Vastus lateralis fibrosis in habitual patella dislocation

An MRI study in 28 patients

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ABSTRACT – We studied 28 patients with habitual or recurrent dislocation of the patella with MRI of both thighs. Apart from the 2 patients whose dislocation could be related to trauma, we found signs of fibrosis of the vastus lateralis muscle in all the affected limbs of the 26 patients with an insidious onset of dislocation. This was seen as low signal intensity cords in the muscles in the T2 weighted image. Muscle degeneration was seen as high intensity signals in the T1 weighted image. In patients with unilateral disease, the vastus lateralis muscle of the affected side was hypotrophic, compared to that of the normal side. 2 patients underwent a biopsy of the affected muscle area. Histopathological examination revealed inflammatory cell infiltration, fibrosis, and muscle fiber degeneration. Fibrosis of the vastus lateralis muscle appears to be common in patients with habitual patella dislocation in our population, and may be the cause of the dislocation. Since release of such a contracture may be of value, MRI study of the thigh muscles is helpful in the evaluation of patients with this disorder.

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Repetitive dislocations of the patella can be classified as habitual or recurrent. Although the terms are often used synonymously, strictly speaking, habitual dislocation describes a condition where an initially painless dislocation occurs every time the knee is flexed, while recurrent dislocation is a painful condition that occurs as isolated episodes, often as a sequel of trauma (Williams 1968, Bergman and Williams 1988).

Gunn (1964) proposed that contracture of the vastus lateralis may give rise to habitual dislocation of the patella. Williams (1968) and later Bose and Chong (1976) respectively reported 14 and 13 cases of habitual dislocation of patella which was thought to be due to quadriceps contracture. Since then, there have been sporadic reports in the literature, but the condition is not well known, and most texts on patella dislocation mentioned it hardly or never (Tachdjian 1990, Sharrard 1993).

Using MRI, we identified vastus lateralis fibrosis in 26 patients seen for habitual patella dislocation, and suspect that, at least in some populations, it may be one of the commonest causes of patella dislocation.

Patients and methods

We studied 28 patients with recurrent or habitual dislocation of the patella. In the first phase, 13 consecutive patients have been prospectively studied since 1993. MRI (Siemens SP63 1.5 Tesla) of both thighs was performed in this sequence: coronal-spin echo T1WI, gradient echo T2*; sagital-turbo spin echo proton density, gradient echo T2*; and axial-gradient echo T2*, spin echo T1WI. 2 of these patients had had previous surgery of the knee due to patellar fractures. The other patients (1–11) could not recall any trauma associated with the first episode of patellar dislocation, but had had multiple intramuscular injections during early childhood (Table). However, the frequency and type of medication given could not be determined with certainty. The symptoms had had an insidious onset at a mean age of 6 (4–

Data on 26 patients with habitual patellar dislocation and fibrosis of the vastus lateralis

