint	space	56	12	0	0	1	0	0	0	0	0	0	0
„	lateral	„	„	56	10	0	0	1	2	0	0	0	0	0	0
Osteophytes	patella			33	8	2	0	13	3	9	1	0	0	0	0

TABLE 15. *The statistical significance of the differences in various roentgenologic signs of osteoarthritis, between operated and nonoperated knees.*

			Operated medially		Operated laterally	
			X ²	d.f.	X ²	d.f.
Osteophytes medial femur condyle			179.3***	2	11.0***	1
" " tibia "			148.8***	2	9.6**	1
" lateral femur "			13.6**	2	10.4**	1
" " tibia "			13.4**	2	43.2**	1
" fossa interc. medially			27.4***	1	2.1	n.s.
" " " laterally			7.5**	1	3.0	n.s.
" eminent. tibiae medially			28.6***	1	11.9***	1
" " " laterally			29.0***	1	41.4***	1
Sclerosis medial femur condyle			n.s.		n.s.	
" lateral " "			n.s.		n.s.	
" medial tibia "			16.8***	1	n.s.	
" lateral " "			3.0	n.s.	7.4***	1
Planning medial femur condyle			59.8***	1	2.0	n.s.
" lateral " "			4.7*	1	15.1***	1
Narrowing medial joint space			85.7***	1		n.s.
" lateral " "			1.6	n.s.		n.s.
Osteophytes patella			33.0***	1	7.1**	1

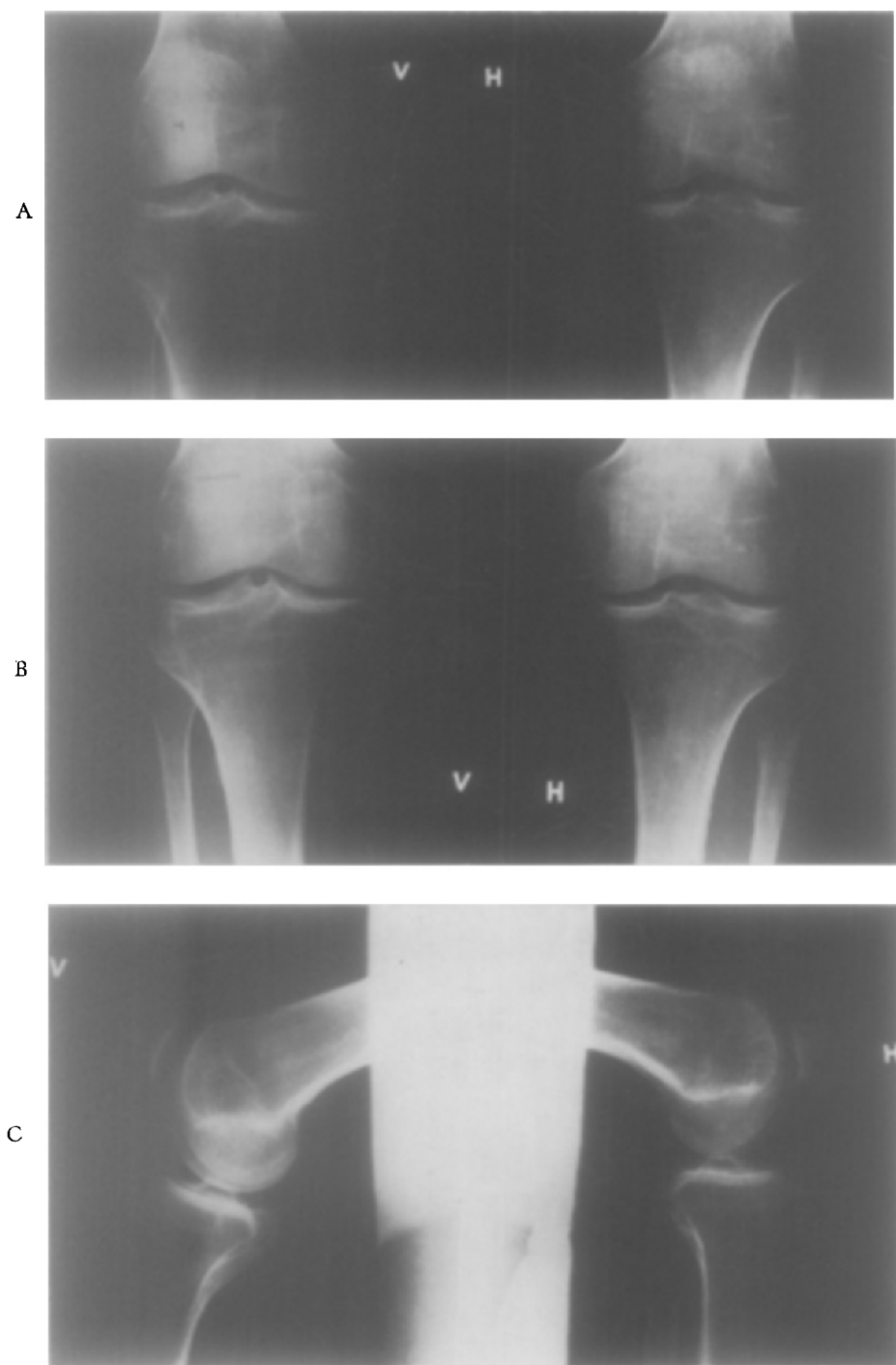
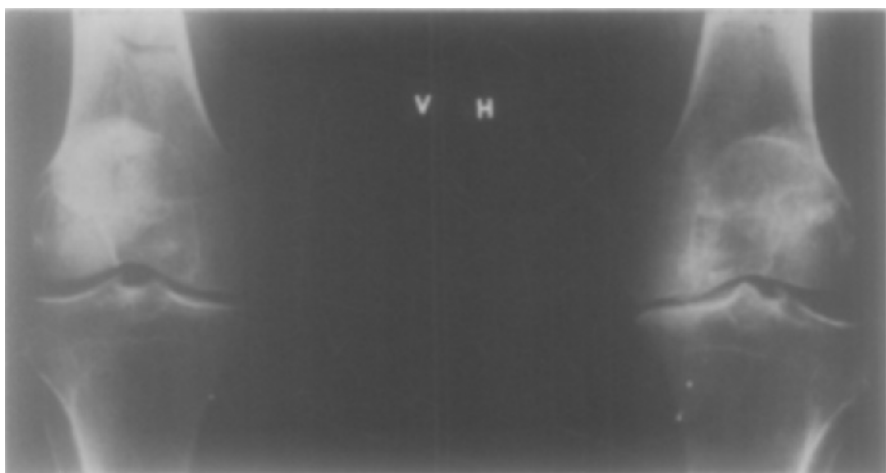
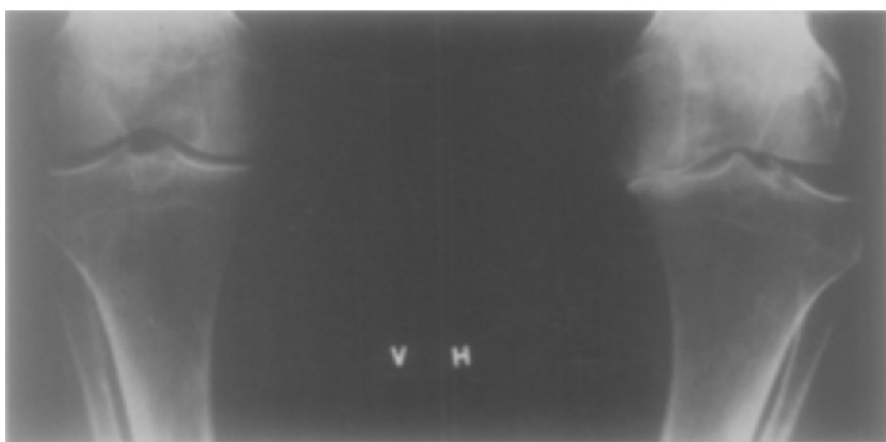


FIG. 6 Characteristic radiographies of cases allocated to *group II*: knees with *pronounced osteoarthritis* (medially meniscectomized knee at the left). A. Frontal projection of both knees with the patient in the lying position. B. Frontal projection with the patient in standing position with weight bearing on both knees. C. Side projection of

A



B



C

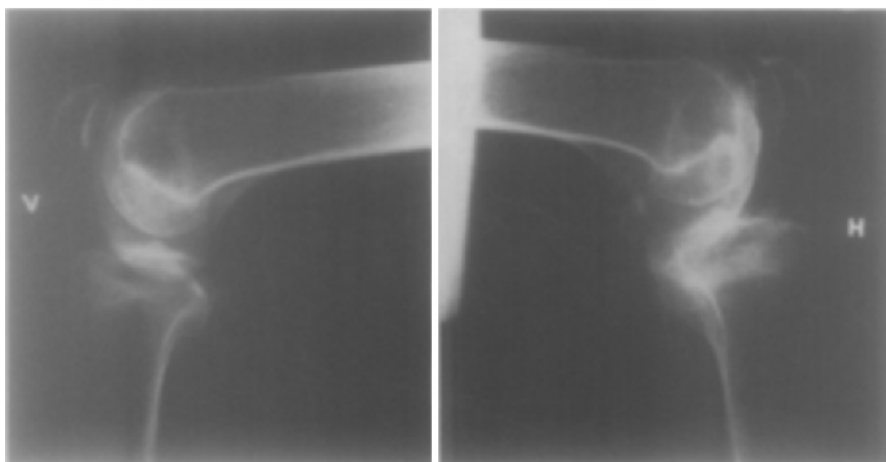


FIG. 7 Characteristic radiographies of cases allocated to *group III*: knees with *severe osteoarthritis* (medially meniscectomized knee at the right). A. Frontal projection of both knees with the patient in the lying position. B. Frontal projection with the patient in standing position with weight bearing on both knees. C. Side projection of both knees

semilunar cartilage rupture, with osteophytes present on the medial aspect of the tibia, of degree ++ in the operated and + in the nonoperated knee, were placed with regard to osteophytes medially on the tibia, in column 8 in table 13. The observed higher frequency of osteoarthritic signs in the operated than the nonoperated knee is significant as shown in table 15. Thus the roentgenologic signs of osteoarthritis following total extirpation of the semilunar cartilage are significantly higher in the operated than in the nonoperated control knee.

In order to be able to compare the obtained results, in respect of roentgenologically demonstrable degenerative arthritis, with those of other authors, the material has been divided into four groups. In this grouping, following the suggestion of earlier authors (Ahlbäck 1968, Danielsson & Hernborg 1969), more attention has been paid to narrowing of the joint space, flattening of the femoral condyle and sclerosis than to the sum of the osteophytes.

Group 0: this group comprises apparently *normal knees*. (Fig. 4)

Group I : here were allocated knees with radiological signs of *initial osteoarthritis* as slight decrease of the joint space without signs of skeletal changes, other than some minor accentuation of the condylar margins of type 1 +. (Fig. 5)

Group II : this contains knees with signs of *pronounced osteoarthritis* such as marked reduction of the joint space with some flattening of the femoral condyle or sclerosis. (Fig. 6)

Group III: here the knees had signs of *severe osteoarthritis* with extensive reduction or total obliteration of the joint space, cystic formations, flattening of the femoral condyles, sclerosis, severe osteophytes and distinct subluxation of the femur in relation to the tibia. As a whole the knees of this group showed signs of extensive osteoarthritic destruction. (Fig. 7)

In view of the difficulties in obtaining a satisfactory evaluation of the radiographies, with necessary requirements of objectivity, when based on the estimations of one person alone, the roentgenograms were evaluated by another senior radiologist as well. He was asked to classify the roentgenologic findings which, according to his opinion, corresponded to the groups of classification referred to above. He obtained no information regarding the results of the first radiologist, and the same measures of security were used to avoid influencing his judgement. The results of the second radiologist were further treated and analysed statistically with regard to the "roentgenologic findings" in the same way as those of the first radiologist. Thus a double control of the estimation of the radiologi-

cal results was achieved. A comparison of the data obtained from both evaluations showed a striking similarity, with only minor divergencies, which will be mentioned separately in the following.

Table 16 shows the number of cases in different groups with regard to the degree of osteoarthritic changes according to the above mentioned criteria. Here it may be pointed out that in 17 patients belonging to group 0 slight signs of degenerative arthritis were found in the nonoperated knee. In group I two patients had more osteoarthritic signs in the nonoperated knee. In groups II and III all the patients had more pronounced signs of degenerative arthritis in the operated knee than in the nonoperated knee. If groups II and III in table 16 are taken together to form one group with distinct osteoarthritic changes in the operated knee, then these cases will amount to only 10.8 per cent¹⁾ of all the knees subjected to total extirpation of the semilunar cartilage. In 4 among the nonoperated knees, i. e. in 0.9 per cent there were, at the time of the follow-up, roentgenologic signs of degenerative arthritis corresponding to group II and III. In this respect the difference between operated and nonoperated knees is highly significant ($X^2 = 226.52^{***}$ d. f. = 2). A comparison between laterally and medially meniscectomized knees showed that osteoarthritic changes of groups II and III were present in 8.7 and 11.3 per cent¹⁾ of the cases respectively. This difference is not significant. When females were compared with males, 19.6 per cent of the former had osteoarthritic changes and 9.6 per cent of the latter.¹⁾ This difference is almost significant ($X^2 = 5.81^*$ d. f. = 2).

TABLE 16. *Distribution of the totally meniscectomized and nonoperated knees in different groups of roentgenologic osteoarthritis. M = males, F = females. % = M + F.*

Operated meniscus	Total number		Group 0			Group I			Group II			Group III		
	M	F	M	F	%	M	F	%	M	F	%	M	F	%
Medial	327	44	178	16	52.3	116	19	36.4	27	6	8.9	6	3	2.4
Lateral	57	12	32	8	58.0	21	2	33.3	4	2	8.7	0	0	0
Total	384	56	210	24		137	21		31	8		6	3	
	440		234		53.2	158		36.0	39		8.8	9		2.0
Nonoperated	440		427		97.0	9		2.1	3		0.7	1		0.2

¹⁾ According to the evaluation of the second radiologist (page 29) the frequency of radiologic osteoarthritis was: All total meniscectomized knees 10.2 per cent, medially meniscectomized knees 10.8 per cent, laterally meniscectomized knees 7.2 per cent, for males 9.1 per cent and for females 17.8 per cent.

Comments

If according to Jackson (1968), groups 0 and I are considered to form together a "normal" group, and groups II and III are combined to form a "degenerative" group, it will be found that both the number and the percentage of knees belonging to the latter group in the present material are lower than in the reports of earlier authors, with the exception of Rothascher (1960) (table 12).

The previously reported occurrence of osteoarthritic changes following total extirpation of the semilunar cartilage was verified and statistically ascertained by the results presented here.

Observed differences between knees operated for rupture of the medial or the lateral semilunar cartilage respectively were not significant. The difference between males and females as regards the frequency of roentgenologic osteoarthritis in the operated knee, was found significant. Thus, earlier statements of a higher frequency of osteoarthritis in females than in males following meniscectomy (Franke 1966) could be verified from the present results.

a. AGE AT THE TIME OF OPERATION

Previous investigations

The frequency of roentgenologic osteoarthritic changes following meniscectomy has been especially correlated with the patient's age at the time of operation only by a few authors. Varying results have been reported. Thus, it has been stated that by preference patients over 45 years of age should not be subjected to meniscectomy on account of the substantially greater risk of development of osteoarthritis when operating patients of advanced age (Scheibe 1963, Herschmann 1965). On the other hand, it has been considered that the patient's age at operation is of no importance for the development of roentgenologic osteoarthritis (Nitter 1946, Saugmann-Jensen 1963).

Own observations

In the entire material of total meniscectomies it was found, on correlating the roentgenologic findings with age at operation, that patients over 41 years had a higher frequency with distinct degenerative arthritis of groups

II and III than those under 41 (table 17). This difference is almost significant ($X^2 = 8.80^*$ d. f. = 2). The frequency of osteoarthritis was also higher in patients subjected to medial meniscectomy when over 41 than those under 41 years at operation. This difference was also almost significant ($X^2 = 7.66^*$ d. f. = 2). In patients subjected to lateral meniscectomy the frequency of osteoarthritis was found to be higher in subjects over than under 41 years at operation, but this difference is not significant. A comparison was also done for men and women separately. For both males and females analysed separately the frequency of roentgenologic osteoarthritis was higher in cases where a total meniscectomy was performed on patients over 41 years than on those under 41. For men this difference is almost significant ($X^2 = 6.76^*$ d. f. = 2), but not for women.²⁾

Comments

In this material the frequency of osteoarthritic changes was higher in patients over 41 subjected to total meniscectomy than in those under 41 at the time of operation. The results are in agreement with the findings reported by Scheibe (1963) and Herschmann (1965). The differences were statistically significant for all patients subjected to total meniscectomy, for medial meniscectomies taken separately, as well as for total meniscectomies in males. For laterally meniscectomized knees, and for females examined separately, observed differences were not significant.

