Patellar complications after knee arthroplasty

A prospective study of 56 cases using the Kinematic prosthesis

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A prospective study on 56 knees was performed to analyze the incidence and cause of patellar complications following total knee arthroplasty with the Kinematic prosthesis inserted with the Universal Instrumentation system. Patellar complications occurred in 23 cases: 15 had anterior knee pain. There was 1 case of patellar fracture. Subluxation of the patella occurred in 13 cases, of which 6 were painful. Although the mechanical alignment was correctly reconstructed to neutral in all but 2 cases, the instrumentation tended to allow malpositioning of the components into excessive femoral valgus and compensatory excessive tibial varus that predisposed to patellar subluxation.

With this prosthesis and instrumentation, patellar stability is hindered by a very short anterior femoral flange, a shallow patellar groove, and insertion of the components at 3° to the mechanical axis. It should be ensured that the components are correctly positioned, that patellar stability is carefully checked before closing the capsule, and that lateral release is performed more often.

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As part of the continuing audit of our unit, we found that patellar complications were common following total condylar knee arthroplasty. The prosthesis used was the Kinematic prosthesis inserted with the Universal Instrumentation system (Howmedica). We report the results of our investigation of this problem.

Patients and methods

A prospective study of a consecutive series of 56 primary Kinematic knee replacements inserted with the universal instrumentation system was undertaken. The 56 procedures were performed in 53 patients over a 6-month period. Eighteen patients were men and 35 were women. The mean age was 69 (36–85) years. Thirty-seven knees were arthrotic and 19 were afflicted with rheumatoid arthritis. The preoperative and the postoperative limb alignment were measured clinically and radiographically in relation to the mechanical axis. Clinical measurements were performed after careful positioning of the limb and measuring the alignment with a long-armed goniometer, using the femoral pulse, the center of the knee, and the center of the ankle joint as reference points. Radiographic assessment was performed on long 36-inch weight-bearing films of the leg with careful positioning of the limb to eliminate rotation. Radiographic control of rotation was not available. Nevertheless, we considered that this method of measurement was more accurate and reproducible than clinical measurement of alignment, and therefore it is the radiographic alignment that will be quoted throughout this paper.

The range of motion of the knees was assessed by careful measurement with the goniometer using the greater trochanter, the center of the knee, and the lateral malleolus as reference points.

The procedures were performed under the supervision of 4 of the surgeons at Winford Orthopedic Hospital. The procedures were performed using parenteral antibiotic prophylaxis (cephamandole 1g), in a turbulent-flow operating room without body exhaust suits (Lidwell et al. 1983). In all the cases a straight medial parapatellar incision was used. The patella was resurfaced with a polyethylene component with a central peg (Howmedica). All the components were cemented in situ using Palacos® cement (Kirby-Warrick). At surgery, the patellar tracking was checked by the "one-thumb" technique before closing the capsule. In eight knees a lateral release was performed. In the postoperative period, the knees were randomized to receive 7 days of immobilization or 7 days of continuous passive motion as part of a concurrent study.

The patients were all personally reviewed at 3, 6, and 12 months, when clinical measurements of joint alignment, rotation, and range of motion were performed. The external rotation was measured with a

Table 1. Data for 56 Kinematic knee arthroplasties with the Universal Instrumentation system