No.	Gender	Side	Onset year	Surgery year	MRI year	Symptom	Q angle ° R/L	LP/LT R/L	Dislocation angle °	Surgery	Note
1	f	both	4	–	22	crepitus	18/18	0.81/0.80	60/60	Nil	
2	m	both	7	13	13	gw	22/18	0.71/0.80	80/70	LRM	
3	m	right	4	7	7	gw	25/20	0.53/0.74	20/–	LRM	biopsy
4	f	both	4	–	16	crepitus	20/25	0.85/0.77	120/130	Nil	
5	f	both	9	–	39	gw	20/20	0.80/0.83	70/90	Nil	
6	m	left	3	–	13	crepitus, gw	18/20	0.93/0.85	–/60	Nil	
7	f	right	8	–	27	pain, gw	18/15	0.90/1.0	110/–	Nil	
8	f	both	9	–	27	crepitus, gw	18/18	0.89/0.91	90/80	Nil	
9	f	both	7	–	20	crepitus, gw	20/18	0.88/0.85	80/70	Nil	
10	m	left	6	–	12	crepitus, gw	13/18	0.93/0.88	–/100	Nil	
11	f	left	9	–	17	crepitus, gw	15/20	1.0 /0.77	–/60	Nil	
12	m	both	8	21	31	pain, gw	18/20	0.73/0.69	80/60	RET	
13	f	left	5	9	18	crepitus, gw	15/20	0.80/0.58	–/40	LRM	
14	m	left	6	16	25	crepitus, gw	15/18	0.98/0.75	–/80	LRM	
15	f	both	5	12	21	gw	22/20	0.71/0.77	60/70	LRM	
16	m	left	5	28	36	pain, gw	20/25	0.89/0.70	–/50	RET	
17	f	right	2	8	15	pain, gw	15/15	0.84/1.0	70/–	LRM	
18	f	right	10	21	28	pain, gw	18/18	0.77/0.84	90/–	RET	
19	f	both	6	35	42	pain, gw	22/22	0.65/0.59	60/40	LR+MP	recurrent
20	m	right	3	4	10	gw	15/15	0.63/0.79	40/–	LR+MP	
21	f	both	9	28	34	gw	20/25	0.74/0.66	50/40	RET	
22	m	left	5	10	16	crepitus, gw	20/25	0.93/0.68	–/30	LR	
23	m	left	5	9	15	crepitus, gw	20/20	0.85/0.72	–/60	Campbell	recurrent
24	f	right	6	10	15	crepitus, gw	30/25	0.67/0.82	80/–	LRM	biopsy
25	f	both	10	14	19	gw	20/15	0.70/0.79	20/30	LRM	
26	f	both	10	25	29	pain, gw	20/22	0.64/0.68	30/40	LR+MP	

gw giving way, RET Roux-Elmslie-Trillat procedure, LR lateral release, MP medial plication, LRM lateral release (including lengthening or reefing of the vastus lateralis tendon) plus medial plication. Dislocation angle knee flexion angle that induces the patella dislocation, R/L right/left.

9) years. These included giving way, pain and crepitus. The patella dislocated laterally at a median 80° (20°–130°) of knee flexion. 2 patients (2 and 3) underwent surgery after the MRI study.

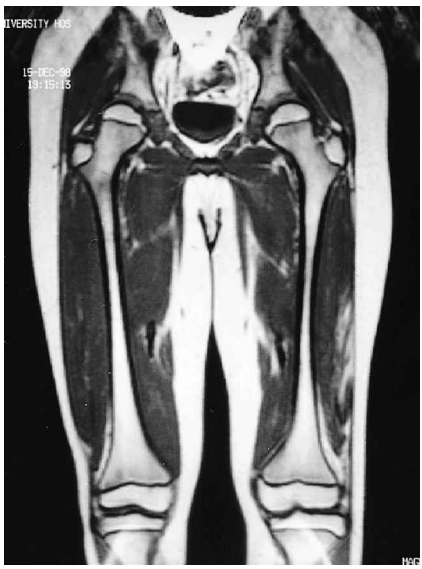
In the second phase, we examined the hospital records for patients who had previously had surgery for habitual or recurrent patella dislocation during the period from 1988 to 1993. 15 patients (12–26) returned to our clinic for physical and MRI examinations (Table). None of them had a history of knee fracture. Median age at the time of study was 21 (10–42) years, and the follow-up period after surgery was 7 (4–10) years. Indications for operation included "giving way" in all 15 patients, pain in 6, and crepitus in 5. The median knee flexion angle at patella dislocation averaged 50°.

The preoperative Insall LP/LT ratio (the ratio of the longitudinal length of the patella to that of the patellar tendon) (Insall et al. 1972) of all the patients averaged 0.74 (0.53–0.91) for the affected knees and 0.88 (0.74–1.0) for the sound knees ($p = 0.001$, one way ANOVA). The Q-angle averaged 21° (15°–30°) for the affected knees and 18° (13°–25°) for the sound knees ($p = 0.03$, one way ANOVA).