TABLE 17. *Distribution of the totally meniscectomized knees in different groups of roentgenologic osteoarthritis with regard to age at operation. M = males, F = females. % = M + F.*

Operated meniscus	Age at operation	Total Number		Group 0 Number		%	Group I Number		%	Group II Number		%	Group III Number		%
		M	F	M	F		M	F		M	F		M	F	
Medial	Under 41 years	241	23	140	10	56.8	75	11	32.6	24	2	9.8	2	0	0.8
Lateral	„ 41 „	49	7	28	6	60.7	18	0	32.1	3	1	7.2	0	0	0
Total	Under 41 years	290	30	168	16	57.5	93	11	32.5	27	3	9.4	2	0	0.6
Medial	Over 41 years	86	21	38	6	41.2	41	8	45.8	3	4	6.5	4	3	6.5
Lateral	„ 41 „	8	5	4	2	46.2	3	2	38.5	1	1	15.3	0	0	0
Total	Over 41 years	94	26	42	8	41.7	44	10	45.0	4	5	7.5	4	3	5.8

²⁾ In this respect the results obtained from the evaluation of the roentgenologic findings by the second radiologist (page 29) were divergent. Thus, no significant difference in the frequency of roentgenologic signs of osteoarthritis existed between men operated before or after 41 years of age.

b. LATENCY PERIOD

Correlation of the total results of a follow-up investigation with the time that elapses between an adequate trauma or the onset of the first symptoms and the time of operation — which has been named here the latency period — has been taken up for discussion by several authors. Moreover, the existence of roentgenologic signs of osteoarthritis has also been correlated with the length of the latency period by some authors. A number of investigators have claimed that a clear-cut connection exists between the occurrence of osteoarthritis and a long latency period (Nitter 1946, Barfod & Bierring 1956, Scheibe 1963, Mohing 1966, Franke 1966, Gear 1967, Pelzl & Rueff 1969). These statements, however, are not based on statistical verification of the results. On the other hand, it has also been held that no connection exists between higher frequency of degenerative arthritis and a long latency period. (Saugmann-Jensen 1963, Allegreni & Dell'Orto 1965, Jackson 1968, Tapper & Hoover 1969). Among the latter authors only Jackson (1968) and Tapper & Hoover (1969) have

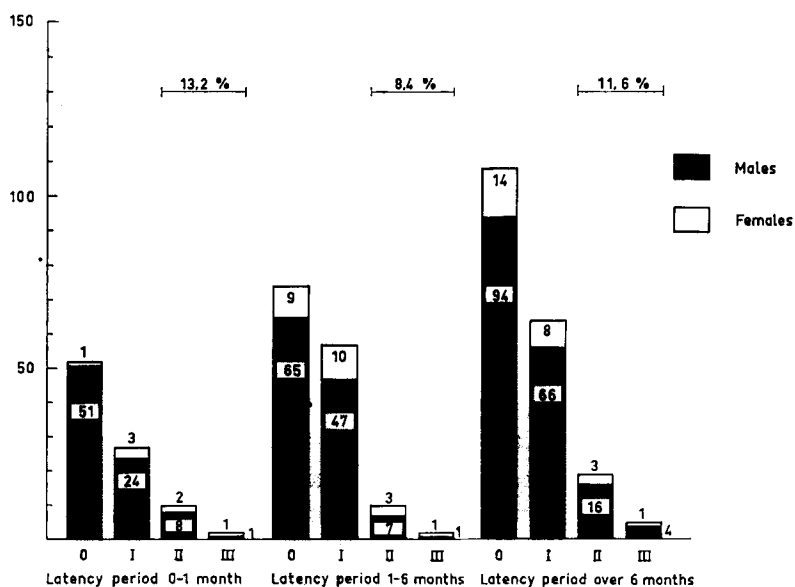


FIG. 8 Number of followed-up meniscectomized patients distributed by different groups of roentgenologic osteoarthritis and latency periods. Percentage of osteoarthritic cases given at the top.

verified their results statistically. Wynn Parry et al. (1958) reported an appreciably higher frequency of osteoarthritic signs at operation in patients with a long latency period.

Own observations

By dividing the material according to the length of the latency period into 3 different groups, namely, under 1 month, 1—6 months and over 6 months and with a demarcation line at 6 months between a short and a long latency period, a distribution of total meniscectomies is obtained as demonstrated in fig. 8. The lowest frequency of osteoarthritic knees occurs within the latency period of 1—6 months and the highest percentage in the group operated with a maximal latency period of 1 month. These differences in the frequency of osteoarthritis are, however, small and not significant. This applies to all total meniscectomies. Nor were any significant differences observed on comparing separately, medially and laterally meniscectomized knees with the length of the latency period. Totally meniscectomized knees have been tested also for males and females separately with regard to the length of latency period. Existing differences in this respect were not significant. The importance of the latency period for frequency of osteoarthritis was also tested separately for totally meniscectomized knees in patients operated on before and after they were 41 years old respectively. The length of the latency period did not influence the results significantly.

Comments

Although certain percentage differences were found on correlating the occurrence of osteoarthritis with the length of latency period, these differences were not significant. It can therefore be concluded that the length of the latency period does not play such an important role for the occurrence of osteoarthritis in a meniscectomized knee as has been stated earlier (Nitter 1946, Barfod & Bierring 1965, Scheibe 1963, Mohing 1966, Franke 1966, Gear 1967, Pelzl & Rueff 1969). The conception that the length of the latency period does not play any part in the occurrence of osteoarthritis in a meniscectomized knee has thus been verified (Saugmann-Jensen 1963, Allegreni & Dell'Orto 1965, Jackson 1968, Tapper & Hoover 1969). It must be pointed out, however, that these observations concern comparisons between short and long latency periods with a borderline at 6 months. It is possible that other correlations would be found if this limit was either increased or decreased.

c. THE TYPE OF TRAUMA

Opinions regarding the importance of the aetiological factor responsible for the rupture of the semilunar cartilage for the occurrence of osteoarthritis diverge widely. It has been stated that trauma as such predisposes to more pronounced osteoarthritis, while the degree of degeneration of the semilunar cartilage is of no importance (Fuss 1951, Tapper & Hoover 1969). On the other hand, there are authors who assert that injuries of the semilunar cartilage without definite trauma are due to increased degeneration of the cartilage and, consequently, of the entire knee. After meniscectomy such a knee is more prone to develop roentgenologic osteoarthritis compared with a healthy knee with traumatic injury of the semilunar cartilage (Rothascher 1960, Franke 1966).

Own investigations

Among the patients subjected to total meniscectomy 80.9 per cent reported trauma in the history. However, only 30.0 per cent could define the type of trauma, which indicates the difficulty of obtaining reliable information on this matter. These latter patients were divided into different groups according to the type of the main trauma reported, namely in combination with rotation, abduction, adduction or hyperextension of the knee. In 19.1 per cent no certain data regarding the mechanism of the injury were obtainable. Table 18 shows the distribution of the material with regard to traumatic and nontraumatic cases as well as to the type of trauma correlated with the degree of osteoarthritis. The traumatic and

TABLE 18. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis in respect of the type of knee injury.*
M = males, F = females. % = M + F.

Factor trauma	Total		Group 0			Group I			Group II			Group III		
	Number		Number		%	Number		%	Number		%	Number		%
Defined trauma	M	F	M	F		M	F		M	F		M	F	
Rotation	61	4	32	2		25	1		4	0		0	1	
Abduction	20	2	14	0		4	2		2	0		0	0	
Adduction	29	6	13	5		13	1		3	0		0	0	
Hyperextension	9	1	6	1		3	0		0	0		0	0	
Total	119	13	65	8	55.3	45	4	37.1	9	0	6.8	0	1	0.8
Non-defined trauma	196	28	103	9	50.0	71	13	37.5	17	6	10.3	5	0	2.2
No certain	69	15	42	7	58.3	21	4	29.8	5	2	8.3	1	2	3.6
Total	384	56	210	24		137	21		31	8		6	3	

nontraumatic cases correlated with the degree of degenerative arthritis are given in fig. 9. Only slight, not significant differences in the frequency of osteoarthritis were found on comparing total meniscectomies in traumatic and nontraumatic cases.

Comments

With regard to the frequency of osteoarthritis no significant difference existed between knees where rupture of the semilunar cartilage was due to trauma or not. This verifies the conception that trauma is not import-

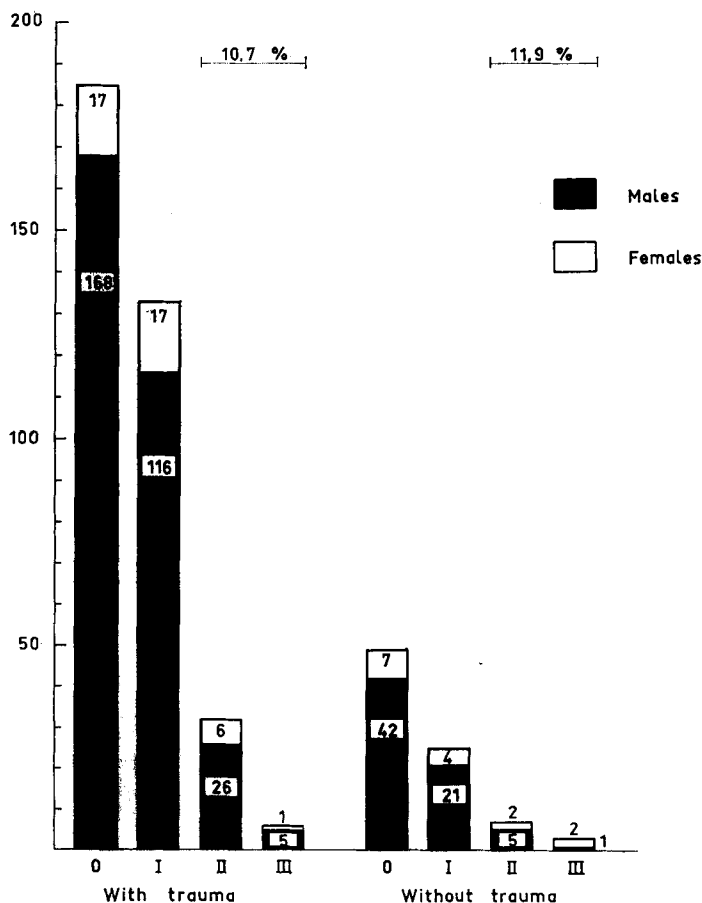


FIG. 9 Number of followed-up meniscectomized patients distributed by different groups of roentgenologic osteoarthritis and factor trauma. Percentage of osteoarthritic cases given at the top.

ant for the occurrence of osteoarthritis after meniscectomy (Rothascher 1960, Franke 1966). On the other hand, it may also be said that the obtained results do not support the opinion of the above-mentioned authors, that rupture of the semilunar cartilage without trauma causes a higher frequency of roentgenologic osteoarthritis in the meniscectomized knee, because of generalized degenerative changes of the joint.

d. OBSERVATION PERIOD

Many authors consider that the length of the observation period is of importance for the occurrence of degenerative arthritis in a meniscectomized knee. They maintain, therefore, that an observation period of at least 15—20 years is required for a material to be considered representative (Nitter 1946, Streli 1955, Saugmann-Jensen 1963, Allegreni & Dell'Orto 1965, Mohing 1966, Jackson 1968). Other authors consider that there is no connection between the frequency of osteoarthritis and a long observation period (Brechling 1942, Fuss 1951, Barfod & Bierring 1956, Tapper & Hoover 1969).

Own investigations

As has been previously stated, the observation period has been divided into 10-year periods. The largest number of cases was found in the observation period 4—13 years. In the entire material there was a higher frequency of radiologic signs of degenerative arthritis of groups II and III in patients with an observation period over 24 years than for those with one under 24 years (table 19). The increase in the frequency of osteo-

TABLE 19. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis with regard to the observation period in decades. M = males, F = females. % = M + F.*

Observation period	Total		Group 0				Group I			Group II			Group III		
	Number		Number		%		Number		%	Number		%	Number		%
	M	F	M	F			M	F		M	F		M	F	
4—13 years	219	44	125	21	55.5		80	16	36.5	10	6	6.1	4	1	1.9
14—23 „	106	8	59	3	54.4		37	3	35.1	9	0	7.9	1	2	2.6
24—33 „	53	4	23	0	40.3		17	2	33.3	12	2	24.6	1	0	1.8
34—43 „	6	0	3	0	50.0		3	0	50.0	0	0	0	0	0	0
Total	384	56	210	24			137	21		31	8		6	3	

arthritis for an observation period over 24 years is almost significant ($X^2 = 14.4^*$ d. f. = 6). For medially meniscectomized patients taken separately, there is also a significant increase in the frequency of osteoarthritis when the observation period exceeded 24 years ($X^2 = 9.5^*$ d. f. = 4). On the contrary, laterally meniscectomized knees do not show any significant differences in the frequency of osteoarthritis in relation to the length of the observation period. When correlating frequency of degenerative arthritis with length of the observation period for males and females separately, the males were found to have increased frequency when the observation period exceeded 24 years. The difference was significant ($X^2 = 13.39^{**}$ d. f. = 4). For the females no significant differences were observed.

TABLE 19 a. *Distribution of nonoperated knees in the different groups of roentgenologic osteoarthritis with regard to the observation period in decades. M = males, F = females. % = M + F.*

Observation period	Total		Group 0			Group I			Group II			Group III		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
4—13 years	219	44	216	42	98.1	3	2	1.9	0	0	0	0	0	0
14—23 „	106	8	104	6	96.5	2	0	1.7	0	1	0.9	0	1	0.9
24—43 „	59	4	55	4	93.6	2	0	3.2	2	0	3.2	0	0	0
Total	384	56	375	52		7	2		2	1		0	1	

As shown in table 19 a, increased frequency of degenerative arthritis occurs also in the nonoperated knee with the increase of time between the operation of the other knee and the follow-up examination. There was, further, a significantly higher frequency of osteoarthritis in the operated as compared with the nonoperated knee increasing with the period of observation, i. e. in the 4—13 years group ($X^2 = 134.04^{***}$ d. f. = 2); in the 14—23 years group ($X^2 = 54.92^{***}$ d. f. = 2); and in the 24—43 years group ($X^2 = 34.92^{***}$ d. f. = 2).

Comments

The results of this investigation show a significant increase in the frequency of roentgenologic signs of osteoarthritis for observation periods exceeding 24 years compared with those under 24 years. Thus, these results support the opinion that a material consisting of meniscectomized knees should have a sufficiently long observation period to be representa-

tive with regard to the roentgenologic signs of osteoarthritis (Nitter 1946, Streli 1955, Saugmann-Jensen 1963, Allegreni & Dell-Orto 1965, Mohing 1966, Jackson 1968).

Moreover, it is obvious from the studies of the nonoperated knee mentioned above, that the higher frequency of roentgenologic osteoarthritis with increasing time of observation does not only depend on the increasing age of the patient. Thus, it has been observed that the frequency of osteoarthritis was significantly higher in the operated than the nonoperated knee in all the groups of observation period.

e. OTHER FACTORS THAT POSSIBLY PROMOTE OCCURRENCE OF OSTEOARTHRITIS

Besides the factors already analyzed there may be others too which possibly can contribute to the occurrence of roentgenologic osteoarthritis following meniscectomy. The results of other analyzed factors will be presented here.

Clinical findings prior to operation, such as effusion, lockings, haemarthrosis or a combination of these occurred in 352 of the 440 cases or 80.4 per cent of total meniscectomies, distinctly more in the medially than in the laterally meniscectomized knees. No significant difference could be established in the frequency of osteoarthritis with regard to the presence or absence of preoperative clinical findings.

As has been previously stated, *roentgenologic signs of degenerative arthritis prior to operation* could be recorded only by means of the radiological reports. It was only in 36 out of 440 cases of totally meniscectomized knees that osteoarthritis had been reported. The frequency of degenerative arthritis at the follow-up investigation was significantly higher in patients with preoperative roentgenologic osteoarthritis than in those without ($X^2 = 36.41^{***}$ d. f. = 3). Among the 36 cases with preoperative roentgenologically demonstrable degenerative arthritis there were 9 knees which did not show any roentgenologic osteoarthritis at the follow up examination; these knees were regarded as belonging to group 0. This finding is in agreement with similar observations reported by Meier (1933) and Pelzl & Rueff (1969). A possible explanation of this regression of osteoarthritic changes may be, that a disturbing agent had been removed from the joint by meniscectomy.

Osteoarthritis and other secondary findings at operation were only described in the hospital records in a comparatively few cases (table 20). Statistical analysis of the effect of other secondary findings on the development of roentgenologic osteoarthritis after the operation was therefore not possible. Description of degenerative changes observed in the joint at the time of operation was, however, frequent and analysis with respect to this finding became possible.

The frequency of roentgenologic osteoarthritis was higher at the follow-up investigation in those patients who at operation had had demonstrable osteoarthritis compared with the patients without signs of it. The difference was highly significant ($X^2 = 24.04^{***}$ d. f. = 3). Here, it is also noteworthy that in 12 patients with osteoarthritis at operation, no signs of such a condition were found in radiographies taken at the follow-up examination.

TABLE 20. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis with regard to the various operative findings. M = males, F = females.*

Operative findings	Group 0 Number		Group I Number		Group II Number		Group III Number	
	M	F	M	F	M	F	M	F
Injuries of coll. lig.	2	0	1	1	0	0	0	0
„ „ cruc. „	3	0	2	0	0	0	0	0
Chondrom. patellae	1	1	5	1	2	0	1	0
Osteochondr. dissec.	2	0	4	0	1	1	1	0
Osteoarthritis	11	1	12	6	6	2	3	1

Signs of infection after operation were recorded in 21 cases (4.8 per cent). One of these cases was allocated to group II and another to group III. *Effusion* persisting longer than 3 weeks postoperatively was noted in the hospital records in 15 cases; none of these cases belonged to group III and only one in group II. *Haemarthrosis* was recorded in 20 cases, with one case in group II and none in group III. The frequency of osteoarthritis at the follow-up investigation did not show any significant differences between patients with and without such postoperative complications.

According to the hospital records *muscular training* had been applied postoperatively in 199 cases or in 45.2 per cent of the total meniscectomies. The frequency of roentgenologic signs of osteoarthritis at the follow-

up investigation in patients who had had muscular training compared with those where data on such training were lacking, did not show any significant difference.

Splint fixation was applied in 167 cases and fixation by a plaster cast only in 4 operated patients. The frequency of degenerative arthritis was higher in patients with postoperative fixation than in those without fixation. The difference is almost significant ($X^2 = 10.8^*$ d. f. = 3).³⁾

Patients who were *allowed to bear weight* on the operated leg first after the 2nd postoperative week had a higher frequency of osteoarthritic changes than those where weight bearing was allowed earlier. (Table 21). This difference is also almost significant ($X^2 = 10.07^*$ d. f. = 4).⁴⁾ This finding together with the observation that postoperative complications did not significantly affect the occurrence of osteoarthritis may indicate partly that restriction with weight bearing was probably due to different principles of treatment (Pelzl & Rueff 1969), and partly that early weight bearing does not promote the occurrence of osteoarthritis.

TABLE 21. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis in respect of the time when weight bearing was allowed postoperatively. M = males, F = females. % = $M \div F$.*

Postop. weight bearing	Total		Group 0			Group I			Group II			Group III		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Within 1 week	40	2	21	2	54.8	18	0	42.8	1	0	2.4	0	0	0
„ 8—14 days	258	31	150	14	56.7	82	13	32.9	22	4	9.0	4	0	1.4
After 2 weeks	86	23	39	8	43.1	37	8	41.3	8	4	11.0	2	3	4.6
Total	384	56	210	24		137	21		31	8		6	3	

Short or long *duration of postoperative hospitalization* did not show any significant difference when correlated with the frequency of osteoarthritis.

141 persons had had *athletic activities after operation*, or 32.0 per cent of the totally meniscectomized patients. None of these cases belonged to group III, and only 4 to group II. That postoperative sport could have a prophylactic effect on the occurrence of osteoarthritis is improbable; it

^{3—4)} The results obtained from the analysis of the roentgenologic findings based on the evaluation of the second radiologist showed no significant difference in the frequency of roentgenologic signs of osteoarthritis between a) patients treated with or without postoperative fixation, and b) patients who were allowed weight bearing earlier or later than 2 weeks.

is more likely that patients with degenerative arthritis refrained from sport after the operation. Scheibe (1963) pointed out, however, that athletic activities after operation do not appear to increase the frequency of osteoarthritis in meniscectomized knees.