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	65	F	A	0	90	0	–	11	7	80	–2	–8	+
2	75	M	A	15	100	25	–	11	0	105	–2	0	+
3	65	F	A	20	95	20	–	9	3	105	5	7	+
4	76	F	R	0	130	–5	–	7	–2	105	2	5	+
5	62	F	A	0	87	1	–	13	–3	55	–6	0	+
6	68	M	A	10	55	0	–	11	0	90	3	0	+
7	61	M	A	0	88	1	–	7	0	95	5	0	+
8	53	F	A	5	110	0	–	7	–3	105	2	0	+
9	62	F	A	0	88	0	–	9	–5	75	1	0	+
10	75	F	A	2	90	0	–	8	0	115	–3	0	+
11	65	F	A	20	95	20	–	7	0	110	–2	0	+
12	70	F	A	0	100	5	–	9	3	80	0	0	+
13	65	F	A	10	85	–5	–	8	–3	92	3	10	+
14	66	M	R	25	75	0	–	7	4	120	4	4	–
15	81	F	A	5	85	–15	–	0	0	115	4	0	–
16	64	F	A	0	90	0	–	7	0	90	–1	10	–
17	64	F	R	3	85	–5	–	8	3	75	3	0	–
18	66	M	R	3	85	–5	–	8	3	75	3	0	–
19	70	F	A	10	120	–30	+	4	2	100	2	5	–
20	65	F	A	20	95	20	–	8	1	90	5	0	–
21	77	M	A	0	115	–18	+	3	1	100	0	8	–
22	68	F	A	10	65	5	–	3	0	85	5	0	–
23	61	F	R	30	105	–25	+	7	5	107	1	0	–
24	71	M	A	0	95	0	–	5	4	90	0	0	–
25	72	F	R	3	85	0	–	4	0	120	–10	20	–
26	85	M	R	0	90	2	–	8	3	90	2	0	–
27	71	F	A	5	60	5	–	3	2	55	4	0	–
28	71	F	A	0	90	–30	+	4	0	108	–5	5	–
29	46	F	R	0	85	0	+	8	2	108	–3	5	–
30	85	M	R	3	90	2	–	5	2	8–	–4	–5	–
31	66	F	A	10	90	5	–	1–	–2	8–	2	4	–
32	74	F	A	5	40	–20	–	6	4	75	–1	5	–
33	77	M	A	5	90	0	–	7	0	90	5	0	–
34	83	F	A	0	85	0	–	4	0	115	–5	–5	–
35	73	F	A	5	100	–10	–	8	5	100	7	5	–
36	76	F	R	5	85	0	–	7	3	110	2	5	–
37	53	F	R	10	80	–10	+	8	2	75	3	5	–
38	36	M	R	0	120	0	–	2	4	92	2	2	–
39	67	M	R	2	90	2	–	3	3	115	8	11	–
40	52	M	R	20	100	–10	–	4	0	100	5	5	–
41	73	F	A	2	85	0	+	5	2	110	–4	3	–
42	63	F	R	0	110	0	–	8	2	117	2	15	–
43	76	F	R	2	90	2	–	4	–2	115	0	–2	–
44	72	F	A	0	90	5	–	6	–2	102	–5	0	–
45	53	F	R	15	30	–20	+	9	–5	65	3	10	–
46	82	M	A	20	90	0	–	5	2	115	2	2	–
47	80	F	A	15	50	15	–	8	7	115	3	10	–
48	65	F	A	0	120	–20	–	6	–1	95	~	2	–
49	62	M	R	25	35	–7	–	9	10	70	3	5	–
50	73	F	A	2	85	0	–	4	0	92	2	5	–
51	69	F	R	0	90	2	–	4	0	95	–5	0	–
52	73	F	A	0	100	0	–	8	0	90	5	7	–
53	73	M	A	2	90	3	–	8	2	95	1	2	–
54	75	M	A	0	110	5	–	4	0	85	1	5	–
55	77	F	A	20	90	15	–	7	7	110	2	0	–
56	67	M	A	5	45	0	–	8	3	90	5	5	–

A Case
B Age
C Sex
D Diagnosis
  A Arthrosis
  R Rheumatoid arthritis
E Preoperative fixed flexion deformity
F Preoperative degrees of knee flexion
G Preoperative limb alignment
  + varus
  – valgus
H Lateral release
I Postoperative Q angle
J Postoperative fixed flexion deformity
K Postoperative degrees of knee flexion
L Postoperative limb alignment
  + varus
  – valgus
M Postoperative rotational deformity
  + external
  – internal
N Patellar subluxation

