Midterm clinical results of the Autocentric II patellofemoral prosthesis

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Abstract We studied the outcome of patellofemoral arthroplasties using the Autocentric prosthesis implanted in our clinic between 1994 and 2004. New insight on indications and contraindications motivated us to find risk factors in the failure of this prosthesis. Twenty-four patients had surgery for patellofemoral arthritis not responding to exhaustive nonoperative measures. The mean age at the time of patellofemoral arthroplasty (PFA) was 63.4 (SD 11.3, range 38–81) years with a mean follow-up of 4.8 (SD 2.9, range 2–11) years. Additional interventions were necessary in 21 knees during follow-up in our population, and seven knees required total knee arthroplasty (TKA) mainly due to progressive tibiofemoral osteoarthritis and maltracking of the patella. The patient outcomes and quality of life scores showed disappointing results, even after revision to TKA. This retrospective analysis underlines the importance of strict indications for patellofemoral arthroplasty and, in particular, of contraindications.

Résumé Les résultats à moyen terme de la prothèse fémoro patellaire Autocentric T. Nous avons étudié dans notre service, le devenir des arthroplasties patello fémorales utilisant la prothèse autocentric « T » posées entre 1994 et 2004. Une nouvelle approche des indications et des contre indications nous permet de mettre en évidence les facteurs de risques et d'échecs de cette prothèse. 24 patients ont été opérés pour une arthrose fémoro patellaire, ceux-ci n'ayant pas répondu à tous les critères du traitement conservateur.

L'âge moyen au moment de la mise en place de la prothèse fémoro patellaire (PFA) a été de 63.4 ans (SD 11.3, puis 38 à 81) avec un suivi moyen de 4.8 ans (SD 2.9, 2 à 11). Des interventions complémentaires ont été nécessaires sur 21 genoux, 7 genoux ayant nécessité la mise en place d'une arthroplastie totale du fait d'une évolution progressive vers une arthrose fémoro tibiale ou du fait de conflits au niveau de la rotule, avec une mauvaise course rotulienne. Le devenir des patients et la qualité de vie sont peu satisfaisants notamment après révision par prothèse totale du genou. Cette analyse rétrospective nous permet de confirmer l'importance du respect des indications des prothèses fémoro patellaires et, notamment des contre indications.

Introduction

Patellofemoral arthroplasty (PFA) is a treatment option for isolated arthritis in the patellofemoral joint and compared to total knee arthroplasty (TKA) it has a number of advantages. PFA preserves the structural integrity of the tibiofemoral joint by sparing the condylar surfaces, menisci, and cruciate ligaments. PFA is assumed to be a limited procedure with less dissection, less blood loss and more rapid recovery after surgery [13, 19].

Recently there has been renewed interest in PFA to treat isolated patellofemoral arthritis [1] not responding to nonoperative treatment. Newer designs have been introduced, but little is published about older designs. The most important causes of failure of patellofemoral implants which are consequently reported in previous studies are patellofemoral malalignment and arthritic disease progression in the tibiofemoral joint [1].

In our study we retrospectively analysed the survival of the Autocentric patellofemoral prosthesis (Depuy, Warsaw,

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Indiana). The Autocentric patellofemoral prosthesis was designed by Grammont and Millon with the aim of restoring (or preserving) normal biomechanics of the patellofemoral joint using a self-centering patellar component even in cases of mild malalignment [2, 3]. To our knowledge, this is the second published series of patients treated with this type of prosthesis in the English literature. We made an attempt to identify risk factors in the failure of this prosthesis by correlating the outcome in series with recently published indications and contraindications for PFA [11–13].

Patients and methods

Patients with patellofemoral arthritis and no substantial abnormalities in other compartments were selected for PFA after exhaustive noninvasive therapy. From 1994 to 2004, 24 Autocentric patellofemoral prosthesis were implanted in 20 patients with patellofemoral pain syndrome in our hospital. The mean time interval between first consultation and PFA was 4.2 years. General patient characteristics are summarised in Table 1.