The *type of occupation engaged in after operation* might conceivably be of importance for the occurrence of roentgenologic arthritis; work causing more knee strain would be liable to result in a higher frequency of osteoarthritis. On the whole, however, there is no significant difference between the various occupational groups in this material with regard to the frequency of degenerative arthritis.

According to Aarstrand (1954), the mean age of patients with roentgenologic signs of osteoarthritis at the follow-up examination was higher than that of patients without such findings.

As shown in table 22 the highest frequency of osteoarthritis occurred among patients who were at least 61 years old at the time of the follow-up investigation. The difference in the frequency of osteoarthritis compared with that of age groups under 61 at the follow-up is highly significant ($X^2 = 19.24^{***}$ d. f. = 4). If, besides *age at the follow-up investigation* also the length of the observation period is taken into consideration, the same high frequency of osteoarthritis will be found for patients over 61 years old and with a short observation period between 4—13 years. This difference is also highly significant ($X^2 = 19.45^{***}$ d. f. = 4). The significantly higher frequency of osteoarthritis in the oldest group of followed-up patients appears to be connected with the demonstrated higher frequency of degenerative arthritis for patients operated after 41 years of age.

A comparison has also been made between the operated and the non-operated knee in respect of the frequency of degenerative arthritis in the

TABLE 22. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis in respect of the patient's age at the follow-up. M = males, F = females. % = M + F.*

Age at follow-up	Total		Group 0			Group I			Group II			Group III		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Under 41 years	118	19	72	13	62.0	39	5	32.1	7	1	5.9	0	0	0
41—60 „	212	25	117	11	54.0	73	9	34.6	19	4	9.7	3	1	1.7
Over 61 „	54	12	21	0	31.8	25	7	48.5	5	3	12.1	3	2	7.6
Total	384	56	210	24		137	21		31	8		6	3	

various age groups at the follow-up. A significantly higher frequency of osteoarthritis is found in the operated knee in all age groups; in the age group under 41 years ($X^2 = 60.86^{***}$ d. f. = 2), in the group 41—60 years ($X^2 = 124.43^{***}$ d. f. = 2) and in the group over 61 years ($X^2 = 46.08^{***}$ d. f. = 2).

f. SUMMARY OF ROENTGENOLOGIC RESULTS

Roentgenologic osteoarthritis following meniscectomy has proved to be significantly more frequent in the operated knee than in the nonoperated knee.

On the whole it has not been possible to establish any significant difference between medially and laterally meniscectomized knees. In agreement with Franke (1966) a significantly higher frequency of roentgenologic osteoarthritis was found in this material too in women as compared with men.

Scheibe (1963) and Herschmann (1965) among others consider that preferably patients over 40—45 years should not be operated, because of the risk of osteoarthritis, developing in the operated knee as a result of the intervention, being greater in older patients than in younger. In this material it was also found that the frequency of osteoarthritis was higher in the operated knees of patients meniscectomized when they were over 41 years old compared with those operated before they were 41. The differences are almost significant for total meniscectomies in the entire material ($X^2 = *$), for medially meniscectomized knees ($X^2 = *$), and for men ($X^2 = *$).⁵⁾ The differences for laterally meniscectomized knees and for women were not statistically significant.

It has been maintained that a long latency period causes an increase in the frequency of degenerative arthritis in a meniscectomized knee (Nitter 1946, Barfod & Bierring 1956, Scheibe 1963, Franke 1966, Mohing 1966). This material has not shown any significant connection between a longer latency period and a higher frequency of osteoarthritis in the meniscectomized knees; this is in agreement with the observations of other authors (Saugmann-Jensen 1963, Allegreni & Dell'Orto 1965, Jackson 1968, Tapper & Hoover 1969).

⁵⁾ see footnote page 32

The importance of an initial trauma for the development of degenerative arthritis following meniscectomy has been pointed out earlier (Fuss 1951, Tapper & Hoover 1969). In the present material no statistically significant difference has been found, between the patients operated for traumatic and nontraumatic injuries of the semilunar cartilage, with regard to the frequency of roentgenologic osteoarthritis in the meniscectomized knee.

It has been asserted that the length of the observation period is of importance for the frequency of roentgenologic osteoarthritis. Consequently several authors have pointed out that a material can be regarded as representative only if the observation period is sufficiently long (Nitter 1946, Strelt 1955, Saugmann-Jensen 1963, Allegreni & Dell'Orto 1965, Mohing 1966, Jackson 1968). In this material an increasing frequency of degenerative arthritis has been found for longer observation periods than 24 years compared with shorter. In this respect the obtained differences are almost significant for the entire material of total meniscectomies ($X^2 = *$), for medially meniscectomized knees alone ($X^2 = *$), and highly significant for men alone ($X^2 = ***$).

Among other factors which possibly provoke osteoarthritis, preoperative symptoms — lockings, effusion, haemarthrosis or a combination of these — and postoperative complications have not been found to affect the frequency of roentgenologic osteoarthritis in a significant way. Correlation of the frequency of roentgenologic osteoarthritis with postoperative muscular training, duration of hospitalization, sport after operation, or effect on the knee of type of occupation did not give significant differences. On the other hand, a significantly higher frequency of degenerative arthritis at the follow-up examination was found in knees in which roentgenologic signs of osteoarthritis existed already prior to operation ($X^2 = ***$), if osteoarthritis was diagnosed at operation ($X^2 = ***$), if fixation was applied postoperatively ($X^2 = *$) ⁶), when weight bearing on the operated knee was allowed first after 2 weeks ($X^2 = *$) ⁷), and in patients of advanced age at the follow-up investigation in spite of shorter observation periods ($X^2 = ***$). Also by comparing the operated and the non-operated knee a higher degree of osteoarthritis was found in patients of advanced age at follow-up as compared with younger patients ($X^2 = ***$).

⁶⁻⁷) see footnote page 41

2. SUBJECTIVE COMPLAINTS

The reported frequency of different subjective complaints varies largely according to different authors (table 23). These variations are probably due to the different methods applied in collecting data. Some authors base their conclusions solely on answers to questionnaires sent to the subject (Strahlmann & White 1921, MacAusland 1931, Meier 1933, Sjövall 1942, Perey 1962). Other authors rely their reports partly on questionnaires and partly on interrogation at personal investigations (Lagergren 1953, Kühnel 1964, Huckell 1965). Some authors base their results exclusively on interrogation at the follow-up investigation (Birgfeld 1928, Aleman & Friberg 1934, Saugmann-Jensen 1963, Franke 1966).

Franke (1966) stated that 75.2 per cent of the patients with roentgenologic changes were subjectively entirely free from symptoms. Jackson (1968) also pointed out that there was not always agreement between roentgenologic signs of degenerative arthritis and subjective complaints.

Sjövall (1942) reported that in his material 44 per cent of the patients complained of weakness in the operated knee.

TABLE 23. *The frequency of subjective complaints in different groups according to different authors.*

Authors	Number of cases	Excellent %	Good %	Fair %	Bad %
Strahlman & White (1921)	50	86.0		14.0	
Birgfeld (1928)	68	79.4	16.2	2.9	1.5
MacAusland (1931)	287	80.1	9.8	10.1	
Meier (1933)	146	68.5	31.5	0	0
Aleman & Friberg (1934)	186	85.5			
Sjövall (1942)	140	20.1	51.4	26.4	2.1
Lagergren (1953)	97	64.0	21.0	10.0	5.0
Perey (1962)	33	70.0	15.0		
Saugmann-Jensen (1965)	93	61.3	25.8	7.5	5.4
Monn (1964)	52	56.0	19.0	25.0	
Kühnel (1964)	326	79.8	15.3	4.9	
Huckell (1965)	64	40.0	24.0	20.0	16.0
Franke (1966)	98	41.9	36.7	16.3	5.1
Appel (1970)	440	62.3	29.1	7.5	1.1

Own investigations

As was mentioned in the chapter on Methods, a standardized form was used to record subjective complaints reported by the patient. The frequency of these complaints, regardless of their degree, is shown in table 24. The two most frequent complaints were pain on weight bearing and a feeling of weakness in the knee. The frequency of pain on weight bearing was significantly higher in females ($X^2 = 21.39^{***}$ d. f. = 1) than in males. There was no significant difference between medially operated and laterally operated knees with regard to pain on weight bearing.

TABLE 24. *The frequency of different subjective complaints in patients after total meniscectomy.*

Subjective complaints	Medial		Lateral	
	Males	Females	Males	Females
Pain at rest	14	5	2	2
Pain on weight bearing	66	22	16	6
Weakness feeling	63	15	16	3
Walking disability	32	14	7	0
Lockings	3	3	2	0
Other complaints	15	1	5	0

Feeling of weakness in the operated knee did not show any significant difference between medially and laterally operated knees, nor when men and women were compared in this respect.

Difficulty in going upstairs or uphill occurred also comparatively often and the frequency was significantly higher for women than for men ($X^2 = 10.16^{**}$ d. f. = 1). No significant difference was established between medially and laterally meniscectomized knees.

Each patient might have no complaints or some or all of those included in the form. Each individual complaint was graded with symbols 1+, 2+ or 3+ according to the intensity mentioned by the patient. Thus, for example, a patient could complain of moderate pains on weight bearing (1+) and pronounced difficulty in going upstairs (2+) and at the same time also slight swelling (1+). This patient was given a *total grading* of 4+. Another patient complained, for example, of mild pain on weight bearing (1+) and moderate feeling of weakness in the knee (1+) and was given a *total* of 2+. A patient was placed with regard to the total score of + he acquired, in one of the four groups for subjective complaints i. e., *Excellent*: symptom-free; *Good*: 1+ or 2+; *Fair* 3+ or

4+ and *Bad*: 5+ or more. However a few patients stating several complaints of slight degree, were allocated to either group *Good* or *Fair* according to the general impression given by the described intensity of their combined complaints.

In respect of subjective complaint, the material consisting of total meniscectomies was divided according to the above principles, as shown in table 25.

TABLE 25. *Distribution of totally meniscectomized knees in different groups of subjective complaints. M = males, F = females. % = M + F.*

Operated meniscus	Total number		Excellent			Good			Fair			Bad		
	M	F	M	F	%	M	F	%	M	F	%	M	F	%
Medial	327	44	219	18	63.9	88	15	27.7	16	10	7.0	4	1	1.4
Lateral	57	12	32	5	53.6	18	7	36.3	7	0	10.1	0	0	0
Total	384	56	251	23	62.3	106	22	29.1	23	10	7.5	4	1	1.1

If subjective complaints are correlated with the roentgenologic findings it is obvious that there is not always an agreement between them (table 26).

TABLE 26. *Distribution of totally meniscectomized knees in different groups of subjective complaints correlated with the distribution by different roentgenologic groups of osteoarthritis. M = males, F = females.*

Roentgenologic findings	Total		Subjective complaints							
	M	F	Excellent		Good		Fair		Bad	
	M	F	M	F	M	F	M	F	M	F
Group 0	210	24	152	9	50	11	8	4	0	0
Group I	137	21	89	10	38	8	10	3	0	0
Group II	31	8	10	3	14	3	4	1	3	1
Group III	6	3	0	1	4	0	1	2	1	0
Total	384	56	251	23	106	22	23	10	4	1

If the occurrence of clear-cut subjective complaints of group *Fair* and group *Bad* is compared between women and men, the total subjective complaints show a significantly higher frequency for women ($X^2 = 15.92^{***}$ d. f. = 2). On the other hand, there is no significant difference between medially and laterally meniscectomized knees.

Comments

The present material shows a lower frequency of cases with clear-cut subjective complaints of groups Fair and Bad compared with the reports of other authors (table 23). Aleman & Friberg (1934) reported higher frequency of *Excellent* and *Good* results, without giving an account, however, of their bad results. Perey (1962) had a lower percentage of cases belonging to groups *Excellent* and *Good* and MacAusland (1931) a higher percentage belonging to groups *Fair* and *Bad*.

The present material shows a significantly higher frequency of subjective complaints for women than for men. There were no significant differences between medially and laterally meniscectomized knees.

As was also reported by Franke (1966) and Jackson (1968) in many cases here the degree of roentgenologic findings of osteoarthritis and the subjective complaints were not always in agreement.

In order to shed more light on the effect of the different factors on the subjective complaints, this has been analyzed in the same way as the roentgenologic findings.

a. AGE AT TIME OF OPERATION

Earlier reports maintain that the frequency of subjective complaints following meniscectomy is lower in younger than in older patients (Mac Ausland 1931, Saugmann-Jensen 1963). Lower frequency of subjective complaints has also been reported for elderly patients at the time of operation (Meier 1933). Some authors have maintained that nothing definite can be stated concerning the importance of age at operation for the occurrence of subjective complaints (Lagergren 1953, Monn 1964, Huckell 1965).

Own investigations

When the subjective complaints in this material are correlated with age at operation, for patients over and under 41 years, there are only small differences in the frequency of subjective complaints (table 27). These differences are not statistically significant.

Comments

Correlation between subjective complaints and age at operation does not show in the present material any statistically significant differences as regards the frequency for subjective complaints of the groups *Fair* and *Bad* in patients operated either before or after 41 years of age. These results point in the same direction as the results of several other authors, who consider that age at operation is of no importance for the occurrence of subjective complaints (Lagergren 1953, Monn 1964, Huckell 1965).

TABLE 27. *Distribution of totally meniscectomized knees in different groups of subjective complaints correlated with age at operation. M = males, F = females. % = M + F.*

Age at operation	Total		Excellent			Good			Fair			Bad		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Under 21 years	44	8	29	2		10	5		4	1		1	0	
21—30 „	144	12	87	3		46	8		10	1		1	0	
31—40 „	102	10	74	5		23	3		4	1		1	1	
Under 41 years	290	30	190	10	62.5	79	16	29.7	18	3	6.6	3	1	1.2
41—50 years	60	17	39	9		19	3		2	5		0	0	
51—60 „	32	8	21	4		7	2		3	2		1	0	
Over 61 „	2	1	1	0		1	1		0	0		0	0	
Over 41 years	94	26	61	13	61.7	27	6	27.5	5	7	10.0	1	0	0.8

b. LATENCY PERIOD

Several earlier authors consider the risk of increased frequency of subjective complaints following meniscectomy to be greater with longer latency period and, consequently, they recommend that operation should be performed as early as possible (Strahlman & White 1921, Birgfeld 1928, MacAusland 1931, Saugmann-Jensen 1963, Kühnel 1964, Huckell 1965). However, there are also authors who did not observe any correlation between subjective complaints and long latency period (Sjövall 1942, Monn 1964).

Own investigations

Table 28 and fig. 10 show the distribution of the material when subjective complaints are correlated with latency periods shorter and longer than 6 months. In total meniscectomies a higher frequency of knees, causing subjective complaints of the groups *Fair* and *Bad*, was observed among patients who were operated with a latency period of less than 6 months compared with knees operated after 6 months, but the difference is not statistically significant. No significant differences in the frequency of subjective complaints in respect of the latency period were observed for either medially or laterally meniscectomized knees or separately for men and women.

Nor has the length of the latency period any effect on the subjective complaints when correlating these with latency periods longer or shorter than 6 months in patients under or over 41 years at the time of operation.

Comments

In the present material no statistically significant differences in the frequency of subjective complaints were established for knees operated after latency periods longer or shorter than 6 months. These results are thus in agreement with the view that the length of the latency period is of no importance for the occurrence of subjective complaints (Sjövall 1942, Monn 1964).

TABLE 28. *Distribution of totally meniscectomized knees in different groups of subjective complaints correlated with the latency period. M = males, F = females. % = M + F.*

Operated meniscus	Latency period	Total Number		Excellent			Good			Fair			Bad		
		M	F	M	F	%	M	F	%	M	F	%	M	F	%
Medial	Under 6 months	177	28	120	13	64.9	46	8	26.3	11	6	8.3	0	1	0.5
Lateral	Under 6 months	27	2	14	2	55.2	9	0	31.0	4	0	13.8	0	0	0
Total under 6 months		204	30	134	15	63.7	55	8	26.9	15	6	9.0	0	1	0.4
Medial	Over 6 months	150	16	99	5	62.7	42	7	29.5	5	4	5.4	4	0	2.4
Lateral	Over 6 months	30	10	18	3	52.5	9	7	40.0	3	0	7.5	0	0	0
Total over 6 months		180	26	117	8	60.7	51	14	31.6	8	4	5.8	4	0	1.9

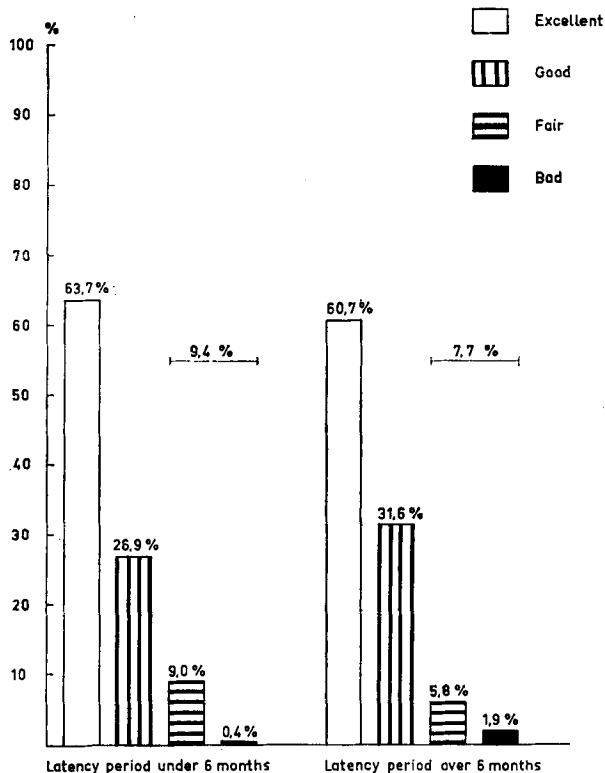


FIG. 10 Percentage of followed-up meniscectomized patients distributed by different groups of subjective complaints and latency periods. Percentage of groups Fair and Bad given together at the top.

c. TYPE OF TRAUMA

There are only a few authors who correlate the type of trauma or its absence with subjective complaints alone. It may be mentioned, however, that MacAusland (1931) stated that even slight traumata are important for the degree of subjective complaints after meniscectomy, while Tapper & Hoover (1969) consider that a more pronounced trauma may be the cause of increased subjective complaints.

Own investigations

When the total meniscectomies are divided into definitely traumatic and nontraumatic cases, and these two groups are then correlated with the

different groups of subjective complaints, the distribution shown in table 29 is obtained. Investigation of the relation between traumatic and non-traumatic injuries of the semilunar cartilage and the frequency of subjective complaints of the groups *Fair* and *Bad* after meniscectomy did not shows any significant differences.

Comments

In the present material there was no significant difference with regard to the subjective complaints, between knees meniscectomized because of traumatic and nontraumatic injuries of the semilunar cartilage respectively. This conflicts with the view held by other authors (MacAusland 1931, Tapper & Hoover 1969).