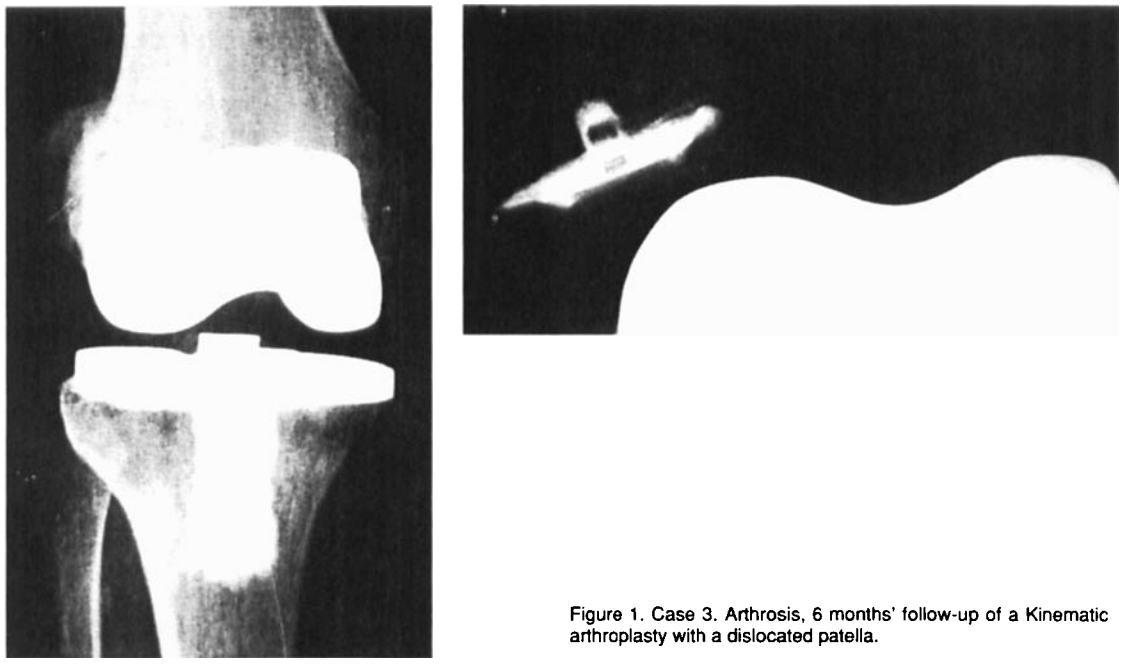

Figure 1. Case 3. Arthrosis, 6 months' follow-up of a Kinematic arthroplasty with a dislocated patella.

goniometer: with the knee in extension, the rotational alignment of the patella and the ankle mortise on the involved side was compared with the contralateral side. Because of the inaccuracies of this measurement, only differences of 5° or greater were considered significant. Radiographic evaluation included skyline views of the patellar articulation and long-leg alignment films. Patellar subluxation was defined as clinical or radiographic evidence that the patella subluxed from its groove onto or beyond the top of the lateral femoral facet during knee flexion on clinical examination or as demonstrated on the skyline patellar views (Figure 1).

Radiographic assessment was also made of the Q angle (the angle between the shaft of the femur and the femoral component, measured on a long-leg alignment radiograph as the angle between the femoral shaft and a line perpendicular to a line drawn across the distal points of the femoral condyles). No allowance was made for the 3° of valgus built into the prosthesis by the patellar flange being offset to the left or right. This makes the ideal position of insertion a neutral mechanical alignment with a Q angle of 7°.

Statistical analysis included the use of contingency table analysis, paired *t*-tests for within patient analyses and two sample *t*-tests for disparate group analysis, and linear regression for the analysis of the Q angle and patellar subluxation.

Results

Of the 56 primary Kinematic total condylar knee replacements undertaken, four knees developed a superficial wound infection that subsequently settled. There were no deep infections. At the last review, 12 months postoperatively, the mean knee flexion was 96° (65°–120°). The mean fixed flexion deformity measured 1° (5° of hyperextension – 10° of fixed flexion), and the mean extensor lag was also 1° (0°–30°).

The mean preoperative alignment by radiographic measurement in the 56 knees was 4° of valgus: 25 knees had a varus deformity, 29 were in valgus, and in two knees there was no deformity (Table 1).

Radiographic postoperative alignment was a mean 1° varus. External tibial rotation was assessed with the knee in extension with the patella reduced. External rotation of 5° or more was present in 23 cases (Table 1). In each case, this appeared to be due to internal rotation of the tibial component rather than tibial torsion.