For all patients in this series surgical exposure was through a medial arthrotomy with lateral displacement and rotation of the patella until the patellar surface and the trochlea were well exposed. The trochlea was reamed with a handbroach, whilst the patella was reamed using a motor-driven reamer. A simple guiding device for positioning of the femoral component was used and kept perpendicular to the epicondylar axis. A primary lateral release was performed in two patients with genu valgum improving alignment and tracking of the patella. The Autocentric patellofemoral prosthesis consists of a polyethylene patellar component implanted using cement and a chrome–cobalt femoral component available in three different sizes (small, medium and large), which can be implanted without cement. For the femoral component, cement was only used in three cases in this series, due to difficulties during placement.

We divided the patients into two groups: (1) patients with no revision surgery (NR), and (2) patients who

required secondary surgical intervention, as in replacement of the patellar component or conversion to TKA (R). We used the Outerbridge classification [17] which grades meniscal and cartilage deformities in arthroscopies that were performed in 20 out of 24 knees. Pre- and postoperative anterior and lateral view radiographs were graded using the Kellgren and Lawrence classification [9]. Postoperative radiographs of patients with ongoing knee pain were assessed for deterioration and maltracking of the patella. For the patients available for questionnaires we created an overview of patient subjective outcome and quality of life after PFA with or without revision using the visual analogue pain intensity scale, the Oxford-12 item knee score, the KOOS and the 36-item short form health survey [7, 18, 20]. Non revised patients were asked explicitly if they were satisfied with the results, if they experienced an improvement, and if they would undergo the same operation again. Because of the limited amount of patients, we only used descriptive statistics.

In order to identify risk factors we evaluated preoperative indications and relative or absolute contraindications as described by Lonner and Leadbetter [11, 12].

Results

After implantation of the PFA, additional interventions were carried out in 21 out of 24 knees to alleviate ongoing knee pain. The mean time interval until the first intervention was 34 (SD37) months. An overview of all additional interventions is presented in Fig. 1. Seven out of 24 PFAs were converted into TKA after a mean follow-up of 45 months (range 20–126).

Data of pre- and postoperative radiographic images are presented in Table 2. Mean time interval to postoperative radiographic imaging after PFA was 32 months. Preoperative radiographic and arthroscopic imaging showed mainly patellofemoral arthrosis. The preoperative arthroscopies showed meniscal and cartilage deformities graded as Outerbridge 1 or 2 in six knees also requiring revision. Postoperative radiographic imaging revealed a higher amount of three-compartmental disease. X-ray imaging as well as preoperative arthroscopic imaging showed deformities in other compartments in patients requiring a revision. These deformities were present in revised and in non revised knees with no trend of differences between groups.

Results of the questionnaires regarding patient outcomes and quality of life are shown in Table 3 involving 18 operated knees. These are postoperative outcomes with no comparison to preoperative status or during follow-up. The results in patient outcomes and quality of life scores are far from good, even after revision using TKA. Only three out of ten non revised patients available for questionnaires were

Table 1 Characteristics of cohort population

Characteristics of patients (24 knees)	Value	SD (range)
Primary arthritis/posttraumatic arthritis	20/4	
Male/female	3/21	
Left/right	9/15	
Body mass index	28.8	4.7
Mean age at PFA (y)	63.4	11.3 (38–81)
Mean follow-up (y)	4.8	2.9 (2–11)

SD standard deviation, PFA patellofemoral arthroplasty

Fig. 1 Overview of all interventions and revisions in chronological order per subject suffering from persistent pain or malfunction

satisfied with the results, four patients experienced an improvement and three patients would undergo the same operation again.

An analysis looking for indications and contraindications for patellofemoral arthroplasty in our population is presented in Table 4. It shows that indications and contraindications were present in patients requiring a revision as well as in non revised knees.

Discussion

Patellofemoral arthroplasty is used as a treatment for isolated osteochondropathy in the patellofemoral joint with varying success. Success rates of PFA as described in English literature vary from 42% to 90% [4, 10–12]. The limited data published and varying indications used in these studies possibly explain the diversity of these rates.