TABLE 29. *Distribution of totally meniscectomized knees in different groups of subjective complaints correlated with the factor trauma.*

M = males, F = females. % = M + F.

Operated meniscus	Factor trauma	Total		Excellent			Good			Fair			Bad		
		Number		Number		%	Number		%	Number		%	Number		%
		M	F	M	F		M	F		M	F		M	F	
Medial	traumatic	279	36	190	16	49.3	73	13	40.0	12	6	8.4	4	1	2.3
Lateral	„	36	5	18	2	48.8	12	3	36.6	6	0	14.6	0	0	0
Total	traumatic	315	41	208	18	63.5	85	16	28.4	18	6	6.7	4	1	1.4
Medial	nontraumatic	48	8	29	2	55.4	15	2	30.4	4	4	14.2	0	0	0
Lateral	„	21	7	14	3	60.7	6	4	35.7	1	0	3.6	0	0	0
Total	nontraumatic	69	15	43	5	57.2	21	6	32.1	5	4	10.7	0	0	0

TABLE 30. *Distribution of totally meniscectomized knees in different groups of subjective complaints correlated with the observation period in decades.*

M = males, F = females. % = M + F.

Observation period	Total		Excellent			Good			Fair			Bad		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
4—13 years	219	44	140	17	59.7	62	18	30.4	15	8	8.8	2	1	1.1
14—23 „	106	8	66	4	61.4	32	2	29.8	6	2	7.0	2	0	1.8
24—33 „	53	4	40	2	73.7	11	2	22.8	2	0	3.5	0	0	0
34—43 „	6	0	5	0	83.3	1	0	16.7	0	0	0	0	0	0
Total	384	56	251	23		106	22		23	10		4	1	

d. OBSERVATION PERIOD

Unanimity in assessing the importance of the length of the observation period in relation to subjective complaints is striking. No author has reported an increase in subjective complaints after a longer observation period. Most authors do not report any difference in this respect between cases with longer and shorter observation periods (Meier 1933, Sjövall 1942, Perey 1962, Tapper & Hoover 1969), while a decrease in subjective complaints after a longer observation period has also been reported (Monn 1964).

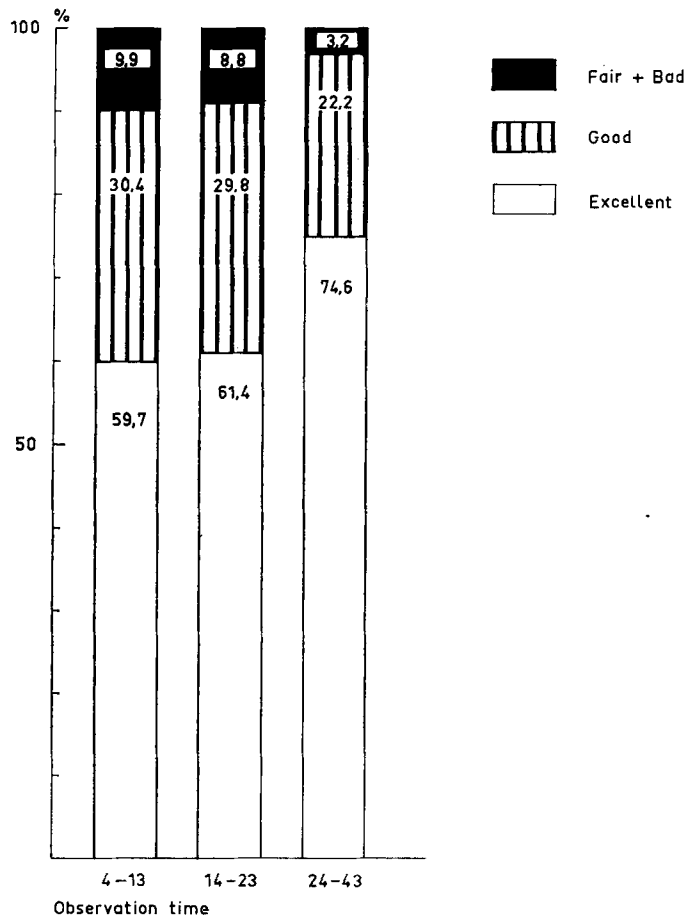


FIG. 11 Percentage frequencies of the different groups of subjective complaints according to observation period in decades.

Own investigations

Table 30 shows the subjective complaints after meniscectomy correlated with the observation time divided into 10-years periods. The frequency of subjective complaints of groups *Fair* and *Bad* decreased slightly with increasing observation periods (fig. 11). The differences are not significant.

Comments

In contrast to a significantly increased frequency of roentgenologic signs of osteoarthritis with an increasing observation period, there was a slight, though not significant decrease in the frequency of subjective complaints of groups *Fair* and *Bad*. This is in agreement with the conception of other authors regarding the influence of the observation period on subjective complaints (Meier 1933, Sjövall 1943, Perey 1962, Tapper & Hoover 1969).

e. OTHER FACTORS WHICH POSSIBLY PROVOKE SUBJECTIVE COMPLAINTS

A comparison between meniscectomized knees with and without *pre-operative clinical findings*, such as lockings, effusion etc. did not show any significant differences in respect of subjective complaints.

When comparing meniscectomized knees with and without *osteoarthritis diagnosed prior to or at operation*, there was no significant difference as regards the frequency of subjective complaints at the follow-up. *Other findings at operation*, such as osteochondritis, ligament injuries etc. occurred in so few cases that no analysis of these was possible.

No *postoperative complications* had occurred in any of the patients belonging to the group *Bad*. Nor did any patient in the group *Fair* display postoperative infection; but in this group there had been three cases of persisting effusion and two patients had had haemarthrosis. No statistically significant differences were observed in the frequencies of the subjective complaints when comparing knees separately with and without either of these postoperative complications after meniscectomy.

Meniscectomized knees in patients with and without *postoperative muscular training* did not show any significant differences on correlation with frequency of subjective complaints of groups *Fair* and *Bad*. The same applies also when comparing operated knees with and without *postoperative fixation*.

Meniscectomized knees where *weight bearing* was allowed first 2 weeks postoperatively showed an almost significant higher frequency of subjective complaints, when compared with knees where weight bearing was allowed earlier ($X^2 = 10.08^*$ d. f. = 4) (table 31).

Patients hospitalized for longer than 2 weeks after the operation showed a higher frequency of subjective complaints compared with those with a shorter *hospitalization* ($X^2 = 6.36^*$ d. f. = 2) (table 32).

No patient in the group *Bad* had practised any kind of *sport* after operation; only five in the group *Fair* had done so.

The *type of occupation after operation* had no significant influence on the frequency of subjective complaints.

With regard to the subjective complaints, *age at the follow-up investigation* does not seem to play the same role as for the roentgenologic findings. No significant differences were found between various age groups when these were correlated with the degree of subjective complaints.

TABLE 31. *Distribution of totally meniscectomized knees in different groups of subjective complaints correlated with the time when weight bearing was first allowed after operation. M = males, F = females. % = M + F.*

Postoperative weight bearing allowed	Total Number		Excellent			Good			Fair			Bad		
			Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Within 1 week	40	2	23	1	57.1	13	1	33.3	4	0	9.6	0	0	0
„ 8—14 days	258	31	174	12	64.3	71	15	29.7	11	4	5.2	2	0	0.8
After 2 weeks	86	23	54	10	58.7	22	6	25.7	8	6	12.8	2	1	2.8
Total	384	56	251	10		106	22		23	10		4	1	

TABLE 32. *Distribution of the degree of subjective complaints in totally meniscectomized knees correlated with length of postoperative hospitalization. M = males, F = females. % = M + F.*

Length of postoperative hospitalization	Total Number		Excellent			Good			Fair			Bad		
			Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
1 week	5	0	3	0	60.0	2	0	40.0	0	0	0	0	0	0
8—14 days	180	19	111	7	59.3	59	9	34.2	8	3	5.5	2	0	1.0
Over 2 weeks	199	37	137	16	64.9	45	13	24.6	15	7	9.3	2	1	1.2
Total	384	56	251	23		106	22		23	10		4	1	

f. SUMMARY OF SUBJECTIVE COMPLAINTS

On the whole, subjective complaints observed in the present material were of the same order of size as that reported by earlier authors (MacAusland 1931, Aleman & Friberg 1934, Perey 1962).

In several respects women were found to have a higher frequency of subjective complaints than men ($X^2 = **$ to ***).

Lower frequencies of subjective complaints for patients who were younger at operation had been reported earlier (MacAusland 1931, Saugmann-Jensen 1963). This conception has not been verified in this material. Thus, with regard to subjective complaints, no significant differences between patients operated before or after 41 year of age were found. This supports the view that the age at the time of operation does not influence the occurrence of subjective complaints (Lagergren 1953, Monn 1964, Huckell 1965).

The length of the latency period has not been found to influence significantly the frequency of subjective complaints. This corresponds with the statements of Sjövall (1942) and Monn (1964) among other investigators.

Trauma or its absence in connection with injury of the semilunar cartilage could not be significantly linked with the occurrence of subjective complaints after operation. This observation disagrees with the assertion made by MacAusland (1931) and Tapper & Hoover (1969), that an initial trauma gives rise to higher frequency of subjective complaints following meniscectomy.

The frequency of subjective complaints with regard to the length of the observation period showed no significant differences, which corresponds with earlier reported observations. (Meier 1933, Sjövall 1942, Perey 1962, Tapper & Hoover 1969).

Weight bearing at a later stage after the operation and longer hospitalization time have shown a significantly higher frequency of subjective complaints ($X^2 = *$).

3. OBJECTIVE CLINICAL FINDINGS

In reports concerning follow-up investigations of meniscectomized patients, thorough analysis of registered objective symptoms, such as decreased range of motion, loss of strength, and muscular atrophy is more or less neglected. Subjective complaints are sometime added to descriptions of the local status as reported by the patient in follow-up investigations based on questionnaires, or objective findings, subjective complaints and roentgenologic findings are all added together in the evaluation of the results of follow-up investigations performed personally by the author. Normal findings in respect especially of objective symptoms have been reported to vary between 40 and 70 per cent (Efskind 1939, Saugmann-Jensen 1963).

Own investigations

As stated in the chapter on "Methods", the objective symptoms observed at the follow-up examination were recorded on the standardized scheme 1 and the results of the comparison of the findings between the operated and the nonoperated knee were transferred to scheme 2. The frequency of the various objective symptoms is demonstrated in table 33. In this connection it should be pointed out that several objective symptoms may have been observed in the same patient.

TABLE 33. *The frequency of various objective findings at the follow-up in totally meniscectomized patients. The operated knee is compared with the non-operated.*

	Medial		Lateral		Total	%
	Males	Females	Males	Females		
Increased skin temp.	0	1	0	0	1	
Soft tissue swelling	6	13	2	1	22	5.0
Hypertrophied "Hoffa"	1	2	0	0	3	
Capsule thickening	11	12	5	2	30	6.8
Effusion	3	0	0	0	3	
Tenderness medially op.knee	54	14	3	1	72	16.4
„ laterally op. knee	7	2	5	0	14	3.2
Other localisation of tenderness op. knee	2	3	0	1	6	1.4
Moderate crepitation	206	29	38	5	278	63.2
Pronounced „	22	6	3	3	34	7.7
Lateral instability	7	1	0	0	8	1.8
Cruciate ligament instability	0	0	0	0	0	

Table 33 (continued)

	Medial		Lateral		Total	%
	Males	Females	Males	Females		
Decreased range of active extension (up to 10°)	8	4	1	0	13	2.9
Decreased range of active extension (more than 10°)	0	0	0	1	1	
Decreased range of active flexion (up to 10°)	20	3	7	1	31	7.0
Decreased range of active flexion (more than 10°)	9	6	6	0	21	4.8
Decreased muscular strength (more than 10°)	39	6	10	2	57	12.9
Quadriceps atrophy (more than 2 cm)	8	1	2	0	11	2.5

The most usual objective symptoms after meniscectomy in the present series were crepitation which occurred in more than 70 per cent of the patients. Tenderness on palpation of the medial side of medially as well as laterally meniscectomized knees was present in 16.4 per cent. Restricted active flexion occurred in 11.8 per cent, whereas 12.9 per cent of the patients had reduced muscular strength in the operated knee as compared with the nonoperated; decreased range of extension up to 10° in the operated knee compared with the nonoperated knee was present in 7.0 per cent of the cases.

Because of the relatively low frequency of clinical objective symptoms the material has been divided only into two groups when summing up these findings.

Normal group: To this group have been allocated not only patients without objective symptoms but also cases with a slight degree of a single objective finding, such as crepitations, reduced muscular strength, muscular atrophy or restriction of active flexion less than 10° .

Group with objective findings: All knees with more than one, or one pronounced objective finding, were assigned to this group.

The results, obtained on dividing the patients according to the above-mentioned principles, are shown in table 34. As seen in the table, a higher frequency of objective findings was present in laterally than medially meniscectomized knees, but the difference is not significant. A higher frequency of objective findings was observed for the women compared with the men, but this difference was also not significant.

No obvious correlation existed between objective findings and roent-

genologic signs of osteoarthritis or subjective complaints (tables 35 and 35 a).

The same analysis, as that done for the roentgenological findings and the subjective complaints, will be attempted in the following, in respect of the possible influence of different factors on the occurrence of objective clinical findings.

TABLE 34. *Totally meniscectomized knees distributed according to the absence or presence of objective findings at the follow-up. M = males, F = females. % = M + F.*

Operated meniscus	Total		Normal		%	With findings		%
	Number		Number			Number		
	M	F	M	F		M	F	
Medial	327	44	270	33	81.7	57	11	18.3
Lateral	57	12	40	10	72.5	17	2	27.5
Total	384	56	310	43	80.2	74	13	19.8

TABLE 35. *Roentgenologic signs of osteoarthritis correlated with the objective findings at the follow-up in totally meniscectomized patients. M = males, F = females.*

Objective findings	Total		Roentgenologic findings							
			Group 0		Group I		Group II		Group III	
	M	F	M	F	M	F	M	F	M	F
Normal	310	43	183	21	107	17	19	4	1	1
With findings	74	13	27	3	30	4	12	4	5	2
Total	384	56	210	24	137	21	31	8	6	3

TABLE 35 a. *Objective findings at follow-up correlated with the degree of subjective complaints in totally meniscectomized patients. M = males, F = females.*

Objective findings	Total		Subjective complaints							
			Excellent		Good		Fair		Bad	
	M	F	M	F	M	F	M	F	M	F
Normal	310	43	223	19	76	20	10	4	1	0
With findings	74	13	28	4	30	2	13	6	3	1
Total	384	56	251	23	106	22	23	10	4	1

a. AGE AT TIME OF OPERATION

In the entire material of totally meniscectomized knees objective findings correlated with age at operation, with a borderline at 41 years of age (table 36) are more frequent in patients operated after than before 41 years of age, the difference being highly significant ($X^2 = 16.80^{***}$ d. f. = 1). Similarly there was also a highly significant increase in objective findings in medially meniscectomized patients who were over 41 years when operated on compared with those under 41 at operation ($X^2 = 18.20^{***}$ d. f. = 1). The difference observed in laterally meniscectomized knees was not significant. Men and women separately showed also higher frequency of objective findings when meniscectomy was performed on patients over 41 years. The differences are significant for both men ($X^2 = 8.84^{**}$ d. f. = 1) and women ($X^2 = 9.93^{**}$ d. f. = 1).

TABLE 36. *Objective findings at follow-up correlated with age at operation in totally meniscectomized patients. M = males, F = females. % = M + F*

Operated meniscus	Age at operation	Total Number		Normal			With findings		
		M	F	M	F	%	M	F	%
Medial	Under 41 years	241	23	209	21	87.1	32	2	12.9
Lateral	„ 41 „	49	7	35	7	75.0	14	0	25.0
Total	under 41 years	290	30	244	28	85.0	46	2	15.0
Medial	Over 41 years	86	21	61	12	68.2	25	9	31.8
Lateral	„ 41 „	8	5	5	3	61.5	3	2	38.5
Total	over 41 years	94	26	66	15	67.5	28	11	32.5

b. LATENCY PERIOD

When correlating the latency period with the objective findings no great differences are found for patients operated after a latency period under or over 6 months (table 37). Throughout, the differences are not statistically significant.

Correlation of the objective symptoms, on the one hand, with the length of the latency period, and, on the other, with the age at operation, gave no significant differences for latency periods under or over 6 months, either for patients under 41 or for those over 41 years at operation.

TABLE 37. *Objective findings at follow-up correlated with the latency period in totally meniscectomized patients. M = males, F = females. % = M + F.*

Operated meniscus	Latency period	Total Number		Normal Number		%	With findings Number		%
		M	F	M	F		M	F	
Medial	Under 6 months	177	28	150	21	83.4	27	7	16.6
Lateral	„ 6 „	27	2	17	1	62.1	10	1	37.9
Total	Under 6 months	204	30	167	22	80.8	37	8	19.2
Medial	Over 6 months	150	16	120	12	79.5	30	4	20.5
Lateral	„ 6 „	30	10	23	9	80.0	7	1	20.0
Total	over 6 months	180	26	143	21	79.6	37	5	20.4

c. TYPE OF TRAUMA

When the objective findings are correlated with the factor preoperative trauma, no statistically significant differences are found in separate analyses for the entire material of total meniscectomies, for medial meniscectomies, for lateral meniscectomies, and for men and for women (table 38).

TABLE 38. *Objective findings at follow-up correlated with the factor trauma in totally meniscectomized patients. M = males, F = females. % = M + F.*

Operated meniscus	Factor trauma	Total Number		Normal Number		%	With findings Number		%
		M	F	M	F		M	F	
Medial	traumatic	279	36	230	28	81.9	49	8	18.1
Lateral	„	36	5	24	3	65.9	12	2	34.1
Total	traumatic	315	41	254	31	80.1	61	10	19.9
Medial	nontraumatic	48	8	40	5	80.4	8	3	19.6
Lateral	„	21	7	16	7	82.1	5	0	17.9
Total	nontraumatic	69	15	56	12	81.0	13	3	19.0

d. LENGTH OF OBSERVATION PERIOD

Table 39 shows the distribution for the entire material when correlating the groups of objective findings with the groups of different observation periods. Existing differences are not statistically significant. This applies to the entire material, to medially operated, to laterally operated knees, and to men and women taken separately.

TABLE 39. *Objective findings at follow-up correlated with the length of observation period in totally menisectomized patients. M = males, F = females.*
 $\% = M + F$.