Patellar complications of some sort occurred in 23 knees. Fifteen cases had troublesome anterior knee pain. There was 1 case of transverse patellar fracture that occurred spontaneously 1 year after surgery. There was no recorded case of patellar loosening or disruption. Radiographically confirmed subluxation of the patella occurred in 13 cases, of which 6 had disabling anterior knee pain (Figure 1). The pain

appeared to be associated with the initiation of knee flexion where the patella comes into contact with the femoral flange on knee flexion. This is related to the length of the anterior femoral flange, which is shorter in the Kinematic knee prosthesis than in other contemporary designs (Figure 2). Of the 13 cases of patellar subluxation, 2 had a preoperative valgus deformity, 5 had a postoperative valgus deformity, and in 3 cases the knee was in postoperative external rotation as measured radiographically. Only 2 of these 13 cases of patellar subluxation were considered to be due to excessive limb malalignment deformity. One was a case in which 10° of external tibial rotation was present, and other was a case in which 6° of valgus alignment was present.

After statistical analysis of the preoperative and the postoperative leg malalignment (including valgus deformity), and postoperative external rotation deformity, none was found to predispose to patellar subluxation (Table 2).

The mean postoperative Q angle was 10° (3°–14°) of valgus, compared with a mean mechanical alignment of 1° of varus (8° of varus–11° of valgus) Although there was no difference in the mechanical alignment in patients with and without patellar subluxation, there was a difference in the Q angle: a mean of 12° in patients with patellar subluxation as compared with 9° in patients with a stable patellar joint ($P < 0.01$; Table 3). Patients who had a postoperative Q

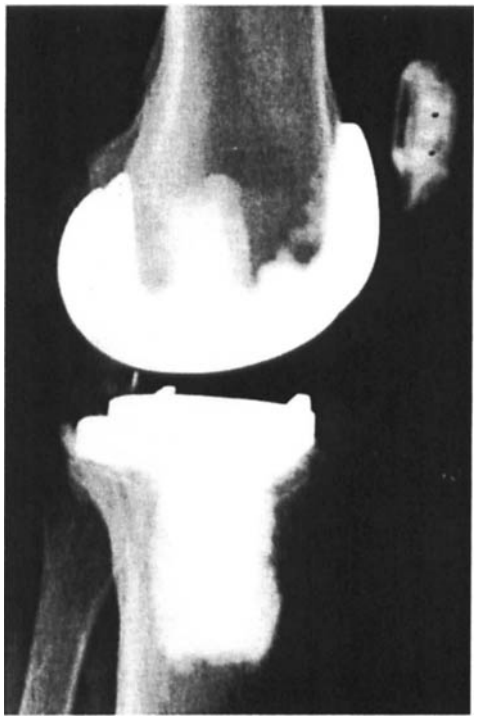

Figure 2. Case 44. Six months after Kinematic arthroplasty for arthrosis. The short patellar flange does not articulate with the patella in extension.

Table 2. Patellar stability in relation to alignment of kinematic knee arthroplasties (mean, degrees)

	n	Preoperative limb alignment	Postoperative limb alignment	Postoperative external rotation
Subluxation	13	9° varus	1° varus	1°
Stable	3	7° valgus	1° varus	3°
Total	56	4° valgus	1° varus	3°

Table 3. Patellar stability in relation to mechanical alignment and Q angle of Kinematic knee arthroplasties (degrees)

	n	Mean	*SD*	Range
Mechanical alignment				
Subluxation	13	0.5° varus	*3.3°*	5° varus– 6° valgus
Stable	43	0.7° varus	*4.5°*	8° varus–11° valgus
Total	56	0.6° varus	*4.2°*	8° varus–11° valgus
"Q" angle				
Subluxation	13	12.0° valgus	*2.0°*	10°–16° valgus
Stable	43	8.8° valgus	*2.3°*	3°–13° valgus
Total	56	9.6° valgus	*2.6°*	3°–16° valgus

angle greater than the ideal 7° valgus had a greater incidence of patellar subluxation ($P < 0.01$). If the Q angle was greater than 9°, patellar subluxation occurred in 4 out of 5 cases ($P < 0.01$).

None of the 8 cases in which a lateral release was performed sustained a subluxed patella. The use of continuous passive motion did not influence the occurrence of subluxation.