Other results of the Autocentric patellofemoral arthroplasty have been published by Argenson et al. [2, 3]. Their population included 66 patients with a mean age of 57 years (range 19–82) at primary PFA. The knees treated in the population were analysed and grouped by aetiology including a history of dysplasia or dislocation of the patella ($n=22$), post-traumatic osteoarthritis (mainly caused by previous patellar fracture) ($n=20$) and primary osteoarthritis ($n=24$). In their first published results, the majority of the conversions to TKA took place in the primary patellofemoral arthritis group, which is the main indication in our series for use of PFA (20 out of 24). In their first published results, seven out of 24 with primary patellofemoral arthritis were converted (29%), with a mean follow-up of 66 months (range 25–120) [2]. In a second publication, with a mean follow-up of 16.2 years (range 12–20), 29 out of 66 patients required conversion to TKA [3]. Fourteen out of these 29 patients were converted due to

Table 2 Radiographic imaging ($n=24$) preoperative and during follow-up

Pre- or postoperative	Grading	Total	Non revised (NR) ($n=15$)	Revised (R) ($n=9$)
Preoperative	Kellgren and Lawrence > 1	3	2	1
	Kellgren and Lawrence 0, 1	21	13	8
	Maltracking patella	5	3	2
	Patella Alta	2	0	2
	Patella Baja	1	1	0
Postoperative	Kellgren and Lawrence > 1	9	6	3
	Kellgren and Lawrence 0, 1	15	9	6
	Chondrocalcinosis	5	2	3

Table 3 Subjective results of patient outcomes and quality of life as scored by questionnaires ($n=18$)

Evaluation	Parameter	Non revised (NR)($n=10$)	SD	Revised (R)($n=8$)	SD
KOOS knee score	Symptoms	60.0	19.5	69.2	21.9
	Pain	47.5	22.2	68.1	20.9
	ADL	42.5	17.5	65.6	20.8
	Sports and recreation	21.5	12.7	36.3	19.2
	Quality of life	41.9	20.0	46.1	23.1
Oxford knee score		36.1	11.0	30.3	9.6
Short form-36	Physical functioning	31.5	19.6	37.5	23.0
	Social functioning	57.5	22.2	62.5	23.1
	Role physical	20.0	36.9	50.0	37.8
	Role emotion	46.7	50.2	54.2	43.4
	Mental health	64.4	16.7	59.0	21.4
	Vitality	49.5	15.9	50.0	18.9
	Body pain	50.2	26.9	40.6	20.9
	General health	52.5	20.7	50.6	14.5
VAS		4.3	3.1	3.9	3.0

SD standard deviation, ADL function in daily living, VAS visual analogue scale

progression of osteoarthritis at an average of 7.3 years. Our population showed a higher rate of prosthetic failure and complications within a shorter follow-up period, with 29% of the knees involved converted to TKA after a mean follow-up of 45 months (range 20–126). Progression of tibiofemoral osteoarthritis and persistent or recurrent maltracking of the patella were our main reasons for conversion to a TKA in the cohort.

Complications requiring interventions were present in both groups in our cohort with no significant differences. In

this way indications and contraindications can be generally associated in our cohort. However, primary indications and contraindications of PFA in the literature are controversial [3, 11–13].

The agreed indication is a severe isolated patellofemoral osteochondropathy not responding to nonoperative measures. The main contraindications described in literature are uncorrected maltracking of the patella, uncorrected tibiofemoral malalignment and other compartmental diseases. Possible risk factors as patella baja, high body mass index

Table 4 Indications and contraindications for patellofemoral arthroplasty present in revised (R) and non revised (NR) subjects [11–13]

Indications and contraindications	Total	NR ($n=15$)	R ($n=9$)
Indications			
Isolated degenerative patellofemoral osteoarthritis	20	12	8
Posttraumatic osteoarthritis	4	3	1
Extensive grade 3 patellofemoral chondrosis	15	10	5
Unresponsiveness to exhaustive nonsurgical therapy	24	15	9
Patellofemoral malalignment/ dysplasia induced degeneration	5	3	2
Relative contraindications			
Quadriceps atrophy	3	2	1
Prior meniscectomy	4	1	3
Chondrocalcinosis	4	2	2
Age < 40 years	1	1	0
Obesity (BMI index > 30)	9	3	6
Patella alta	2	0	2
High patient activity or bent knee use	6	2	4
Contraindications			
Arthritis greater than Kellgren-Lawrence grade 1 involving tibiofemoral articulation	3	2	1
Patella baja	1	1	0
Systemic inflammatory arthropathy	0	0	0
Uncorrected tibiofemoral mechanical malalignment (genu valgus > 8 degrees or varus > 5 degrees)	9	6	3
Active infection	0	0	0
Patellofemoral osteoarthritis/ chondrosis less than grades 3/4	2	1	1