Period of observation	Total Number		Normal			With findings		
	M	F	M	F	%	M	F	%
4—13 years	219	44	176	35	80.2	43	9	19.8
14—23 "	106	8	87	6	81.6	19	2	18.4
24—33 "	53	4	42	2	77.2	11	2	22.8
34—43 "	6	0	5	0	83.3	1	0	16.7
Total	384	56	310	43	80.2	74	13	19.8

e. OTHER FACTORS POSSIBLY CONNECTED WITH THE DEVELOPMENT OF POSTOPERATIVE OBJECTIVE FINDINGS

Preoperative clinical findings did not show any significant influence on the occurrence of objective symptoms postoperatively.

Secondary findings at operation — with the exception of osteoarthritis — could not be analyzed statistically on account of the few cases recorded. Knees with signs of osteoarthritis diagnosed at operation showed, compared with knees without osteoarthritis at operation, an almost significantly higher frequency of objective findings at the follow-up investigation ($X^2 = 5.38^*$ d. f. = 1).

Postoperative complications did not show any significant influence on the objective symptoms.

Nor was *postoperative muscular training* found to influence the objective symptoms significantly.

Knees treated with *postoperative fixation* showed a higher frequency

of objective findings compared with operated knees without postoperative fixation. The difference was almost significant ($X^2 = 4.04^*$ d. f. = 1).

An almost significant increase in the frequency of objective findings was observed in patients with later start with *postoperative weight bearing* compared with patients who were allowed weight bearing earlier ($X^2 = 8.56^*$ d. f. = 2).

Patients with longer *postoperative hospitalization* showed a significantly higher frequency of objective findings compared with those with shorter hospitalization ($X^2 = 10.25^{**}$ d. f. = 1).

Sport after operation did not influence significantly the frequency of objective symptoms.

The *type of occupation* did not seem to have any significant importance for the occurrence of objective symptoms in the meniscectomized knee.

TABLE 40. *Objective findings correlated with age at follow-up in totally meniscectomized patients. M = males, F = females. % = M + F.*

Age at follow-up	Total		Normal			With findings		
	Number		Number		%	Number		%
	M	F	M	F		M	F	
Under 41 years	118	19	98	18	84.9	20	1	15.1
41—60 „	212	25	178	19	83.1	34	6	16.9
Over 61 „	54	12	34	6	60.6	20	6	39.4
Total	384	56	310	43		74	13	

Age at the follow-up investigation correlated with the objective symptoms showed a higher frequency of objective findings in patients over 61 at the time of the follow-up, compared with younger patients (table 40). The observed difference is highly significant ($X^2 = 19.20^{***}$ d. f. = 2). On further correlation with the length of the observation period a highly significant increase in the frequency of objective findings was found in the group with the shortest observation period among older than in younger patients at the time of the follow-up ($X^2 = 22.10^{***}$ d. f. = 2). Thus, the high frequency of objective findings among older patients at the follow-up investigation seemed to be connected with the high frequency of objective findings among patients over 41 years at time of operation.

f. SUMMARY OF OBJECTIVE SYMPTOMS

Very few authors have presented separately, objective findings present in meniscectomized knees during follow-up investigations.

In the present material the scanty occurrence of objective symptoms is striking. With regard to objective findings, there were no statistically significant differences between medially and laterally meniscectomized knees, nor between men and women.

The frequency of objective findings was higher for patients who were over 41 years at operation compared with those operated before they were 41. The difference is highly significant for the entire material of total meniscectomies ($X^2 = ***$), and for medially meniscectomized knees analysed separately ($X^2 = ***$), and significant for men ($X^2 = **$) and for women ($X^2 = **$) separately.

A latency period shorter or longer than 6 months did not influence the occurrence of objective findings significantly.

Nor did trauma, as aetiologic factor for the injury of the semilunar cartilage, influence the occurrence of objective symptoms significantly.

The length of the observation period did not seem to play any significant role in the occurrence of objective symptoms.

With regard to the other factors which might possibly affect the occurrence of objective findings, the following proved to influence the results significantly.

Signs of degenerative arthritis at operation were followed by an almost significant increase in the frequency of objective findings at the follow-up examination ($X^2 = *$). Postoperative fixation also showed an almost significant increase in the frequency of objective findings ($X^2 = *$) and so did late weight bearing ($X^2 = *$). A significant increase in objective findings was connected with a longer period of hospitalization ($X^2 = **$). A more advanced age at the time of the follow-up, in combination with a short observation period and, consequently, advanced age at time of operation showed a highly significant increase in the objective findings ($X^2 = ***$).

4. COMBINED TOTAL RESULTS

In several reports on follow-up investigations of meniscectomized series no account is given of the roentgenologic findings, subjective complaints or objective symptoms separately. Usually total results combining all three parameters are presented, and the patients are divided into 4 groups (table 41). The criteria for this classification, which can vary to some extent between the different authors, are discussed below in connection with the own classification. In some reports, in this respect the patients are divided for preference into 3 groups (table 42).

TABLE 41. *Combined total results of earlier reported series distributed in 4 different groups.*

Authors	Total number	Excellent %	Good %	Fair %	Poor %	Type of oper.
Dengler (1938)	74	32.4	33.8	24.3	9.5	
Uebermuth (1941)	55	50.8	25.4	20.0	3.8	
Streli (1955)	82	74.4	24.4	1.2	0	partial
Scheibe (1963)	127	72.4	26.1	1.5	0	part. + tot.
Leuschner & Weickert (1964)	91	57.1	31.9	11.0	0	„
Herschmann (1965)	163	69.7	20.0	9.1	1.2	total
Springorum (1966)	150	96.7	2.0	1.3	0	„
Tapper & Hoover (1969)	113	42.0	25.0	20.0	13.0	part. + tot.

TABLE 42. *Combined total results of earlier reported series distributed in 3 different groups.*

Authors	Total number	Excellent %	Good %	Poor %
Raess (1930)	21	81.0	14.0	5.0
Spira (1933)	76	71.0	22.4	6.6
Meier (1933)	98	72.4	27.6	
Andersson (1934)	23	60.9	30.4	8.7
Brechling (1942)	45	78.0	11.0	11.0
Nitter (1946)	35	82.5	11.7	5.8
Barfod & Bierring (1956)	110	81.0	13.0	6.0

Reported results of follow-up investigations of meniscectomized patients are sometimes divergent.

Thus, it has been stated that a higher frequency of unsatisfactory total results occurs in laterally than in medially meniscectomized knees (Ale-

man & Friberg 1934, Uebermuth 1941), but also that the frequency of satisfactory combined results is higher after lateral than after medial meniscectomies (Meier 1933).

Several authors have reported a distinctly higher frequency of unsatisfactory total results in women compared with men (Aleman & Friberg 1934, Brechling 1942, Lagergren 1953, Barfod & Bierring 1956, Tapper & Hoover 1969).

It has further been reported that "excellent" total results were observed in all 25 followed-up patients, who were over 60 years at the time of the operation (Litchman et al. 1966).

Own investigations

The main part of the present material, which comprises all totally meniscectomized knees, has been subjected to separate analyses of the roentgenologic findings, the subjective complaints, and the objective symptoms, and has also been analyzed in respect of different factors which might possibly cause deterioration of the results. The entire material investigated will also be analyzed in the same way, with regard to the combined total results.

In conformity with several other authors the material has been divided into 4 groups. Certain variations in the criteria used for the division of the material in relation to those of other authors could not be avoided. The difficulties in obtaining entirely comparable principles of classification are illustrated, for example, by the fact that Streli (1955) includes, in his total group of "Gut" knees, with a range of motion "from fully extended up to 70° flexed position", while Springorum (1966) considers that knees, with such a restriction of motion "up to 70°", can obviously not be regarded as "Gut".

An account of the criteria used for allocation of the patients to the different groups is given below:

Group Excellent: comprises 1. patients with no subjective complaints, objective symptoms and roentgenologic findings. 2. cases with roentgenologic signs of osteoarthritis of grade I, if no subjective complaints or objective symptoms were simultaneously present, and 3. cases with subjective complaints of the type *Good* (1+), if there were no roentgenologic findings.

To *group Good:* were allocated patients with 1. grade II roentgenologic findings at most, if at the same time the subjective complaints were not more than of the type *Good* (1+), and there were no objective symp-

toms. 2. Subjective complaints of type *Fair* (3+) or less, but with simultaneous grade I roentgenologic findings at most and no objective findings.

Group Fair: 1. Most of the patients in this group had grade II roentgenologic findings and subjective complaints varying between *Good* and *Fair*, with objective findings. 2. Here were also included cases with grade III roentgenologic osteoarthritis, but then in association with either mild or no subjective complaints of group *Good* or *Excellent* and with objective findings. 3. Patients with grade 0 or I roentgenologic findings, but with simultaneous subjective complaints of type *Bad*, and with objective findings, were also placed in this group.

Group Poor: All the patients in this group had grade III roentgenologic findings, subjective complaints varying between *Fair* and *Bad*, as well as objective findings.

Table 43 shows the distribution of the totally meniscectomized knees in accordance with the grouping described above.

TABLE 43. Combined total results at follow-up in totally meniscectomized patients distributed in 4 groups. M = males, F = females. % = M + F.

Operated meniscus	Total		Excellent			Good			Fair			Poor		
	Number		Number	%		Number	%		Number	%		Number	%	
	M	F	M	F		M	F		M	F		M	F	
Medial	327	44	259	22	75.7	47	14	16.5	16	6	5.9	5	2	1.9
Lateral	57	12	41	8	71.0	14	3	24.7	2	1	4.3	0	0	0
Total	384	56	300	30	75.0	61	17	17.7	18	7	5.7	5	2	1.6

When comparing medially and laterally meniscectomized knees no significant differences were observed in respect of the combined late results.

A significantly higher frequency of unsatisfactory combined total results of group *Fair* and *Poor* was observed in the women as compared with the men ($X^2 = 16.53^{***}$ d. f. = 2).

Comments

If a comparison is made between the results of this material and those reported by other authors, it will be found that more satisfactory combined late results were obtained in the present investigation than in several earlier series (Dengler 1938, Uebermuth 1941, Leuschner & Weickerd 1964, Herschmann 1965). However, better results have also

been reported by earlier authors (Streli 1955, Scheibe 1963, Strelec & Wozleka 1964, Springorum 1966). Comparison of reported observations from series where the material is allocated to 3 and 4 groups respectively gives no reliable results. If, however, the group *Poor* in the former classification is considered to correspond to groups *Fair* and *Poor* in the classification with 4 groups, the frequency of unsatisfactory combined total results will be approximately the same according to both systems of classification.

In the present material there was a significantly higher frequency of unsatisfactory total results in women compared with men, which verifies the results reported by some earlier authors (Aleman & Friberg 1934, Brechling 1942, Lagergren 1953, Barfod & Bierring 1956, Tapper & Hoover 1969).

With regard to the combined total results no significant differences existed between medially meniscectomized and laterally operated knees, a fact which does not agree with some earlier reports (Meier 1934, Aleman & Friberg 1934, Uebermuth 1941).

In what follows analyses of the combined total results will be made with regard to the same factors, as for the roentgenologic findings, the subjective complaint, and the objective symptoms.

a. AGE AT TIME OF OPERATION

It has been stated earlier that the more advanced the age of the patient at operation the higher will be the frequency of unsatisfactory results, and the conclusion has been drawn that in patients over 40—45, meniscectomy should be performed only if absolutely necessary (Raess 1930, Meier 1933, Dengler 1938, Scheibe 1963, Herschmann 1965). It has also been maintained, however, that the age of the patient at operation does not affect the subsequent total result (Andersson 1934, Barfod & Bierring 1956, Saugmann-Jensen 1963, Litchman et al. 1966). A lower mean age at operation for patients with unsatisfactory results in the operated knee has even been reported by Nitter (1946).

Own investigations

When correlating the combined total results with age at operation, for the entire material of total meniscectomies a higher frequency of unsatisfactory results of groups *Fair* and *Poor* was found for patients operated

TABLE 44. Combined total results correlated with age at operation. M = males, F = females. % = M + F.

Operated meniscus	Age at operation	Total Number		Excellent Number %			Good Number %			Fair Number %			Poor Number %		
		M	F	M	F		M	F		M	F		M	F	
Medial	Under 41 years	241	23	191	14	77.7	39	7	17.4	10	2	4.5	1	0	0.4
Lateral	Under 41 years	49	7	35	4	69.6	12	3	26.8	2	0	3.6	0	0	0
Total	Under 41 years	290	30	226	18	76.2	51	10	19.1	12	2	4.4	1	0	0.3
Medial	Over 41 years	86	21	68	8	71.0	8	7	14.0	6	4	9.4	4	2	5.6
Lateral	Over 41 years	8	5	6	4	76.9	2	0	15.4	0	1	7.7	0	0	0
Total	Over 41 years	94	26	74	12	71.7	10	7	14.2	6	5	9.1	4	2	5.0

when over 41 years compared with those operated before 41 (table 44). The difference is significant ($X^2 = 12.21^{**}$ d. f. = 2). A similar, significant difference was also obtained for medially meniscectomized ($X^2 = 10.78^{**}$ d. f. = 2), but not for laterally meniscectomized knees alone. A comparison for men and women separately showed an almost significantly higher frequency of unsatisfactory results for men operated after 41 years than for those operated before 41 ($X^2 = 6.65^*$ d. f. = 2). A similar difference for women was not significant.

Comments

In the present material a higher frequency of unsatisfactory combined results was found for patients operated when over 41 years compared with those operated under 41. This appears to verify observations reported by earlier investigators (Raess 1930, Meier 1933, Dengler 1938, Scheibe 1963, Herschmann 1965).

b. LATENCY PERIOD

Higher frequency of unsatisfactory results of groups *Fair* and *Poor* has been reported following meniscectomy with long latency period, i. e. if a long time elapsed between trauma, or the onset of the complaint, and the operation (Meier 1933, Dengler 1938, Nitter 1946, Streli 1955, Barfod &

Bierring 1956, Scheibe 1963, Leuschner & Weickert 1964, Herschmann 1965). On this account these authors recommend that operation for ruptured semilunar cartilage should be performed as early as possible, but only after the acute symptoms have subsided. There are also some authors who were unable to find any clear-cut connection between the length of the latency period and a higher frequency of unsatisfactory results after a meniscectomy (Raess 1930, Spira 1933, Andersson 1934, Efskind 1939, Tapper & Hoover 1969). There is no unanimity about the demarcation line between a short and a long latency period, but many authors take 6 months as the borderline.

Own investigations

Table 45 shows the groups of combined results correlated with latency periods under and over 6 months. The small differences in the distribution of unsatisfactory results between short and long latency periods are not significant.

TABLE 45. *Combined total results correlated with the latency period. M = males, F = females. % = M + F.*

Operated meniscus	Latency period	Total		Excellent			Good			Fair			Poor		
		Number		Number		%	Number		%	Number		%	Number		%
		M	F	M	F		M	F		M	F		M	F	
Medial	Under														
	6 months	177	28	142	13	75.6	24	9	16.1	10	5	7.3	1	1	1.0
Lateral	Under														
	6 months	27	2	18	1	65.5	8	0	27.6	1	1	6.9	0	0	0
Total	Under 6 months	204	30	160	14	74.4	32	9	17.5	11	6	7.3	1	1	0.8
Medial	Over														
	6 months	150	16	117	9	75.9	23	5	16.9	6	1	4.2	4	1	3.0
Lateral	Over														
	6 months	30	10	23	7	75.0	6	3	22.5	1	0	2.5	0	0	0
Total	Over 6 months	180	26	140	16	75.8	29	8	17.9	7	1	3.9	4	1	2.4

Comments

In the present material it was not possible to demonstrate a deterioration in the combined results due to a longer latency period. This agrees with the conception that the length of the latency period does not affect the postoperative combined results (Raess 1930, Spira 1933, Andersson 1934,

Efskind 1939, Tapper & Hoover 1969). If the combined results are correlated with the latency periods, over and under 6 months respectively and at the same time with the age at operation, the length of the latency period will not be found to influence significantly the results for patients operated either before or after 41 years of age.

c. TYPE OF TRAUMA

Andersson (1934) and Streli (1955) consider that trauma as etiologic factor for the injury of the semilunar cartilage may be the cause of less satisfactory total results. Andersson (1934) found a fourfold unsatisfactory combined result for meniscectomies following a traumatic injury of the semilunar cartilage compared with nontraumatic cases. Tapper & Hoover (1969) consider that the less satisfactory results observed in young patients, operated before the age of 20 were due to severe trauma being responsible for the injury of the semilunar cartilage. A contrary opinion was held by Springorum (1966), who considers that less satisfactory results follow meniscectomies performed for nontraumatic ruptures. In such cases the rupture of the semilunar cartilage would be due to a higher degree of degeneration in both the semilunar cartilage and the knee as a whole, and hence the unsatisfactory results.

Own investigations

When correlating the combined groups of results after meniscectomy in traumatic and nontraumatic cases (table 46), no significant difference is found in the frequency of unsatisfactory results of groups *Fair* and *Poor*.

TABLE 46. *Combined total results correlated with the factor trauma. M = males, F = females. % = M + F.*

Operated meniscus	Factor trauma	Total Number		Excellent			Good			Fair			Poor		
		M	F	M	F	%	M	F	%	M	F	%	M	F	%
Medial	traumatic	279	36	225	19	77.5	36	12	15.2	14	5	6.0	4	0	1.3
Lateral	„	36	5	24	3	65.8	11	1	29.3	1	1	4.9	0	0	0
Total	traumatic	315	41	249	22	76.1	47	13	16.9	15	6	5.9	4	0	1.1
Medial	nontraumatic	48	8	34	3	66.0	11	2	23.2	2	1	5.4	1	2	5.4
Lateral	„	21	7	17	5	78.6	3	2	17.8	1	0	3.6	0	0	0
Total	nontraumatic	69	15	51	8	70.2	14	4	21.4	3	1	4.8	1	2	3.6

Comments

Contrary to Andersson (1934), Strelt (1955) and Tapper & Hoover (1969), in the present material there is no significant difference in the combined results after meniscectomy between traumatic and non-traumatic cases. Nor do the present results verify the view, that less satisfactory results would be achieved after meniscectomy in nontraumatic cases (Springorum 1966).

d. OBSERVATION PERIOD

Many authors consider that a sufficiently long observation period is required in order to be able to assess the late results following a meniscectomy. The length of a sufficiently long observation period is estimated, however, differently by different authors and, varies between 10 and 20 years; in general about 14—15 years.

It has been stated in this context that the length of the observation period does not play any role in the quality of the late results (Brechtling 1942, Barfod & Bierring 1956, Herschmann 1965). Better results have been reported, however, after a long observation period (Meier 1933, Spira 1933, Springorum 1966), but there are also reports to the contrary (Nitter 1946).

Own investigations

As is evident from table 47 only small differences existed between the various groups of observation periods in respect of unsatisfactory combined results of groups *Fair* and *Poor*. These differences were not significant.

