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CHONDROMALACIA PATELLAE

The Relation to Abnormal Patellofemoral Joint Mechanics

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Twenty-two patients treated non-operatively for chondromalacia patellae were followed up after an average of 5.7 years in order to evaluate the effect of abnormal patellofemoral biomechanics on the natural history of the symptoms. Clinical and radiological investigation revealed 15 patients with signs of malalignment, femoral trochlear dysplasia or excessive lateral pressure syndrome, 3 patients with marginal signs of malalignment and 4 patients with no demonstrable abnormalities. A statistically significant difference in the evolution of symptoms between the normal and the abnormal group is demonstrated, 14 out of 15 in the latter group having unchanged or worsened symptoms.

The stage of chondromalacic change as judged arthrographically at the beginning of the observation period did not influence the clinical outcome.

Key words: arthrography; chondromalacia patellae; excessive lateral pressure syndrome; knee joint; patellofemoral malalignment syndrome

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Compromised patellofemoral mechanics constitutes a group of disorders presenting with or often developing symptoms and signs considered characteristic of chondromalacia, e.g. pain on climbing stairs, movie sign, medial facet tenderness, pain on grinding the patella against the femur and pain on resisted extension (Dandy & Poirier 1975, Outerbridge & Dunlop 1975, Insall et al. 1976). The natural history of chondromalacia patellae in male military personnel has been studied by Karlson (1939) and Robinson & Darracott (1970). A majority of the patients continued to have troublesome symptoms. In neither of these studies were the patients evaluated for abnormal patellofemoral mechanics.

The purpose of the present study was to follow a group of patients suffering from chondromalacia patellae at the beginning of the observation period in order to investigate the effect of biomechanical abnormalities on the evolution of symptoms.

PATIENTS AND METHODS

A review of arthrographies performed in the period 1972–1977 was made to identify patients with chondromalacia of the patella as the only positive finding. Only patients with a significant clinical syndrome of chondromalacia who had been treated non-operatively were included in the study. Arbitrarily an upper limit of 45 years of age at the beginning of the observation period was chosen. Twenty-two such patients were available for follow-up (12 women, 10 men). Mean age was 27 years (range 14–44), mean duration of symptoms at follow-up was 7.6 years (range 4–16) and mean follow-up time was 5.7 years (range 3–8).

Chondromalacia was graded according to Øwre (1936) as it appeared arthrographically on the axial

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patellofemoral projection. Such grading correlates well with peroperative grading (Schmidt 1973, Horns 1977).

The evolution of symptoms (pain on heavy exercise, climbing stairs and squatting, giving way, patellar luxations, movie sign, catching, grating, swelling, stiffness and reduced power) was assessed in the following way: the patient filled in a detailed questionnaire that was reviewed at follow-up, and the status of symptoms was designated as better (slight or no trouble), unchanged or worse relative to the status at the time of arthrography. Likewise it was estimated whether the patient had to avoid certain activities to keep symptoms at an acceptable level.

The lower extremities were examined clinically. No instances of significant ligamentous instability were noted; anteromedial instability was especially searched for as this has been incriminated as a cause of patellar instability (Mansat et al. 1977). The Q-angle was measured according to James (1979) and considered marginal when it was 15° in males, 20° in females and abnormal when it was wider. The vastus medialis obliquus muscle was considered dysplastic when no bulk of muscle could be seen or felt reaching at least one-third of the way down the medial patellar edge (Outerbridge & Dunlop 1975); however the isolated finding of such dysplasia was not considered significant since clinical judgment often proves to be wrong when the structures are inspected at operation (Hughston 1968).

At follow-up all patients were subjected to radiological investigation consisting of frontal view, lateral view with 45° knee flexion and axial patellofemoral view according to Merchant et al. (1974). Signs of arthrosis were searched for on all films. Patellar index according to Insall & Salvati (1971) was calculated, patella alta being diagnosed when the LT/LP ratio was more than 1.20, while a value of 1.20 was considered marginal. On the axial film the sulcus angle (Brattström 1964) was measured. Using the technique described by Merchant et al. (1974) a value of more than 150° (Normal material mean + 2 SD) signifies femoral trochlear dysplasia. Patellar tilt and patellar subluxation were recorded. The tangential view also allows determination of patellar type. Wiberg types 1, 2 and 3 (W1, W2, W3) (Wiberg 1941) and the Baumgartl type (B) (Baumgartl