Discussion

Although the success of knee arthroplasty has improved dramatically over recent years (Insall et al. 1976, Merkow et al. 1985, Goodfellow and O'Connor 1986, Scuderi et al. 1989), the patellar articulation remains a frequent source of complications (Scott et al. 1978, Sneppen et al. 1978, Merkow et al. 1985). When the patella is resurfaced, problems such as patellar fracture, disruption, and loosening may occur (Clayton and Thirupathi 1982, Lynch et al. 1987); but most particularly, patellar subluxation still occurs in up to 25 percent of the cases (Mochizuki and Schurman 1979, Ranawat 1986, Lynch et al. 1987). Several predisposing causes of patellar subluxation have been postulated: absence of a patellar groove in the early designs (Moreland et al. 1979), excessive preoperative valgus deformity, an insufficient length or height of the lateral femoral facet of the patellar groove, patella alta or a short femoral flange (Merkow et al. 1985, Simison et al. 1986), persistent postoperative valgus deformity, external tibial rotation, the failure of the surgeon to correctly align the patella and to perform a lateral retinacular release when necessary (Insall et al. 1982), and the malposition of the components into valgus or external tibial rotation (Scott et al. 1978, Mochizuki and Schurman 1979, Merkow et al. 1985, Ranawat 1986, Picetti et al. 1990).

The Kinematic knee prosthesis was designed to be inserted aligned perpendicular to the mechanical axis of the leg when the action of the quadriceps along the femoral shaft is at 6° to the patellar articulation. The system originally included its own instrumentation, but the prosthesis is often inserted with the universal instrument system. This system reconstructs the mechanical axis of the leg, but the components are then inserted perpendicular to the vertical axis during one-legged stance, i.e., at 3° of valgus to the mechanical axis (Hungerford and Krackow 1985). This increases the obliquity of action of the quadriceps along the femoral-shaft axis to the patellar articulation axis to an average 9°, and therefore increases the force tending to sublux the patella laterally. Obliquity of the patellar tendon will also increase the tendency towards patellar subluxation if the prosthesis is inserted perpendicular to the mechanical axis, but with external rotation of the tibia.

Our study demonstrates a high incidence of patellar complications, particularly subluxation, following Kinematic knee replacement with the universal instrumentation system. This was not related to preoperative valgus deformity, postoperative valgus, or external rotation deformities. The association between an excessive Q angle and patellar subluxation suggested that subluxation was more common when the mechanical axis was reconstructed well, but the components were malaligned, with the femoral component in excessive valgus and the tibial component in excessive compensatory varus.

Lateral patellar release was successful in avoiding subluxation. With this prosthesis and instrumentation, patellar stability is hindered by a very short anterior femoral flange, a shallow patellar groove, and the instrumentation system that, while reconstructing the leg alignment, ensures that the components are inserted in 3° of valgus to the mechanical axis. While this instrumentation when used correctly presented no problems, any tendency for inaccuracy and malposition of the femoral component into excessive valgus resulted in an unacceptable rate of patellar subluxation. Therefore, if this system is used, particular attention must be paid to accurate positioning of the components; patellar stability should be carefully checked before closing the capsule, and a lateral release should be performed more frequently. Alternatively, a neutral rather than a 3° tibial cutting jig and a corresponding 5°, 7°, or 9° femoral cutting block should be used to align the components perpendicular to the mechanical axis.

The results of this study contrast with another study of the kinematic knee arthroplasty (Wright et al. 1990) in which patellar subluxation occurred in 2 out of 155 cases. The Q angle was not reported in this study, and no mention was made as to the type of instrumentation used. Other patellar complications found included patellar fracture in 2 cases, patellar loosening in 8 cases, and a total incidence of 8 percent patellar complications in those resurfaced.

More recent designs of total condylar knee prostheses have incorporated measures to stabilize the patellar joint: the femoral component may have a patellar groove offset at an angle of 3° to the right or left, the anterior femoral flange may be lengthened, the lateral facet raised, or the patellar groove deepened. Patellar stability is also helped by an anatomic or an ellipsoid patella (Kenna and Hungerford 1984).

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