TABLE 47. *Combined total results correlated with the observation period. M = males, F = females. % = M + F.*

Period of observation	Total		Excellent			Good			Fair			Poor		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
4—13 years	219	44	179	26	78.0	27	13	15.2	9	4	4.9	4	1	1.9
14—23 „	106	8	79	4	72.8	21	2	20.2	6	1	6.1	0	1	0.9
24—33 „	53	4	36	0	63.2	13	2	26.3	3	2	8.8	1	0	1.7
34—43 „	6	0	6	0	100.0	0	0	0	0	0	0	0	0	0
Total	384	56	300	30		61	17		18	7		5	2	

Comments

The results of this material show that the length of the observation period does not play any part in the development of the combined results, which is in agreement with the earlier reports mentioned above.

e. OTHER FACTORS POSSIBLY CAUSING DETERIORATION OF RESULTS

Preoperative clinical findings

MacAusland (1931) considers that preoperative clinical findings, such as lockings, effusion or combinations of these can often cause unsatisfactory combined results. Barfod & Bierring (1956), on the other hand, concluded that the frequency of lockings and effusion have no detrimental influence on the combined results.

Own investigations

As is evident from table 48, preoperative clinical findings were about equally distributed among the groups of combined total results. Existing small differences, with regard of unsatisfactory results, between knees with or without preoperative clinical findings were not significant.

TABLE 48. *Combined total results correlated with preoperative findings. M = males, F = females. % = M + F.*

Preoperative findings	Total Number		Excellent		Good		Fair		Poor	
	M	F	M	F	M	F	M	F	M	F
Only lockings	99	10	80	6	14	3	3	0	2	1
„ effusion	86	24	65	14	14	7	7	3	0	0
„ haemarthrosis	4	0	4	0	0	0	0	0	0	0
Lockings + effusion	113	8	86	3	20	2	4	3	3	0
„ + haemarthrosis	8	0	7	0	1	0	0	0	0	0
Total with preop. find.	310	42	242	23	49	12	14	6	5	1
%	100.0		75.3		17.3		5.7		1.7	
Without preop. findings	74	14	58	7	12	5	4	1	0	1
%	100.0		73.9		19.3		5.7		1.1	

Comments

In contrast to the data reported by MacAusland (1931), the present observations show that existence of preoperative clinical findings did not influence significantly the combined late results. This is in agreement with the results reported by Barfod & Bierring (1956).

Secondary findings at operation

Existence of varying intra-articular changes, among others, degenerative arthritis and lesions of the ligaments, diagnosed at the time of meniscectomy, have been reported to deteriorate the prognosis concerning the combined late results (Streli 1955, Springorum 1966, Mohing 1966).

Own investigations

Table 49 shows the frequency of different secondary findings at operation. On account of the few cases with secondary findings at operation, other than osteoarthritis, it was not possible to analyze these statistically. The frequency of unsatisfactory total results of groups *Fair* and *Poor* was, however, found to be higher in patients with than without osteoarthritis diagnosed at operation. The observed difference was highly significant ($X^2 = 26.44^{***}$ d. f. = 3).

TABLE 49. *Combined total results correlated with the various operative findings.*
M = males, F = females.

Operative findings	Total Number		Excellent		Good		Fair		Poor	
	M	F	M	F	M	F	M	F	M	F
Injuries of coll. lig.	3	1	1	1	2	0	0	0	0	0
" " cruc. "	5	0	5	0	0	0	0	0	0	0
Chondr. patellae	9	2	4	1	2	1	2	0	1	0
Osteochondr. dissec.	8	1	5	0	1	1	1	0	1	0
Osteoarthritis	32	10	19	5	5	3	5	1	3	1

Comments

The existence of osteoarthritis at operation has been shown to deteriorate significantly the combined late results after meniscectomy. The role possibly played by other secondary findings at operation could not be analyzed statistically on account of the few cases with such findings according to the available information in the hospital records.

Postoperative complications

Efskind (1939) stated that in his series less satisfactory results were observed consistently in patients with prolonged effusion in the joint after a meniscectomy.

Own investigations

The frequency of different postoperative complications with regard to the combined results is demonstrated in table 50. No patient belonging to group Poor had had such complications. No statistically significant differences in the frequency of unsatisfactory results of group *Fair* and *Poor* were found between patients with or without different postoperative complications.

TABLE 50. *Combined total results correlated with postoperative complications.*
M = males, F = females.

Postoperative complications	Total Number		Excellent		Good		Fair		Poor	
	M	F	M	F	M	F	M	F	M	F
Persisting effusion	14	1	7	1	6	0	1	0	0	0
Haemarthrosis	19	1	13	1	5	0	1	0	0	0
Signs of infection	19	2	17	1	2	0	0	1	0	0

Comments

The results obtained from the present material show that postoperative complications do not cause deterioration of the combined late results. This observation is contrary to the findings of Efskind (1939).

Postoperative treatment

Fixation with some type of splint or plaster is applied as a postoperative routine by many authors. Several others prescribe *muscular training* as part of their routine. No information is given, however, about the effect of these therapeutic managements on the combined results after meniscectomy. There is lack of information also regarding the influence of various routine measures on the late results: when postoperatively the patient is allowed to begin *weight bearing* on his leg, and the length of *postoperative hospitalization*.

Own investigations

During the long period covered by this material a number of routines must have been prevalent with regard to the above-mentioned postoperative forms of treatment. Thus, information on postoperative muscular training has been obtained for 199 patients, and application of postoperative fixation for 171 patients. This enables statistical analysis of the observed differences, and, hence reliable information can be obtained regarding the influence of these therapeutic measures on the combined results.

TABLE 51. *Combined total results correlated with different forms of postoperative treatment. M = males, F = females. % = M + F.*

Postoperative treatment	Total Number		Excellent		Good		Fair		Poor	
	M	F	M	F	M	F	M	F	M	F
Muscular training	170	29	143	17	19	9	6	2	2	1
%	100		80.4		14.1		4.0		1.5	
Without training	214	27	157	13	42	8	12	5	3	1
%	100		70.5		20.7		7.1		1.7	
Fixation by splint or plaster	150	21	120	11	22	7	4	2	4	1
%	100		76.6		17.0		3.5		2.9	
Without fixation	234	35	180	19	39	10	14	5	1	1
%	100		74.0		18.2		7.1		0.7	

Table 51 shows the allocation of the material to the different groups of combined total results, for the cases where muscular training was applied, and for patients treated with postoperative fixation separately. There were no significant differences in the frequency of unsatisfactory combined results between patients who were prescribed postoperative muscular training and those who were not, or between patients treated with or without postoperative fixation.

When correlating the combined late results with the time when weight bearing was first allowed postoperatively (table 52), it was found that the frequency of unsatisfactory results was higher for patients who began weight bearing later compared with those who began earlier, i. e. within 2 weeks after the operation. The differences were statistically significant ($X^2 = 13.66^{**}$ d. f. = 4).

The length of hospitalization did not influence significantly the frequ-

TABLE 52. Combined total results correlated with the time when weight bearing was first allowed after the operation. M = males, F = females. % = M + F.

Postoper. weight bearing allowed	Total		Excellent			Good			Fair			Poor		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Within 1 week	40	2	34	2	85.6	3	0	7.2	3	0	7.2	0	0	0
„ 8—14 days	258	31	203	19	76.8	43	10	18.3	9	2	3.8	3	0	1.1
After 2 weeks	86	23	63	9	66.1	15	7	20.2	6	5	10.1	2	2	3.6
Total	384	56	300	30		61	17		18	7		5	2	

TABLE 53. Combined total results distributed according to length of postoperative hospitalization. M = males, F = females. % = M + F.

Postoperative hospitalization	Total		Excellent			Good			Fair			Poor		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
1 week	5	0	5	0	100.0	0	0	0	0	0	0	0	0	0
8—14 days	180	19	136	13	74.9	34	6	20.1	8	0	4.0	2	0	1.0
Over 2 weeks	199	37	159	17	74.6	27	11	16.1	10	7	7.2	3	2	2.1
Total	384	56	300	30		61	17		18	7		5	2	

ency of unsatisfactory late results in patients discharged within the first two weeks after meniscectomy or later (table 53).

Comments

The fact that postoperative muscular training does not influence the frequency of unsatisfactory late results may not be surprising. Postoperative fixation was, however, expected to cause bad results, as was the case with roentgenologic findings⁸⁾ and objective symptoms. It is evident, however, that the fact that subjective complaints, were not influenced by postoperative fixation, probably affected the combined results to a greater extent than did the roentgenologic findings and the objective symptoms together. The observation that a delayed start with weight bearing caused significantly less satisfactory results is difficult to explain. It is possible, however, that patients with preoperative signs of roentgenologic osteoarthritis, osteoarthritis diagnosed at operation, or advanced age at operation, were not allowed early weight bearing and then the bad late results must be assigned to these factors rather than to the time of weight bearing per se.

⁸⁾ see footnote page 41

Age at the follow-up investigation

The mean age at the follow-up investigation was for patients with total meniscectomy 47.5 ± 0.6 years. When age at the follow-up investigation is correlated with the different groups of combined late results (table 54) there is a distinctly higher frequency of unsatisfactory results of group *Fair* and *Poor* for patients over 61 compared with younger persons at the time of the follow-up. The differences were highly significant ($X^2 = 19.60^{***}$ d. f. = 4). A further correlation with different observation periods did not show any statistically significant effect on the results for the different age groups at the time of the follow-up.

TABLE 54. *Combined total results distributed by patients' age at the follow-up examination. M = males, F = females. % = M + F.*

Age at follow-up	Total		Excellent			Good			Fair			Poor		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Under 41 years	118	19	98	12	80.3	16	6	16.1	4	1	3.6	0	0	0
41—60 „	212	25	162	13	73.8	39	9	20.3	9	2	4.6	2	1	1.3
Over 61 „	54	12	40	5	68.2	6	2	12.1	5	4	13.6	3	1	6.1
Total	384	56	300	30		61	17		18	7		5	2	

Comments

The observation of a higher frequency of unsatisfactory combined late results in patients over 61 at the time of the follow-up compared with younger patients can hardly be explained by any cause other than generalized changes of the knee with advancing age; meniscectomy might possibly promote the rapid development of such changes.

Sport and occupation after operation

Raess (1930) reported that the degree of occupational strain for the operated knee after the operation does not influence the late results and Meier (1933) stated that all the patients in his own material were able to return after the operation to their previous, often heavy, work.

Own investigations

Practising of sport after the operation did not cause deterioration in the combined late results (table 55). That so few of those who practised

TABLE 55. *Combined total results distributed according to the factor postoperative sport. M = males, F = females.*

Postoperative sport	Total		Excellent		Good		Fair		Poor	
	M	F	M	F	M	F	M	F	M	F
Medial	117	2	104	1	11	1	2	0	0	0
Lateral	22	0	18	0	4	0	0	0	0	0
Total	139	2	122	1	15	1	2	0	0	0

athletic activities after operation were placed in the groups *Fair* or *Poor*, can hardly be due to the fact, however, that sport after operation improved the results; it is more probable that patients with knee complaints after meniscectomy abstained from sport.

When the degree of occupational strain is correlated with the different groups of combined total results (table 56), it is found that the lowest frequency of unsatisfactory results occurred among those patients who, after operation, had the most knee-straining work. No statistically significant differences in the frequency of unsatisfactory late results were found for patients with heavier work compared with those having less knee-straining work after operation.

TABLE 56. *Combined total results distributed by type of occupational knee strain after operation. M = males, F = females. % = M + F.*

Type of work after operation	Total		Excellent			Good			Fair			Poor		
	Number		Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Mainly sitting work	57	10	45	7	77.6	7	3	14.9	5	0	7.5	0	0	0
Moderately knee-straining work	212	43	163	21	72.2	36	14	19.6	9	6	5.9	4	2	2.3
Knee-straining work	115	3	92	2	79.7	18	0	15.3	4	1	4.2	1	0	0.8
Total	384	56	300	30		61	17		18	7		5	2	

Comments

The results of the present investigation show that sport after meniscectomy does not aggravate the late results for the operated knee. This investigation also verifies earlier reports, namely, that the type of postoperative occupation does not influence the combined total results (Raess 1930, Meier 1933).

f. SUMMARY OF THE COMBINED TOTAL RESULTS

The results reported in this part can be summarized as follows:

a. In the present material of totally meniscectomized knees no significant differences, between medially and laterally operated knees, could be demonstrated with regard to the combined total results. The frequency of unsatisfactory total results was, however, higher for women compared with men, and this difference is highly significant ($X^2 = ***$).

b. Patients over 41 years at time of operation showed a higher frequency of unsatisfactory combined results of group *Fair* and *Poor* compared with patients under 41 at operation. Differences obtained in this respect are significant for the entire material of total meniscectomies ($X^2 = **$) and for medially operated knees alone ($X^2 = **$), and almost significant for men alone ($X^2 = *$). For laterally operated knees and for women separately the differences were not significant.

c. The length of the latency period was not of significant importance for the occurrence of unsatisfactory combined late results after meniscectomy.

d. No significant differences, could be shown in the combined results after meniscectomy, between patients whose lesion of the semilunar cartilage was of traumatic origin and those where it was not.

e. No significant differences, in the frequency of unsatisfactory total results of group *Fair* and *Poor* could be shown to exist in this material, between patients with shorter and longer observation periods respectively.

f. The occurrence of preoperative clinical findings has not been found to cause deterioration of the combined late results to a significant extent.

g. Osteoarthritis established at operation has caused a highly significant deterioration of the combined late results after meniscectomy ($X^2 = ***$).

h. Postoperative complications, such as effusion, haemarthrosis or signs of infection have not been shown to be of significant importance for the combined late results.

i. Muscular training or fixation after the operation had no significant influence on the late results.

j. The length of hospitalization did not influence the frequency of unsatisfactory results in a significant way. However, significantly higher frequency of unsatisfactory combined total results occurred in cases where weight bearing was allowed first after the 2nd postoperative week than in those where it was introduced earlier ($X^2 = **$).

k. The frequency of unsatisfactory results was significantly higher for

patients over 61 at the follow-up investigation compared with those under 61 ($X^2 = **$).

1. Athletic activities after operation do not seem to have caused deterioration of the late results after meniscectomy. Nor has occupational knee-strain postoperatively influenced the combined late results in any significant way.

5. TOTAL MENISCECTOMIES EXCLUDING CASES WITH PRE-OPERATIVE ROENTGENOLOGIC OSTEOARTHRITIS OR OSTEOARTHRITIS DIAGNOSED AT OPERATION

In earlier investigations of meniscectomized patients no special attention has been paid to cases with preoperative roentgenologic signs of osteoarthritis. Materials including such cases are inhomogeneous and the latter might, therefore, influence the degree of significance of the obtained results. Preoperative roentgenograms available for comparison at the time of follow-up examination restrict to some extent such an undesired interference.

The material reported on hitherto has included all cases of total meniscectomy. As mentioned earlier, preoperative radiographies were not available during the follow-up investigation. In order to ascertain whether the obtained results were influenced in any degree by the presence in the material of such patients as had preoperative roentgenologic signs of osteoarthritis or osteoarthritis diagnosed at operation, these cases were excluded and then the remaining material was analyzed in respect of roentgenologic findings and combined late results. A short account of the most important results obtained from these analyses will be given herewith.

TABLE 57. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis by age at operation. Patients with preoperative roentgenologic osteoarthritis or osteoarthritis diagnosed at operation are excluded. M = males, F = females. % = M + F.*

Age at operation	Total Number		Group 0			Group I			Group II			Group III		
			Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Under 41 years	270	26	159	14	58.5	87	9	32.4	22	3	8.5	2	0	0.6
Over 41 „	66	16	33	8	50.0	32	6	46.3	1	2	3.7	0	0	0
Total	336	42	192	22	56.6	119	15	35.5	23	5	7.4	2	0	0.5

When, after this exclusion, roentgenologic osteoarthritis at follow-up is correlated with age at time of operation, *there is no significant difference in the frequency of degenerative arthritis of grade II and III between patients operated before or after 41 years of age* (table 57). The same conditions were found to exist on correlating the combined late results with age at operation.

The length of the latency periods shows no significant influence on either the frequency of roentgenologic osteoarthritis or the frequency of unsatisfactory combined results.

The length of the observation period showed, even under these conditions, a highly significant increase in the frequency of roentgenologic osteoarthritis in the groups with longer observation period ($X^2 = 30.65^{***}$ d. f. = 4). On the other hand, an almost significant higher frequency of unsatisfactory combined late results of groups *Fair* and *Poor* was obtained in the new analysis with increasing length of the observation period ($X^2 = 11.03^*$ d. f. = 4), which was not the case when the total number of meniscectomies was analyzed.

TABLE 58. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis according to postoperative muscular training. Patients with preoperative roentgenologic osteoarthritis or osteoarthritis diagnosed at operation are excluded.*

	Total Number	Group 0 Number %	Group I Number %	Group II Number %	Group III Number %
Muscular training	157	102 65.0	50 31.8	5 3.2	0 0
No muscular training	221	112 50.7	84 38.0	23 10.4	2 0.9
Total	378	214	134	28	2

TABLE 58 a. *Combined total results distributed according to postoperative muscular training. Patients with preoperative roentgenologic osteoarthritis or osteoarthritis at operation are excluded.*

	Total Number	Excellent Number %	Good Number %	Fair Number %	Poor Number %
Muscular training	157	136 86.6	18 11.5	3 1.9	0 0
No muscular training	221	160 72.4	46 20.8	14 6.3	1 0.5
Total	378	296	64	17	1 0.5

Patients, who received postoperative muscular training, compared with those who did not, showed a highly significant decrease in frequency of

TABLE 59. *Distribution of totally meniscectomized knees in the different groups of roentgenologic osteoarthritis at follow-up according to postoperative fixation. Patients with preoperative roentgenologic osteoarthritis or osteoarthritis diagnosed at operation are excluded.*

	Total Number	Group 0 Number	%	Group I Number	%	Group II Number	%	Group III Number	%
Fixation postoperatively	147	77	52.4	65	44.2	4	2.7	1	0.7
No fixation „	231	137	59.3	69	29.9	24	10.4	1	0.4
Total	378	214		134		28		2	

roentgenologic osteoarthritis ($X^2 = 11.93^{***}$ d. f. = 2) as well as unsatisfactory combined results ($X^2 = 163.90^{***}$ d. f. = 2) (table 58 and 58 a).

From table 59 it is evident that patients treated with fixation with splints after operation showed a lower frequency of roentgenologic osteoarthritis of grade II and III when compared with patients treated without fixation. The difference is highly significant ($X^2 = 12.21^{***}$ d. f. = 2). On the other hand, even now there was no difference in respect of unsatisfactory combined results between patients with or without postoperative fixation.