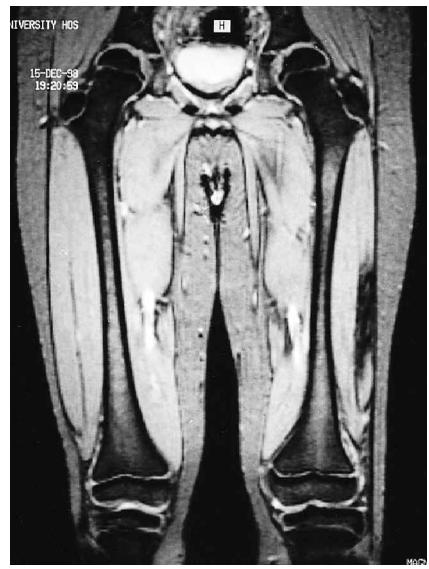
The following surgical procedures were performed: the Roux-Elmslie-Trillat procedure (Cox 1982), (z-lengthening of the lateral retinaculum and vastus lateralis tendon, medial transfer of the tibial tubercle and tightening of the medial retinaculum), in 6 knees of 4 patients; lengthening of the vastus lateralis tendon plus lateral release and medial plication of the joint capsule in 11 knees of 8 patients; lateral retinaculum release plus medial retinaculum plication in 5 knees of 3 patients; and one instance each of the Campbell procedure (Freeman 1987) and of simple lateral release.

2 patients (3 and 24) underwent muscle biopsy of the fibrotic portion of the vastus lateralis mus-

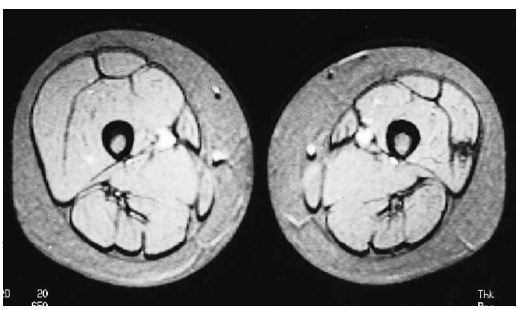
A 13-year-old boy (no.6) with habitual dislocation of the left patella.



A. Coronal T1 weighted image of both thighs. The hyperintense strips in the left vastus lateralis muscle may represent fatty degeneration.



B. Coronal T2* image of both thighs. The low signal bands in the left vastus lateralis muscle are typical findings of fibrosis.



C. Axial T2* image of both thighs at the junction of the middle and lower thirds. The circumference of the affected thigh is smaller and the entire quadriceps is also hypotrophic.

cle (as indicated by the MRI scans). These areas were not near the operative site.

Results

The MRI examination showed that all 26 patients without a history of trauma had fibrotic bands of varying width and length in the belly of the vastus lateralis muscle of the affected limb, usually in the proximal and middle parts. These were denoted by low signal (dark) cords in the T2 weighted images (Figure). In 11 limbs, the subcutaneous fat and the vastus intermedius muscle adjacent to the vastus lateralis were also thinner and had fibrotic bands. The high signal area in the T1 weighted image may represent fatty degeneration of the muscle (Figure).

In patients with unilateral disease, the vastus lateralis of the affected limbs was thinner in medio-lateral diameter than that of the sound side in both T1 weighted and T2 weighted coronal images (Figure). The circumference of the thigh and the quadriceps muscle of the affected side were also smaller than those of the sound side.

Histopathological examination of the muscles taken from the fibrotic portion of the vastus lateralis of 2 affected limbs showed varying degrees of muscle degeneration, along with inflammatory cell infiltration and fibrous degeneration.