Table 1. Clinical and

Patient no.	Sex	Proband knee	Age	Stage of chondromalacia 1–4	Q-angle	Hip internal rotation*	Lateral patellar squint (90° knee flexion) 0–3+	Medial patellar squint standing 0–3+	Vastus medialis dysplasia	Trauma rel. to debut	Apprehension	Quadriceps atrophy = 2 cm
1	♀	L	18	2	17	50	0	+	+	+	0	0
2	♂	R	14	1	15	35	0	0	0	+	0	0
3	♂	L	34	3	6	25	0	0	0	0	0	0
4	♀	R	32	2	20	42	0	0	+	0	0	0
5	♀	L	29	1	27	60	++	++	+	0	+	0
6	♂	R	16	2	18	20	0	+	0	0	0	0
7	♂	R	33	2	12	32	0	0	0	0	0	0
8	♀	R	21	1	29	70	0	++	+	+	0	0
9	♂	R	20	2	12	40	0	0	+	+	0	0
10	♀	L	14	2	25	55	+	0	+	+	+	0
11	♂	R	35	2	15	38	0	0	0	0	0	0
12	♀	L	25	2	24	45	0	0	+	0	0	0
13	♂	R	22	1	12	28	+	0	0	0	0	0
14	♀	R	29	2	21	40	0	0	+	0	0	0
15	♂	L	44	3	6	17	++	0	0	0	0	0
16	♀	R	44	3	0	60	+++	0	+	0	+	0
17	♀	L	23	3	15	45	+++	0	+	0	+	0
18	♀	R	36	3	24	40	0	0	0	0	0	0
19	♂	L	26	1	8	22	0	0	0	0	0	0
20	♀	R	41	2	20	45	++	+	+	0	0	0
21	♂	L	15	2	15	30	0	+	0	+	0	0
22	♀	R	25	3	25	45	+	+	+	0	0	0

* measured as the vertical-tibial angle with the patient prone and the knees flexed to a right angle.

** Excessive Lateral Pressure Syndrome.

1966) were recorded. Although the Wiberg 3 and Baumgartl varieties are often considered dysplastic, we have chosen not to consider the isolated finding of these types to be significant.

The excessive lateral pressure syndrome (ELPS) was diagnosed when medial displacement of the patella was decreased, a tight lateral patellofemoral band was palpable and the axial view revealed patellar tilt. This definition is narrower than that of Ficat & Hungerford (1977) who include medial retinacular and muscular weakness, but these are usually difficult to assess clinically in an objective manner.

In summary, malalignment was diagnosed when the Q-angle and/or the patellar index was abnormal, marginal malalignment when the Q-angle was 15° in the male, 20° in the female and/or when there was a patellar index of 1.20; femoral trochlear dysplasia was present when the sulcus angle was more than 150°; and finally ELPS was considered present when the above-listed criteria were fulfilled.

RESULTS

Table 1 shows the findings in the 22 patients and Table 2 relates the results of the examination to the change in symptoms. "Unchanged" and "worse" are grouped together because both represent significant symptoms, at least as severe as when the patient was referred to the hospital. Table 3 shows that the cause in the normal and the abnormal group is significantly different irrespective of the placement of the marginal group.

Patient no. 7 had a torsional trauma to his right knee after 2.5 years, resulting in a tear in the medial meniscus. He has not been excluded because he had been well a long time before the incident and tolerated badminton playing. After meniscectomy, knee function was again restored. Patients nos. 16 and 17 apparently do not fulfil

radiological findings

Patellar index LT/LP	Sulcus angle	Patellar tilt	Patellar subluxation	Arthrosis	Patellar type	Diagnosis	Symptoms			Reduced activity
							Better	Un-changed	Worse	
1.06	135	0	0	0	W2	normal	×			
1.20	136	0	0	0	W2	marginal	×			
1.02	139	0	0	0	W2	normal	×			
1.28	145	0	0	0	W2	malalignment		×		×
1.02	139	0	0	0	W3	malalignment			×	×
0.98	140	0	0	0	W3	malalignment		×		
0.96	130	0	0	0	W2	normal	×			
1.37	150	0	0	0	W3	malalignment	×			
1.17	143	0	0	0	W2	normal	×			
1.14	137	+	0	0	W2	malalignment		×		×
0.99	138	0	0	0	W2	marginal		×		
1.10	142	+	0	0	W3	malalignment		×		
0.83	136	+	0	0	W2	ELPS**		×		
1.05	140	0	0	0	W3	malalignment			×	
1.17	138	+	+	0	W3	ELPS		×		
1.17	133	0	0	0	W2	malalignment		×		
1.20	137	0	0	0	W2	malalignment			×	×
0.98	133	+	0	0	W2	malalignment			×	
1.17	152	0	+	0	B	dysplasia		×		
1.25	144	+	0	0	W3	malalignment		×		
0.80	135	0	0	0	W3	marginal			×	×
1.18	152	0	0	0	W2	malalignment dysplasia		×		

Table 2. Development of symptoms related to diagnosis

	better	unchanged or worse
normal	4	0
marginal	1	2
malalignment, ELPS, dysplasia	1	14

Table 3. P-values by Fisher's exact test. (O-hypothesis: mechanical abnormality does not influence the clinical course)

	abnormal	abnormal + marginal
normal	$P<0.002$	$0.01>P>0.002$
normal + marginal	$0.01>P>0.002$	

the criteria set up for diagnosing malalignment. However both had a clearly abnormal patellar tracking, the patella being laterally subluxed when the knee was extended (accounting for the normal Q-angle in this position). On knee flexion the patella entered the femoral trochlea (accounting for the normal Merchant view), but on further flexion again drifted laterally (accounting for the lateral patellar squint at 90° flexion). These two patients had both experienced several luxations.