The time when weight bearing was first allowed and the length of hospitalization did not show any significant differences with regard to roentgenologic osteoarthritis or unsatisfactory combined results. Apparently the previously observed significant differences in this respect were due to the fact that patients, with preoperative roentgenologic signs of degenerative arthritis or osteoarthritis at time of operation, were allowed to start weight bearing later and were also discharged from hospital later.

Results of follow-up investigation after partial meniscectomy

Reports regarding results of follow-up investigations of partially meniscectomized patients are scarce (table 41). Streli (1955), and Böhler (1955) have reported the results for a material consisting solely of partial meniscectomies. Scheibe (1963) and Leuschner & Weickert (1964) present results for totally and for partially meniscectomized knees separately. Tapper & Hoover (1969) state that the results after partial meniscectomy are not more satisfactory than after total meniscectomy, except when partial meniscectomy is performed in cases of so-called "bucket-handle" ruptures of the semilunar cartilage, where the results are better. Streli (1955) reported separately the results for roentgenologic findings and for combined total results, but not for subjective complaints or objective symptoms.

The material under review comprised only 21 partially resected cases, 17 of which were medially and 4 laterally meniscectomized. Only 2 women were partially meniscectomized, both medially. This material is too small to afford any possibility of an analysis similar to that of the material of total meniscectomies. A short account of this material will, however, be given.

1. ROENTGENOLOGIC RESULTS

In accordance with the principles of classification applied for the totally meniscectomized knees, the partial meniscectomies can be grouped as shown in table 60 (p. 86). The frequency of roentgenologic signs of degenerative arthritis was 9.5 per cent. Compared with the results obtained by Streli (1955) (table 41) who reported cases with osteoarthritis in 14.6 per cent, the results of the present material seem to be somewhat more

satisfactory. With regard to the frequency of roentgenologic findings of osteoarthritis, there were no significant differences between totally and partially meniscectomized knees.

Only one patient was operated when over 41. Twenty patients were younger than 41 at time of operation. The two patients in group II were operated with a latency period less than 6 months, and in both the rupture of the semilunar cartilage was of traumatic origin. — Regarding the observation period these two patients belonged to group 14—23 years. Moreover, it may be mentioned that none of the partially meniscectomized patients had postoperative complications.

2. SUBJECTIVE COMPLAINTS

When classifying the material into different groups with regard to the subjective complaints, the same criteria were used as for total meniscectomies. Fifteen men and 1 woman among the partially meniscectomized patients were allocated to the group *Excellent*, 3 men and 1 woman to the group *Good*, and only 1 man to the group *Fair*. None of these patients had subjective complaints of the type *Bad*. When the frequency of subjective complaints of groups *Fair* and *Bad* was compared between partially and totally meniscectomized patients no significant differences were found.

3. OBJECTIVE SYMPTOMS

With regard to objective symptoms the partially meniscectomized patients were assessed in the same way as the totally meniscectomized. Seventeen men and 1 woman belonged to the *normal* group, and 2 men and 1 woman to the group *with symptoms*. There was no significant difference between totally meniscectomized and partially meniscectomized knees in the frequency of cases with symptoms.

4. COMBINED RESULTS FOR PARTIAL MENISCECTOMIES

The principles used for the assessment of the combined results for the totally meniscectomized knees were also used for the partially operated. Fifteen men and 2 women belonged to the group *Excellent*, 3 men to the group *Good*, and 1 man to the group *Fair*. Observed differences in frequency of unsatisfactory combined results between totally and partially meniscectomized patients were not significant.

TABLE 60. *Partially meniscectomized patients distributed by different groups of roentgenologic osteoarthritis at follow-up. M = males, F = females.
% = M + F.*

Operated meniscus	Total Number		Group 0			Group I			Group II			Group III		
			Number		%	Number		%	Number		%	Number		%
	M	F	M	F		M	F		M	F		M	F	
Medial	15	2	9	2	64.7	5	0	29.4	1	0	5.9	0	0	0
Lateral	4	0	3	0	75.0	0	0	0	1	0	25.0	0	0	0
Total	19	2	12	2	66.7	5	0	23.8	2	0	9.5	0	0	0

TABLE 61. *"Double-operated" knees distributed according to the combined total results.*

"Double-operated" knees	Excellent	Good	Fair	Poor
Both knees medial	18	2	0	0
One medial + other lateral	3	3	0	0
Same knee medial and lateral	4	1	1	0
Number of operated knees	25	6	1	0

"Double-operated"

There are few reports regarding cases where more than one semilunar cartilage was removed and in none are the results of such cases analyzed separately. Streli (1955) reported one "double-operated" patient in his material. Springorum (1966) had in his material 51 patients in whom more than one semilunar cartilage was operated. Leuschner & Weickert (1964) stated that they had only 2 "double-operated" patients.

Own results

Here an account is given of 19 patients in whom 2 different semilunar cartilages were operated, either at the same operation or on two different occasions, in the same or in both knees. These patients were separated from the main material in order to make it as homogeneous as possible. Table 61 shows the grouping of the "double-operated" patients, with regard to the combined results. In the knee in the *Fair* group both semilunar cartilages were operated on the same occasion 20 years after the onset of the symptoms. The observation period was 8 years. The patient's disorder was almost entirely localized in the lateral side, where roentgenologic changes of type II were found. The patient had only moderate subjective complaints and objective symptoms.

On account of the character of the material, the results of these observations cannot be treated in the same way as in the main material. However, the following observation may be pointed out. No significant differences in the frequency of unsatisfactory combined results were found on comparing "double-operated", partially meniscectomized, and totally meniscectomized knees.

CHAPTER VII

Re-operations

In the dispute between the advocates of total meniscectomy and the adherents to partial meniscectomy, re-operations have also been used as an argument. It has, thus, been stated that after partial meniscectomy a new rupture of the remaining semilunar cartilage occurs only in about 0.5—1.0 per cent of the cases, while the risk for a new rupture after total meniscectomy is 3.0—5.0 per cent (Böhler 1955). Streli (1955) stated that in his material of 82 partially meniscectomized patients, and with an observation period of between 18 and 25 years, there was no case of relapse.

On the other hand, authors who advocate total extirpation of the semilunar cartilage maintain that a new rupture is rather usual after partial meniscectomy in the residual part of the cartilage, as sometimes also occurs after total meniscectomy (Andreesen 1937, Stumpfegger 1940, Schaefer 1953, Mandl 1954, Schilling 1963, Springorum 1966). Scheibe (1963) reported that among 127 total meniscectomies recurrence occurred in only 2 cases (1.5 per cent).

Own results

In this material, consisting of 480 meniscectomized and followed-up patients, there were 5 cases or 1.04 per cent where a new operation on a previously operated semilunar cartilage was necessitated. Of these five patients one had previously undergone partial resection of the semilunar cartilage, and in four total meniscectomy had been performed at the first operation. The percentage of a rupture of the "regenerate" after total meniscectomy, i. e. 0.9 per cent, diverged from that reported by Böhler.

General discussion

Operation on account of injuries of the semilunar cartilage in the knee tends to become more usual. The possibility of verifying the clinical diagnosis by means of arthrography is probably one of the reasons which contributed towards this development. The existence of several reports of a varying, but nonetheless unambiguous, frequency of roentgenologic osteoarthritis and unsatisfactory combined results after meniscectomy, gives rise to the question whether meniscectomy is an entirely safe and invariably necessary operation.

Access to a fairly large material of meniscectomies and the results of a follow-up investigation performed personally by the author made it possible to provide statistically verified data and thus, increase our knowledge of the fate of the meniscectomized knee in several respects. The following main questions put in the introduction can now be answered.

1. TO WHAT EXTENT DOES ROENTGENOLOGIC OSTEO- ARTHRITIS OCCUR AFTER MENISCECTOMY?

A significantly higher frequency of different signs of degenerative arthritis in the operated than in the nonoperated control knee is clearly demonstrated in this investigation. Thus, when the different signs of osteoarthritis are allocated to four groups it is found that patients with pronounced or severe roentgenologic signs of osteoarthritis in the operated knee represent 10.8 per cent of all totally meniscectomized knees. In the nonoperated knees the frequency of osteoarthritis was only 0.9 per cent. The frequency of roentgenologic signs of osteoarthritis in the meniscectomized knee has been reported to vary between 6.8 per cent (Rothascher

1960) and 40 per cent (Efsskind 1939). In general, a substantially higher frequency of osteoarthritis in the operated knee has been reported than that observed in this material. Thus, besides Efsskind, who has already been mentioned, Nitter (1946) reported a frequency of 34.3 per cent, and Franke (1966) a frequency of osteoarthritis in the operated knee of 38.8 per cent.

Conclusions

Different roentgenologic signs of osteoarthritis occur in a significantly higher frequency after meniscectomy in the operated knee compared with the nonoperated control knee in the same patients. The frequency of pronounced or severe osteoarthritis in the operated knee is 10.8 per cent⁹⁾ of all the totally meniscectomized knees. This relatively low frequency of knees with a considerable degree of osteoarthritis can hardly lead to the conclusion that one should abstain from removing a ruptured semilunar cartilage in the knee, despite the fact that osteoarthritis in the nonoperated knee was observed in only 0.9 per cent of the cases. No certain information exists on the extent of osteoarthritis which can occur in knees with an injured semilunar cartilage that is not operated.

2. TO WHAT EXTENT DO SUBJECTIVE COMPLAINTS, OBJECTIVE FINDINGS AND UNSATISFACTORY COMBINED RESULTS OCCUR AFTER MENISCECTOMY?

Subjective complaints in the meniscectomized knee occurred somewhat less frequently than roentgenologic findings in this material. There were 8.6 per cent of the patients who had distinct subjective complaints. The degree of subjective complaints was not always in agreement with the degree of roentgenologic findings. Thus, patients with substantial subjective complaints could be entirely without signs of roentgenologic osteoarthritis and vice versa.

The frequency of subjective complaints reported by different authors varies considerably. These variations are probably due to differences in the way the data were collected. If the frequencies obtained in the pre-

⁹⁾ see footnote page 30

sent material are compared with those reported by authors who, as in this material, obtained their information by means of personal interrogation (Birgfeld 1928, Aleman & Friberg 1934, Saugmann-Jensen 1963, Franke 1966), then, the frequencies of subjective complaints in the material under review are somewhat lower than those earlier reported.

The frequency of objective findings was still lower than that for subjective complaints and for roentgenologic findings. When the group *Excellent* for subjective complaints is compared with the group *Normal* for objective findings the frequencies are 62.3 per cent and 80.2 per cent respectively. Patients with objective findings could be entirely without signs of roentgenologic osteoarthritis or subjective complaints or vice versa.

There are very few other authors who have reported their results for objective findings separately. Usually these are evaluated together with the subjective complaints. Normal findings were reported by Efskind (1939) only in 40 per cent of his cases, whereas Saugmann-Jensen (1963) reported 70 per cent normal objective findings in his series.

If the roentgenologic findings, subjective complaints and objective symptoms were taken together, in order to estimate the combined total results, then 7.3 per cent of the operated knees gave unsatisfactory results of groups *Fair* and *Poor*.

Despite the fact that the classification used by several authors is in general similar to that used for the present material, reported results are largely divergent. Thus, Dengler (1938) reported unsatisfactory combined results in 33.8 per cent of the patients, and Tapper & Hoover (1969) in 32.0 per cent; on the other hand, Streli (1955) had only 1.2 per cent of cases with unsatisfactory results, and Springorum (1966) 1.3 per cent.

In the present material the frequency of unsatisfactory combined results was significantly higher for women than for men. Similar observations have also been reported by other authors, but only Tapper & Hoover found existing differences to be statistically significant.

Conclusions

The frequency of both subjective complaints and objective symptoms was lower than that of the roentgenologic findings, and this affects the combined results to some extent. Thus, there were 7.3 per cent of unsatisfactory combined results compared with 10.8 per cent of roentgenologic osteoarthritis in the meniscectomized knees. It is further evident that the combined results are influenced by the sex of the patients. Women show a significantly higher frequency of unsatisfactory combined results than men.

3. DOES AGE AT TIME OF OPERATION AFFECT THE RESULTS?

In all total meniscectomies in the present material a significantly higher frequency of roentgenologic osteoarthritis was established in patients operated when over 41 years than in those under 41. Objective symptoms also showed a significantly higher frequency for patients operated when over 41, while, on the other hand, subjective complaints did not show any significant difference in relation to age at operation. The frequency of unsatisfactory combined results was significantly higher for patients operated when over 41 years than for those under 41.

A higher frequency of roentgenologic osteoarthritis in elderly patients at the time of the operation was reported by Scheibe (1963) and Herschmann (1965) among other investigators. A higher frequency of subjective complaints in operated patients of advanced age was reported by MacAusland (1931) and Saugmann-Jensen (1963). Higher frequency of unsatisfactory combined results for older patients at operation has been reported by several authors (Raess 1930, Meier 1933, Degler 1938, Scheibe 1963, Herschmann 1965). Many of these authors consider that injuries of the semilunar cartilage in patients over 40—45 should not be operated unless the intensity of the symptoms makes the intervention absolutely necessary.

As part of the investigation, meniscectomized knees with preoperative roentgenologic osteoarthritis or demonstrable osteoarthritis at operation were excluded from the total material, in order to ascertain the effect of the operation on a more homogeneous material. When the remaining meniscectomies are correlated with age at operation there is no significant difference, between patients operated when either over 41 or under 41, with regard to the frequency of roentgenologic signs of osteoarthritis or of unsatisfactory combined results. This is in agreement with the statement that there is no difference between older and younger operated patients with regard to the combined results (Nitter 1946, Lagergren 1953, Barfod & Bierring 1956, Monn 1964, Huckell 1965). Litchman et al. (1966) reported "Excellent" combined results in a series where all patients were at least 60 years old at time of operation.

Conclusions

The statement that a meniscectomy should not be performed on persons of advanced age must be regarded as too far-reaching. There is, however, reason to be more restrictive about operating on elderly patients if

roentgenologic osteoarthritis is present already preoperatively. If this is not the case, then there does not seem to be any reason why a diagnosed injury of the semilunar cartilage should not be operated in elderly patients, for the same indications as those for younger patients.

4. IS THE LENGTH OF THE LATENCY PERIOD OF ANY IMPORTANCE FOR THE RESULTS AFTER MENISCECTOMY?

The length of the latency period had no significant influence on any of the recorded findings or on the combined results in the present material.

With regard to the reports of several authors who in view of their observations recommend operation as early as possible (Strahlman 1921, Birgfeld 1928, MacAusland 1931, Meier 1933, Dengler 1938, Nitter 1946, Streli 1955, Barfod & Bierring 1956, Scheibe 1963, Kühnel 1964, Leuschner & Weickert 1964, Huckell 1965, Herschmann 1965, Mohing 1966, Franke 1966, Gear 1967, Pelzl & Rüeff 1969), a longer latency period was expected to give rise to a higher frequency of roentgenologically demonstrable osteoarthritis and unsatisfactory late results. However, in the present material this was not the case, which is in agreement with the reports of other authors (Raess 1930, Spira 1933, Andersson 1934, Efskind 1939, Sjövall 1942, Saugmann-Jensen 1963, Monn 1964, Allegreni & Dell'Orto 1965, Jackson 1968, Tapper & Hoover 1969). The significance of the observed results has been verified statistically in the present series and only in two earlier works (Jackson 1968, Tapper & Hoover 1969).

Nor did the length of the latency period affect the obtained results when the cases with preoperative signs of roentgenologic osteoarthritis or osteoarthritis diagnosed at operation were excluded.

Conclusions

If the clinical and roentgenologic diagnosis of ruptured semilunar cartilage is uncertain, there is no reason to decide on an early operation of an exploratory character. The operation can be postponed until the internal derangement of the knee is further manifested, for example, by repeated locking or swelling, since the risk of higher frequency of osteoarthritic changes is not thereby significantly increased.

5. DOES THE TRAUMATIC ORIGIN OF A RUPTURED SEMILUNAR CARTILAGE PLAY ANY PART IN THE RESULTS?

No significant influence on the obtained results was observed when traumatic and nontraumatic ruptures of the semilunar cartilage were correlated with the different findings following a meniscectomy. Some authors have maintained that a higher frequency of unsatisfactory results occurs after operation in cases of traumatic ruptures of the semilunar cartilage (Andersson 1934, Fuss 1951, Strelé 1955, Tapper & Hoover 1969). This observation was statistically proved in the series of Tapper & Hoover, but the present results do not verify this conception. Nor do the present results verify Springorum's (1966) view, that less satisfactory results are obtained after meniscectomy if the injury was sustained without any definite trauma. According to Springorum unsatisfactory results in such cases are due to a higher degree of degeneration in both the semilunar cartilage and the joint as a whole.

Conclusions

Whether the injury of the semilunar cartilage was of traumatic origin, or no certain trauma was established, neither of these conditions was found to be of any significance for the late results following meniscectomy.

6. IS THE LENGTH OF THE OBSERVATION PERIOD DECISIVE FOR THE UNSATISFACTORY RESULTS OBTAINED AFTER MENISCECTOMY?

A correlation of the roentgenologic findings at the follow-up investigation with the different groups of observation periods showed a significant increase in the frequency of osteoarthritis with progressing length of the observation period. The correlation is particularly evident when observation periods over and under 24 years are compared. This is in agreement with the findings of other authors who consider that analyses of the results after meniscectomy are representative only if there is a sufficiently long observation period (Nitter 1946, Strelé 1955, Saugmann-Jensen 1963, Allegreni & Dell'Orto 1965, Mohing 1966, Jackson 1968). That the frequency of osteoarthritis increases with longer observation period may, to a certain extent, be due to the fact that osteoarthritis is more common in persons of advanced age. A higher frequency of osteo-

arthritis in the operated knee has been found, however, even in elderly patients with a shorter observation period. Moreover, when patients with preoperative osteoarthritis were excluded from the material, the frequency of osteoarthritic changes at the follow-up was still significantly higher in the groups of longer observation period. Furthermore, increasing frequency of osteoarthritis occurred also in the nonoperated knee in patients with a long observation period, but the frequency of osteoarthritis was significantly higher in the operated knee compared with the nonoperated in all the groups of observation period. These findings provide evidence that the increased frequency of osteoarthritic changes observed in patients with a long observation period was an effect of the meniscectomy rather than of the more advanced age of the patients.

Contrary to the roentgenologic findings, subjective complaints, objective findings and combined total results were not influenced significantly by the length of the observation period. Nor have other authors reported that a longer observation period had any effect on the combined late results (Brechling 1942, Barfod & Bierring 1956, Herschmann 1965).

Conclusions

A material of meniscectomized patients is considered representative if there is a sufficiently long observation period. In respect of roentgenologic findings the results of the present investigation confirm this statement. The most accurate conception of the importance of an observation period for the late results after meniscectomy would be obtained, however, if the same material of meniscectomies was followed up on different occasions at intervals, for example of 5—10 years.