It was usually necessary to release the vastus lateralis at its insertion into the patella or the quadriceps common tendon before the patella could be returned to its normal position. Of the 24 knees that had surgery, the vastus lateralis tendon was lengthened or realigned in 17 knees (including the Roux-Elmslie-Trillat procedure in 6 limbs of 4 adults and lengthening in 11 limbs of 8 chil-

dren). There was no recurrence of dislocation after these procedures. However, of the 7 knees in which the contracted vastus lateralis was not released, recurrence of dislocation occurred in 3 knees (patient 19 bilateral and patient 23). Of the remaining 4 knees, none were able to achieve full flexion (patients 20, 22 and patient 26 bilateral).

Discussion

We found signs of vastus lateralis fibrosis in every patient with an insidious onset of habitual patella dislocation. Gunn (1964), Williams (1968), and Bose and Chong (1976) reported a total of 31 cases of fibrosis of the vastus lateralis as a part of fibrosis of the quadriceps. Habitual patella dislocation was reported as a manifesting sign. Despite these and later reports (Bergman and Williams 1988), the association between vastus lateralis contracture and habitual patella dislocation remains unknown, as opposed to contractures of the deltoid, gluteus maximus, and quadriceps muscles (Shen 1975, Hang 1979, Shen 1982, Ko et al. 1998), where the typical deformities and functional limitations are readily recognized.

Patella dislocation is due to an imbalance of the 4 quadrant vectors around the patella. Attenuation of the medial patellar retinaculum, contracture of the lateral patellar retinaculum, weakness of the vastus medialis, hypertrophy of the vastus lateralis, generalized ligmentous laxity, abnormal patellar facets, dysplasia of the lateral femoral condyle, patella alta, lateral insertion of the patellar tendon, genu valgum and genu recurvatum are predisposing factors. These factors are not necessarily independent. It seems likely that the small LP/LT ratio (patella alta), and large Q angle seen in our series are caused by traction forces exerted by the fibrosed and contracted vastus lateralis muscles.

MRI is an excellent diagnostic tool for muscle fibrosis. Chen et al. (1998) reported the characteristic findings of fibrosis of the deltoid muscle as being low signal cords in the muscle on T2 weighted images. The vastus lateralis of the diseased limb was also hypotrophic and shorter than that of the normal side. The smaller circumference of the thigh and hypotrophic quadriceps on the affected side may be the result of disuse.

Although MRI is often used in evaluating injuries to the knee, the standard field in a knee study does not include the thigh and will miss lesions in the vastus lateralis. Most of the surgical procedures for treating habitual patellar dislocation are done without exposing the muscle belly part of the vastus lateralis, so pathological specimens are not routinely obtained. Muscle biopsy was performed on 2 patients in this series and the histopathological picture was compatible with that described by Chen (1983) and Chen et al. (1988) in previous studies of injection-induced myopathy of the deltoid and the gluteal muscles. Fibrosis of the gluteal, deltoid and quadriceps muscles is thought to be closely related to intramuscular injections, though the mechanism is still poorly understood (Norman et al. 1970, Oh et al. 1977, Mukherjee and Das 1980, Jackson and Hutton 1985). It is very likely that vastus lateralis fibrosis is also due to injections.

Clinical evidence suggests that the observed fibrosis is not just incidental, but is, in fact, a cause of the dislocation. We found it necessary to release the vastus lateralis in order to relocate the patella. Wijesekera (1990) studied 26 knees in 25 children with habitual dislocation of the patella. At operation, it was noted that the contractures were confined to the iliotibial band, vastus lateralis and the lateral fibers of the rectus femoris muscle. Division of the contracted bands corrected the dislocation.

Bergman and Williams (1988) reoperated 10 knees with patellar redislocation, and found reformation of contractures in 6 knees. In our series, although the number is small, failure of surgery also appeared to be associated with failure to release the contracted vastus lateralis. Recurrence of dislocation may result from an insufficient release of contracture, and loss of full flexion may be due to an insufficient release of vastus lateralis contracture plus tightening of the medial soft tissues about the knee which converts a vastus lateralis contracture into a quadriceps contracture.

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