DISCUSSION

The present study confirms that detailed investigation of patients with a significant clinical syndrome of chondromalacia patellae reveals a majority with compromised patellofemoral biomechanics. Through the assessment of the natural history of the symptom complex it is demonstrated that the presence of clinical and radiological markers of abnormal biomechanics indicates that symptoms are unlikely to regress. However an occasional patient may improve on conservative therapy. We would agree with the recommendation of Insall et al. (1979) that a conservative treatment programme lasting at least 6 months should be tried as a general rule before surgery is contemplated.

Some of our patients are of the type described by Insall et al. (1976) with excess femoral neck anteversion (FNA), squinting patellae, genu varum and recurvatum, increased Q-angle and external tibial torsion. This combination of clinical findings, where FNA is the basic lesion, clearly produces excess lateral force acting on the patella and thus may cause a secondary clinical syndrome of chondromalacia patellae. FNA may be assessed clinically by increased internal rotation of the hip. Exact figures are not available for the mature patient, but information from Staheli (1980) shows that internal hip rotation is probably excessive when 55° or more in women and 40° or more in men.

Our findings suggest that when signs of abnormal biomechanics are not found a good prognosis can be expected. However there are so few "normal" patients in this series that no firm conclusion can be drawn and it is an established fact that progressive symptoms of chondromalacia patellae unassociated with apparent faulty biomechanics do exist (Goodfellow et al. 1976, Ficat & Hungerford 1977). Patients with this type of idiopathic (or primary) chondromalacia patellae have recently been studied by Sikorski et al. (1979) using serial axial radiography under conditions of simulated weight-bearing. In normal controls the femur rotated medially with the onset of muscle activity thus stabilizing the patella; children with a symptomatic patellofemoral joint showed reversal of this reaction, the femur rotating laterally. Any patient with an abnormal hip was excluded from the study and the possible role of occult femoral torsion abnormality was not investigated.

Arthrographic grading of the chondromalacic change, most often noted on the medial facet, did not have any predictive value as to the future progress of symptoms. The relationship between the clinical syndrome of chondromalacia patellae and the state of the cartilage is an unsolved problem. Leslie & Bentley (1978) examined 78 patients with a positive clinical diagnosis of chondromalacia patellae. Employing arthroscopy they found that only half of the patients had any de-

gree of chondromalacic change of the patellar cartilage. The two groups of patients thus defined gave similar histories of symptoms and length of anamnesis; also they exhibited identical clinical signs except for a significantly higher frequency of retropatellar crepitation, effusion and quadriceps wasting attributed to secondary synovitis among patients with a pathologic patellar cartilage. The patients were followed for 9 months to 2 years. Forty-two per cent of the patients with normal cartilage were unchanged or worse; among patients with abnormal cartilage 34 per cent were unchanged or worse (28 per cent of patients operated, 50 per cent of patients not operated). No clinical evaluation for abnormal patellofemoral mechanics was done. In our opinion these findings indicate that the state of the cartilage is not the main determinant of the evolution of symptoms although severe cartilage change may aggravate some clinical findings. Examination of patellofemoral articulation during arthroscopy or arthrography may suggest patellar lateralisation; however the distension of the joint by fluid or air makes the assessment inaccurate. To our knowledge no conclusive investigation of this problem has been carried out.

In this study clinical investigation was more efficient than radiological investigation in establishing a diagnosis; the patellofemoral view was often normal in cases of malalignment. Probably the more elaborate technique described by Ficat & Hungerford (1977) would have revealed more abnormal joints, but this finding emphasizes the importance of the clinical examination and rejects the radiological examination as a screening procedure. The radiological survey is necessary to establish the diagnosis of patella alta and femoral trochlear dysplasia and to discover loose bodies, osteochondral fractures and signs of arthrosis. The finding of patellar types often interpreted as dysplastic (Wiberg 3 and Baumgartl types) did not correspond significantly to the finding of malalignment or to an unfavourable clinical course.

No patients were found to have significant signs of arthrosis. The observation period is too short to reject the hypothesis, held by some authors, that compromised joint mechanics eventually leads to arthrosis. Other data suggest that mechanical abnormalities often lead to patellofemoral arthrosis (Ahlbäch & Mattsson 1978, Goutaillier & Debeyre 1974).

CONCLUSIONS

1. The present study confirms that a majority of patients with significant symptoms of chondromalacia patellae have compromised patellofemoral biomechanics.
2. Demonstration of clinical and radiological signs of abnormal biomechanics strongly suggest an unfavourable prognosis. Failure to demonstrate such signs indicated a good prognosis in our patients – but these patients were few.
3. Arthrographic grading of chondromalacic cartilage change has no prognostic value.

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