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ORIGINAL STUDY

Primary total knee arthroplasty in patients with Parkinson's disease : Analysis of outcomes

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The prevalence of Parkinson's disease is expected to rise. We evaluated the short term clinical outcomes following primary Total Knee Arthroplasty (TKA) in a group of patients with Parkinson's disease in a case controlled study. Within the review period 32 TKAs were implanted in patients with Parkinson's disease and 33 TKAs were implanted in an age-matched control group (mean age : 73 years). Pre-operatively there were no between-group differences in Knee Society Score, Pain score, Knee Society Function Score or range of movement. Knee Society Score (KSS) improved in both groups post-operatively with no significant between-group differences (p = 0.707). Pain score also improved in both groups. There was no functional improvement following TKA in the Parkinson group. Total Knee Arthroplasty provided excellent pain relief in patients with Parkinson's disease with an acceptable complication profile, although functional ability did not improve.

Keywords : knee ; total knee arthroplasty ; Parkinson's disease.

INTRODUCTION

Parkinson's disease is a progressive neurodegenerative disorder caused by the loss of dopamine and dysfunction within the basal ganglia (*11*). Parkinson's disease is characterised by motor features including bradykinesia, tremor, rigidity and postural instability as well as non-motor features such as cognitive impairment and psychiatric manifestations (*6*). The prevalence of Parkinson's disease in individuals over 50 years of age in the world's most populated nations is projected to double from between 4.1 and 4.6 million in 2005 to between 8.7 and 9.3 million by 2030 (*2*). It is reasonable to expect that orthopaedic surgeons will increasingly be required to assess the suitability of patients with Parkinson's disease for knee arthroplasty.

Contemporary Total Knee Arthroplasty (TKA) designs have shown excellent short to long term clinical results and durability in patients with osteoarthritis and rheumatoid arthritis (*7,10*). Nonetheless, reports of the outcomes of total knee arthroplasty (TKA) in patients with Parkinson's disease in the literature are sparse. Whereas pain relief has been satisfactory, reports indicating limited functional improvement and significant complications have

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contributed to concern that patients with Parkinson's disease may not be suitable candidates for reconstructive knee surgery (*8*). We therefore conducted a case-controlled study to evaluate short term clinical outcomes following primary TKA in a group of patients with Parkinson's disease.

PATIENTS AND METHODS

We performed a retrospective analysis of prospectively collected data from our regional arthroplasty registry. All patients with a confirmed diagnosis of Parkinson's disease having primary TKA between January 1993 and February 2011 were included. In total, 32 TKAs were implanted in 25 patients, 18 men (72%) and 7 women (28%). Seven patients had staged bilateral procedures. Twelve were implanted on the left side and 20 on the right. Mean age at operation was 73 years (62 to 86).

An age matched control group without Parkinson's disease was randomly computer-generated from registered cases between January 1995 and February 2011, a pool of 5707 TKAs. In total, 33 TKAs were implanted in the control group of 33 patients, 12 men (36%) and 21 women (64%). Fifteen were implanted on the left side and 18 on the right. Mean age at operation was 73 years (51 to 90).

The primary indication for surgery was osteoarthritis for all knees in the study. In order to maximise sample size in the Parkinson's disease group, implant design was not a controlled variable. However, the Nexgen Legacy Posterior Stabilised (Zimmer Inc, Warsaw, USA) prosthesis was the most commonly used implant overall, accounting for 17 (53%) knees in the Parkinson's disease group and 18 (56%) knees in the controls. All patients were followed up prospectively by independent arthroplasty audit nurses before surgery and at 1, 3, 5, 10 and 15 year intervals post-operatively. Complications and revision operations were recorded throughout the follow-up period. Outcome measures analysed in the study included Knee Society Score (KSS) and Knee Society Function Score (KSFS) (*5*). As KSS is a composite score including objective clinical parameters distinct from pain, the pain score component of the KSS was also analysed separately. Range of Movement (RoM) was also analysed as an independent variable.

Median follow-up was 3 years (range 0 to 10) for both the Parkinson's disease and control groups. Three patients in the Parkinson's disease group died at 5.8, 6.7 and 10.7 years post-operatively from causes unrelated to the surgery. Six patients in the control group died during follow-up at 0.5, 1.3, 5.9, 6.0, 7.2 and 8.1 years post-operatively. Two patients in the Parkinson's disease group and 1 patient in the control group withdrew from the study or were otherwise lost to follow-up during the first 5 post-operative years under analysis. As follow-up data beyond 5 years was available for only 4 patients (1 in the Parkinson's group and 3 in the control group) analysis was limited to 5 year review.

Statistical analysis was performed with SPSS v20 software (SPSS Inc., Chicago, USA). Generalised Estimating Equations (GEE) were used to assess the effects of review point and group on changes in KSS, KSFS and RoM. All bilateral TKRs in the study were carried out on Parkinson's disease patients and GEE methods were also used to compare outcomes of unilateral and bilateral surgery within this group. A p-value < 0.05 was considered to be statistically significant. Sample sizes were too small to perform a reliable survival analysis.