(BMI) or age are less often described and remain arbitrary. For instance, Lonner indicates an age above 55 as a relative contraindication [13] and Argenson [2] suggests PFA as a temporary procedure for middle-aged patients because of the number of patients that require conversion to TKA during long-term follow-up. Patellofemoral osteoarthritis is considered a different entity to tibiofemoral osteoarthritis [8, 10]. According to Kooijman [10], treatment should not be postponed until development of tibiofemoral arthrosis makes TKA essential. The assumption however is made that implanting a PFA will postpone the further development of arthritis in the medial and lateral component. For this no evidence exists.

Our results show a high failure rate in patients with a mean age of 63.5 years (SD 11.4), and the mean age of patients with knees requiring conversion into TKA was even higher at 66.8 years (SD 6.7). A mean body mass index of 28.4 (SD 4.7) at implantation of PFA is indicative of failure in our population. Six subjects in our cohort with a BMI higher than 30 needed revision of the prosthesis and five were converted into TKA. A history of meniscectomy was present in three knees which later required revision after PFA. This may have been caused by a subsequent induction or unnoticed progression in tibiofemoral osteoarthritis after meniscectomy [5]. Both knees with a patella alta were revised. One subject with a patella baja, which is mentioned as an absolute contraindication in literature, began to experience discomfort in the operated knee after 2.5 years, but died due to nonrelated heart disease before intervention took place.

According to Lonner et al., TKA after PFA does not compromise results, compared to primary TKA [14]. The outcome instruments we used show a trend of improvement after revision into TKA, but still a relatively low quality of life. Whether these patients have been better off with primary TKA is not certain but is a matter for speculation.

Design considerations

Even though this prosthesis is designed as a self-centering patellofemoral prosthesis to restore the normal biomechanics of the patellofemoral joint, X-rays of knees with PFA showed tilting and subluxation of the patella in three knees. However, these were valgus knees and mild valgus deformity is now known to be a contraindication for PFA. A lateral release and correction of the extensor mechanism alignment has proven beneficial to avoid maltracking and impingement decreasing the amount of wear of the polyethylene [15, 16]. In patients with genu valgum we noticed a trend to better outcome if a concomitant lateral release took place leading to less symptoms of pain and fewer interventions.

A definite choice for the size of the components was sometimes difficult, because of the specific curve of the femoral implant which does not always properly match the trochlear anatomy. For the femoral component, cement was used in three cases in this series due to difficulty during placement. There was one patient in our cohort with an uncemented femoral component that suffered from loosening and was converted into TKA. The use of cement seems beneficial in the prevention of loosening but consequently withdraws the advantage of an easier conversion into TKA. (Figure 2)

The simple guiding device for positioning of the femoral component remained more or less free-handed and was not consistently precise. We find this lack of instrumentation for adequate rotation and placement a major issue in this concept. Newer designs of patellofemoral prosthesis with adjustments to curvature, the proximal extension of the anterior flange, the width of the implant and the level of constraint have been made to reduce complications. Computer-assisted patellofemoral arthroplasty [6] may also be of help in optimising implant positioning.

Fig. 2 A removed Autocentric patellofemoral prosthesis. Note the bone-formation on the back of the trochlear component

Conclusions

We used PFA in patients with patellofemoral arthritis and other minor compartmental diseases. Risk factors present in our population, such as obesity (BMI > 30), a previous meniscectomy, patella alta or baja and arthritis greater than Kellgren-Lawrence grade 1, constitute a contraindication for PFA, especially in the elderly. This retrospective analysis underlines the importance of strict indications for patellofemoral arthroplasty and, in particular, searching for contraindications.

Looking at the outcome of our population we consider the number of revisions of the Autocentric patellofemoral prosthesis together with the low patient satisfaction rate unacceptable and for these reasons the use of this implant was abandoned.

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