7. ARE THE LATE RESULTS AFTER MENISCECTOMY INFLUENCED BY ANY OTHER FACTORS?

a. *Preoperative clinical findings:* effusion, lockings, haemarthrosis or a combination of these, have not been shown in this investigation to affect significantly the late results. Barfod & Bierring (1956) stated that especially Anglo-American authors consider that osteoarthritis after meniscectomy is related to preoperative clinical findings rather than to the operation itself. These authors point out, however, that in their own material there was no correlation between preoperative clinical findings and development of degenerative osteoarthritis after meniscectomy.

Conclusions

The observation that the occurrence of preoperative clinical findings does not influence the late results after meniscectomy supports the conclusions drawn with regard to the latency period, namely, that the late results are not necessarily worse after long postponement before operation.

b. *Preoperative osteoarthritis*, demonstrated roentgenologically or at operation has been shown to give rise to unsatisfactory late results to a significantly greater extent. At the same time it was found at the follow-up investigation that 9 patients who did not show signs of roentgenologic osteoarthritis at the follow-up exhibited such changes preoperatively. In 12 cases, in which osteoarthritis was found at operation, there were no roentgenologic signs of such a condition at the follow-up. Similar findings have been reported by Meier (1933) and Pelzl & Ruëff (1969). A possible explanation of this "regress" of osteoarthritic changes after meniscectomy may be the removal of a disturbing agent from the joint.

Conclusions

Preoperatively demonstrated osteoarthritis either radiologically or at operation cannot be regarded as a contraindication to meniscectomy. But such preoperative findings may require caution before operating, especially on elderly patients.

c. *Postoperative infection* was reported in the patients' records in 4.8 per cent. *Other signs of postoperative complications*, such as effusion in the joint, prolonged for more than 3 weeks, or haemarthrosis were recorded rarely in this series. When they did occur there was no significant deterioration in the late results after meniscectomy. According to Efsskind (1939), one could believe that prolonged postoperative effusion would cause a higher frequency of unsatisfactory results. This is not verified by the present material.

Conclusions

Postoperative complications need not necessarily cause a higher frequency of unsatisfactory results.

d. *Postoperative muscular training* in totally meniscectomized patients exerted no significant influence on the late results. However, when patients with preoperative osteoarthritis, diagnosed radiologically or at ope-

ration, are excluded from the material, a significantly higher frequency of osteoarthritis and unsatisfactory combined results is found in patients who did not have postoperative muscular training compared with those who did. A significantly higher frequency of roentgenologic osteoarthritis occurred in patients with total meniscectomy where *postoperative fixation* was applied, compared with those where it was not.¹⁰⁾ On the other hand, postoperative fixation was not found to have any significant effect on the combined results. The same conditions were prevalent also when patients with preoperative osteoarthritis were excluded from the total material.

Conclusions

The results reported above indicate that physiotherapy and especially muscular training should be introduced as early as possible after a meniscectomy. This is at present a generally accepted routine procedure in the postoperative treatment of meniscectomized patients.

e. Patients who were allowed *to bear weight* on the operated leg first after the 2nd postoperative week showed a significantly higher frequency of roentgenologic osteoarthritis¹¹⁾ and unsatisfactory combined results than patients starting weight bearing earlier. Postoperative weight bearing at a later stage may be a routine measure applied by some surgeons. It is probable, however, that patients with preoperative osteoarthritis, diagnosed radiologically or at operation, were not allowed to start weight bearing until later after the operation. This assumption is supported by the fact that no significant differences in respect of either earlier or later weight bearing were found when all the patients with preoperative osteoarthritis were excluded from the material of totally meniscectomized knees.

Nelson (1968) reported better results for patients who were allowed to bear weight already after 3—4 days, though with the knee immobilized with a splint for 2 weeks, compared with those who only started weight bearing after 8—10 days.

Conclusions

Starting weight bearing at an earlier or later stage postoperatively did not seem to influence either the roentgenologic findings or the combined results when patients with diagnosed osteoarthritis already at the time of the operation were excluded from the total material.

^{10—11)} see footnote page 41

f. Prolonged *postoperative hospitalization* seemed to be connected with a higher frequency of unsatisfactory combined results, but the increased frequency was apparently linked with patients who had osteoarthritic changes in the knee already at the time of the operation. Evidently for this reason the hospitalization time was prolonged for such patients.

g. *The type of occupation* after meniscectomy does not seem to influence the late results. Patients who performed heavy work that involved knee strain did not show higher frequency of osteoarthritic changes in the knee or of unsatisfactory late results compared with patients engaged in lighter work. In this material only 8 patients stated that they had had to change to lighter work because of difficulties with the operated knee. Four of these patients reported at the follow-up that they had only slight subjective complaints.

Raess (1930) and Meier (1933) also stated that the type of work did not influence the postoperative results.

Conclusions

As might be expected, the degree of the occupational strain on the knee after meniscectomy does not appear to affect the results. Heavier work, requiring greater knee strain, did not cause a higher frequency of osteoarthritis or of unsatisfactory combined results. Consequently, there is no reason to advise a patient to change to lighter work after meniscectomy.

h. Patients who were older at the follow-up investigation showed a significantly higher frequency of osteoarthritis, objective symptoms and unsatisfactory combined results compared with younger patients. There was no difference in the frequency of subjective complaints between older and younger patients. In respect of roentgenologic osteoarthritis and objective symptoms the significantly higher frequency observed in older patients was associated with a shorter observation period, which was not the case for the combined results. In the present material the frequency of degenerative arthritis increased with advancing age also in the operated knee. However, the frequency of osteoarthritic changes in all the age groups at the follow-up was significantly higher in the operated than in the nonoperated knee.

Conclusions

It is clear that the older the patient the more liable he will be to osteoarthritic changes in his knees. It appears, however, that a meniscectomized

knee is affected by osteoarthritis to a still greater extent than a non-meniscectomized knee. This has also been pointed out earlier (Jackson 1968).

8. SHOULD A RUPTURED SEMILUNAR CARTILAGE BE PARTIALLY OR TOTALLY REMOVED?

In the present material there were only 21 knees where a partial meniscotomy was performed. These were also classified in the same way as the totally meniscectomized knees, namely, in different groups depending upon the degree of the roentgenologic findings, subjective complaints, objective findings, and in respect of the combined results. When the partially meniscectomized knees were compared statistically with the totally meniscectomized there were no significant differences in the frequency of roentgenologic osteoarthritis, the subjective complaints, the objective symptoms, or the unsatisfactory combined results.

Conclusions

The results obtained in this material did not show any significant differences between partially and totally meniscectomized knees. Consequently, the author considers that in each individual case it should be decided which surgical method is to be preferred.

Summary and general conclusions

1. MATERIAL

a. The material of this investigation consists of 480 out of a total of 718 patients who were operated for injuries of the semilunar cartilage during the years 1921—1960 at the Regional Hospital in Linköping, Sweden. Of these 480 patients, who were followed-up personally, and evaluated as well clinically as roentgenologically, 440 were subjected to total meniscectomy and form the main material for this investigation.

b. The mean age of the patients at the time of the operation was for the entire material 31.9 ± 0.46 years and for the followed-up 33.5 ± 0.53 years.

c. The sex distribution for the entire material was, females to males 1 : 7.54, and for the followed-up patients 1 : 7.27.

d. The ratio lateral to medial meniscectomies was for the entire material 1 : 4.43 and for the followed-up patients 1 : 5.08.

e. The ratio left to right operated knee was for the entire material 1 : 1.20 and for the followed-up patients 1 : 1.26.

f. Definite trauma was stated to be the cause of the injury of the semilunar cartilage in 80 per cent both in the entire and in the followed-up material.

Trauma sustained in connection with athletics was reported as the cause of the injury of the semilunar cartilage in 28 per cent.

g. Meniscectomies after a latency period of more than 6 months were performed in 45.3 per cent of the entire material and in 46.8 per cent of the followed-up patients.

h. For 199 cases (41.5 per cent) the observation period was at least 14 years and for 73 cases (15.2 per cent) it was at least 24 years.

2. METHODS

a. *Roentgenologic findings*

When assessing the signs of osteoarthritis present on the radiographies made at the follow-up investigation, the nonoperated knee was taken as the control. The different signs of osteoarthritis in the operated and the nonoperated knee were summed up and divided into 4 groups in accordance with the degree of osteoarthritis. *Group 0*: no sign of osteoarthritis; *Group I*: signs of *initial* osteoarthritic changes; *Group II*: *pronounced* osteoarthritis; *Group III*: *severe* osteoarthritis.

Because of the difficulties encountered in meeting the need of objective evaluation of the radiographies and in order to obtain as safe information as possible from the results of the radiologic study, two senior radiologists were asked to evaluate the radiograms separately without consulting each other. The results of each evaluation were then analyzed separately. Despite the fact that the allocation of the material to the 4 groups of radiologic findings varied considerably in the two evaluations, the results of the statistical analyses were strikingly similar with only very few minor divergencies. This fact has been regarded as indicating a high degree of reliability in the estimation of the roentgenologic findings in the present investigation.

b. *Subjective complaints*

The assessment of the subjective complaints was based on a standardized questionnaire used at the personal interrogation of all the patients. According to the information supplied by the patients concerning their complaints, the different degrees of complaints were allocated to 4 groups. *Excellent*: no complaints; *Good*: only mild complaints; *Fair*: distinct subjective complaints; *Bad*: fairly pronounced complaints.

c. *Objective clinical findings*

The assessment of the objective findings was also based on a standardized investigation form. The frequency of the objective symptoms was substantially less than the frequency of the subjective complaints and the roentgenologic findings. Consequently, the objective findings were divided into only two groups. *Normal*: no, or only slight, objective symptoms. *With findings*: knees with distinct objective symptoms.

d. *Combined results*

Roentgenologic findings, subjective complaints and objective symptoms were combined to form 4 different groups of combined results. *Group Excellent*: none or at most, slight roentgenologic findings, subjective complaints or objective symptoms. *Group Good*: moderate findings. *Group Fair*: evident findings. *Group Poor*: pronounced roentgenologic findings, subjective complaints and objective symptoms.

3. ROENTGENOLOGIC RESULTS

a. A significantly higher frequency of roentgenologic osteoarthritis was shown to occur in the meniscectomized knee compared with the non-operated knee. No statistically significant difference was demonstrated between totally and partially meniscectomized knees, in respect of roentgenologic osteoarthritis. Among total meniscectomies no significant difference was found between medially and laterally operated knees, but a significantly higher frequency for women than for men. The small number of partial meniscectomies makes a detailed statistical analyses of these cases impossible. Totally meniscectomized knees were analyzed for different factors which could possibly promote arthritis.

b. A correlation of the roentgenologic findings for all followed-up meniscectomized patients with *age at time of operation* showed a significantly higher frequency of osteoarthritis in patients meniscectomized when over 41 years compared with those operated when under 41. When all the patients with preoperative osteoarthritis, diagnosed radiologically or at operation, were excluded, there were no significant differences in the postoperative roentgenologic findings between patients operated when over 41 and those operated when under 41.

c. *Latency period*, — the time that elapsed between trauma, or occurrence of symptoms, and operation, — shorter or longer than 6 months did not influence significantly the occurrence of roentgenologic signs of osteoarthritis. Nor were any significant differences observed, in respect of latency periods, between patients meniscectomized after or before the age of 41. Moreover, when cases with osteoarthritis already at time of the operation were excluded, there were not any significant differences in the frequency of roentgenologic osteoarthritis in respect of the latency period.

d. *Trauma* as cause of the rupture of the semilunar cartilage did not show any significant influence on the occurrence of roentgenologic osteoarthritis following meniscectomy.

e. *The length of the observation period* was found to be of significant importance for the occurrence of roentgenologic osteoarthritis in meniscectomized knees. When the observation period was longer, the frequency of osteoarthritis increased; the difference was especially pronounced if knees with observation periods over and under 24 years were compared. If knees with osteoarthritis already at the time of the operation are excluded from the main material of meniscectomies, there was still a significantly increased frequency of roentgenologic osteoarthritis in patients with longer observation period.

f. Furthermore, a significantly higher frequency of roentgenologic osteoarthritis was found to be present at the follow-up investigation, 1) if the patient had roentgenologically demonstrable osteoarthritis prior to operation, 2) if osteoarthritis was found at the time of operation, 3) if weight bearing was started later postoperatively¹²⁾, and 4) if at the follow-up the patient's age was over 61 years, and then especially in connection with a short observation period. With regard to the time when weight bearing was started, no significant differences occurred if all the cases with preoperative osteoarthritis, diagnosed radiologically or at time of operation, were excluded.

g. *Clinical findings prior to operation*, such as lockings, effusion and haemarthrosis or a combination of these, as well as *postoperative complications* — prolonged effusion, haemarthrosis or signs of infection — did not show any significant influence on the frequency of roentgenologic osteoarthritis in the meniscectomized knee.

h. Patients, where *muscular training* was applied postoperatively, developed a significantly lower frequency of osteoarthritis compared with patients who had not received muscular training, if all cases with osteoarthritis at the time of operation were excluded.

In contrast to this, patients where *postoperative fixation* had been applied had a significantly higher frequency of osteoarthritis compared with patients treated without postoperative fixation¹³⁾. But this holds only for all totally meniscectomized patients, and not for those with no preoperative signs of osteoarthritis, where the frequency is lower.

¹²⁻¹³⁾ see footnote page 41

i. *Postoperative heavier work*, which involved also more knee strain, compared with work requiring less knee strain, did not influence significantly the frequency of roentgenologic osteoarthritis in the meniscectomized knee.

4. RESULTS FOR SUBJECTIVE COMPLAINTS

a. When comparing males and females with regard to the different subjective complaints either separately or in groups, women had a significantly higher frequency of subjective complaints than men.

Nor were there any significant differences, with regard to subjective complaints, between partially and totally meniscectomized knees.

b. Contrary to what was the case with roentgenologic findings, there were no significant differences in the frequency of subjective complaints, between totally meniscectomized knees, whether these had been operated when the patient was under or over 41 years.

c. Nor was the length of the *latency period* of any significance for the frequency of subjective complaints.

d. *Trauma* as the cause of rupture of the semilunar cartilage did not have any significant influence on the frequency of subjective complaints after total meniscectomy.

e. The length of the *observation period* was not found to have any significant effect on the subjective complaints.

f. Among other factors, a later start with weight bearing showed a significantly higher frequency of subjective complaints.

5. RESULTS FOR OBJECTIVE FINDINGS

a. The objective findings showed no significant difference in frequency between medially and laterally meniscectomized knees, or between men and women. Nor was there any significant difference between totally and partially meniscectomized knees with regard to the frequency of objective findings.

b. *Age at time of operation* showed a significantly higher frequency of objective findings in patients meniscectomized when over 41 years than in those under 41.

c. *Latency periods* longer or shorter than 6 months did not show any significant influence on the occurrence of objective findings.

d. *Trauma* as cause of the lesion in the semilunar cartilage did not seem to influence significantly the frequency of objective findings after total meniscectomy.

e. The length of the *observation period* did not play any significant role in the occurrence of objective findings.

f. Of the other factors, osteoarthritis at time of operation and postoperative fixation increased significantly the frequency of objective findings after total meniscectomy.

g. Later start with weight bearing and longer postoperative hospitalization showed a higher frequency of objective findings.

h. A higher frequency of objective findings was observed in patients over 61 years at time of the follow-up investigation than in those under 61. This applies especially to patients over 61 at the time of the follow-up who, at the same time, had a short observation period.

6. COMBINED TOTAL RESULTS

a. Differences, in the frequency of unsatisfactory combined results, between medially and laterally meniscectomized knees did not prove to be significant; here women showed a significant increase in the frequency of unsatisfactory total results compared with men.

b. No significant differences were obtained with regard to the frequency of unsatisfactory combined results when the totally meniscectomized, the partially meniscectomized and the "double-operated" knees were compared.

c. The frequency of unsatisfactory combined results in totally meniscectomized patients, who at operation were older than 41 years, was significantly higher than that of younger patients. If, however, patients with

preoperative osteoarthritis were excluded from the material, no significant differences were obtained.

d. *Latency periods* over or under 6 months did not have any significant influence on the combined results for the total meniscectomies.

e. The frequency of the unsatisfactory combined results after total meniscectomy in *traumatic* and *nontraumatic* ruptures of the semilunar cartilage was not affected significantly.

f. The length of the *observation period* did not influence significantly the frequency of unsatisfactory combined results.

g. Of other factors which might possibly cause less satisfactory results, the existence of preoperative roentgenologic osteoarthritis and osteoarthritis diagnosed at time of operation deteriorated the combined total results significantly.

h. Preoperative clinical findings, postoperative complications, and postoperative fixation were not found to affect significantly the combined results after total meniscectomy.

i. If postoperative weight bearing was started later, then a significantly higher frequency of unsatisfactory combined results was observed for all the meniscectomized patients. If, however, patients with osteoarthritis at time of operation were excluded from the material no significant differences were found.

j. Postoperative muscular training gave rise to a significantly lower frequency of unsatisfactory results, if the patients who had osteoarthritis at the time of operation were excluded.

k. Patients of advanced age at the follow-up investigation showed a significantly higher frequency of unsatisfactory results.

l. The type of the postoperative occupation was not found to have any significant influence on the combined total results.

7. GENERAL CONCLUSIONS

Degenerative osteoarthritis occurs in a significantly higher frequency in a meniscectomized knee compared with the nonoperated control knee.

The frequency of different degrees of roentgenologic osteoarthritis in this investigation was about 10.8 per cent in the operated and 0.9 per cent in the nonoperated knee in the totally meniscectomized patients, and 9.5 per cent in the partially meniscectomized knees.

The frequency of subjective complaints and objective symptoms is lower than that of the combined total results. The frequency of roentgenologic findings is contrary higher. Apparently the low frequency of subjective complaints affect the combined total results in a higher extent than roentgenologic findings do.

Age at time of operation does not appear to influence the results.

A longer *latency period* does not cause worse results.

Trauma as an aetiologic factor for the rupture of the semilunar cartilage does not influence the postoperative results.

Radiological signs of osteoarthritis increase with the length of the *observation period*. This applies especially for observation periods exceeding 24 years.

Existence or absence of *preoperative clinical findings* does not affect the results.

Roentgenologic osteoarthritis prior to operation gives rise to increased frequency of unsatisfactory results.

Postoperative complications need not necessarily imply a worse prognosis with regard to the late results.

Postoperative muscular training gives rise to substantially better results for the subsequent course.

Postoperative fixation of the knee decreases the frequency of late osteoarthritis.

Early or late *postoperative weight bearing* does not affect the late results.

The *type of occupation* after a meniscectomy is of no importance for the late result.

Partial resection or total extirpation of a ruptured semilunar cartilage does not influence the late results.

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