RESULTS

Median in-patient stay was comparable in Parkinson's disease patients and controls (8 days and 7 days respectively, $p = 0.714$).

Knee Scores

Post-operative improvement in KSS was comparable between the Parkinson's disease and control groups ($p = 0.707$, Fig. 1). In the Parkinson group, the median pre-operative KSS of 30.5 points increased to 85 points at 1 year post surgery and 91 points at 5 years. In the control group, the median pre-operative KSS of 32.5 points increased to 91.5 points at 1 year post surgery and 88 points by 5 years.

Overall, differences in KSFS between the groups were not statistically significant at the 5% level ($p = 0.061$). However, in contrast to controls who demonstrated an increase in KSFS at Year 1, there was no functional improvement in Parkinson's disease cases (Fig. 1).

For patients with Parkinson's disease, post-operative improvements in KSS were similar in those undergoing unilateral and bilateral knee replacement ($p = 0.546$, Table I). Patients with Parkinson's disease who underwent bilateral surgery showed a significant deterioration in KSFS at

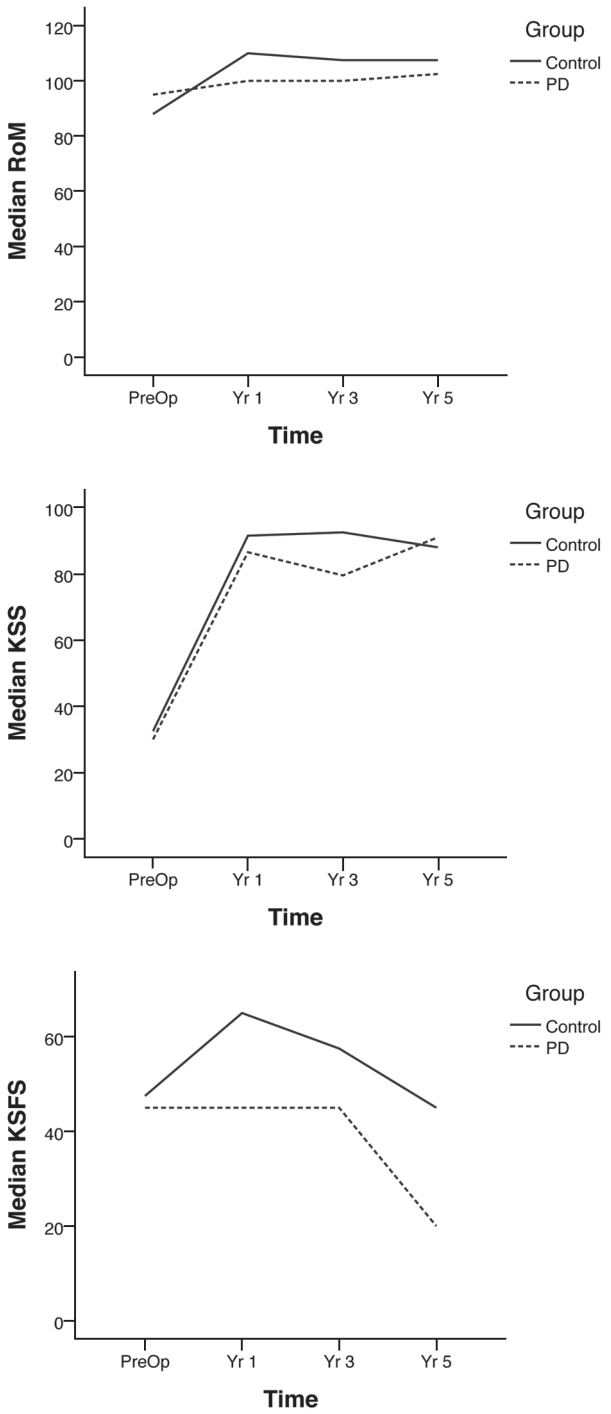

Fig. 1. — Line graphs of scores by time of review and group

3 years ($p = 0.001$, Table I) in contrast to those with unilateral knee replacement where KSFS was maintained at that time. By 5 years post-operation KSFS had declined markedly in all patients with Parkinson's disease (Table I).

Pain

Pre-operative pain scores were comparable in both groups ($p = 0.496$). Although pain demonstratively improved in both groups following TKA (Fig. 2) it was not possible to demonstrate this with statistical significance using χ^2 tests, most likely due to low sample sizes.

RoM

The Range of Movement increased from a mean of 88 degrees (46 to 125) preoperatively to 110 degrees (10 to 125) at 1 year in the control group and from 95 degrees (30 to 120) to 100 degrees (70 to 125) in the Parkinson's disease group (Fig. 1). This improvement was probably of clinical importance for patients in the control group. However, there was no statistical difference between the groups ($p = 0.206$). In patients with Parkinson's disease, post-operative improvements in RoM were similar in cases undergoing unilateral and bilateral knee replacement. ($p = 0.548$, Table I).

Complications and Revisions

The complications in both groups are listed in Table II. Of note in the Parkinson group, there was 1 case of bilateral quadriceps tendon avulsion in the same patient. On the right side a spontaneous, complete quadriceps tendon rupture occurred 77 months after primary TKA and was surgically reconstructed. On the left side a spontaneous, partial quadriceps tendon rupture occurred 18 months following primary TKA and was treated conservatively. Another patient presented with spontaneous posterior dislocation at 6 months following primary TKA and the implant was successfully revised to a rotating hinge TKA. One implant in the control group was revised for aseptic loosening in the seventh post-operative year.

Table I. — Range of Movement and Knee Society scores, by Surgery (unilateral vs bilateral) and time of Review (Parkinson's Group only)

Review	Measure	Surgery	No. of patients	Median (Range)
Pre-op	RoM 30	Unilateral	16	90.5 (30,120)
		Bilateral	14	100 (70, 110)
	KSFS 31	Unilateral	17	45 (0, 75)
		Bilateral	14	45 (0, 50)
	KSS 28	Unilateral	15	28 (0, 53)
		Bilateral	13	35 (11, 67)
Year 1	RoM 28	Unilateral	15	100 (70, 120)
		Bilateral	13	105 (80, 125)
	KSFS 28	Unilateral	15	45 (0, 90)
		Bilateral	13	45 (0, 100)
	KSS 27	Unilateral	14	86.5 (59, 98)
		Bilateral	13	85 (76, 99)
Year 3	RoM 17	Unilateral	10	105 (75, 115)
		Bilateral	7	90 (65, 117)
	KSFS 17	Unilateral	10	45 (0, 60)
		Bilateral	7	20 (0, 65)
	KSS 16	Unilateral	9	83 (68, 96)
		Bilateral	7	76 (63, 92)
Year 5	RoM 12	Unilateral	7	100 (80, 125)
		Bilateral	5	105 (100, 115)
	KSFS 13	Unilateral	8	15 (0, 50)
		Bilateral	5	20 (15, 80)
	KSS11	Unilateral	6	89.5 (69, 95)
		Bilateral	5	91 (85, 96)

DISCUSSION

Parkinson's disease is common, with a prevalence previously estimated at 1.8% in those aged over 65 years in European populations (*1*). To our knowledge, we present the first study directly comparing outcomes of TKA in Parkinson's disease patients with a control group of patients without Parkinson's disease.

Oni and Mackenney reported poor outcomes and impaired post-surgical rehabilitation following TKA in a series of 3 patients with Parkinson's disease and concluded that TKA was contra-indicated in this group (*9*). Complications included hamstring rigidity and flexion deformity in all 3 cases and distal quadriceps tendon rupture or avulsion in 2 cases. Unlike contemporary practice the operated knee was routinely immobilised in a cylinder cast for 3 weeks following surgery in this series.

Vince *et al* published a case series of 12 primary total knee replacements in 9 patients with Parkinson's disease and osteoarthritis with a mean follow-up of 4.3 years (*12*). Nine of the 12 primary TKAs were rated as excellent using the Hospital for Special Surgery Knee Scale and 3 knees were rated as good. The authors concluded that Parkinson's disease is not an absolute contra-indication to TKA.

In the largest study to date, Duffy and Trousdale reported a retrospective review of 24 patients with Parkinson's disease undergoing 33 TKAs followed up for a mean of 33 months (*3*). They concluded that good pain relief was achievable, although this was

Table II. — Complications (*implant revised)

Group	No. of patients	Complication general/knee
Parkinson's	1	Deep vein thrombosis
	1	Superficial infection
	1	Urinary retention
	1	Urinary tract infection
	1	Bilateral quadriceps avulsion
	1*	Posterior tibial dislocation
Control	1	Deep infection
	1	Urinary retention
	1	Patellar subluxation
	1*	Aseptic loosening

based on comparison of full pre and post-operative Knee Society Scores (which they term "pain scores") which includes scoring for clinical parameters distinct from pain. Nonetheless, scores improved from a mean of 34 points before surgery to 89 points at latest follow-up. They were unable to show consistent improvement in functional status and attributed this to progression of Parkinson's disease as judged by disease classification at latest follow-up.

More recently Erceq and Maricevic reported a female patient with Parkinson's disease (from a series of 136 patients that underwent posterior-stabilised primary TKA) who developed recurrent posterior dislocation of the tibia 9 months following surgery, which required revision (*4*).

Our study demonstrates a clear improvement in knee pain following TKA in patients with Parkinson's disease as judged both by improved KSS and by comparison of pain scores independently. This improvement was maintained to Year 5 post-operation and was of a similar magnitude to the pain improvement observed in a control group without Parkinson's disease. Consistent with the

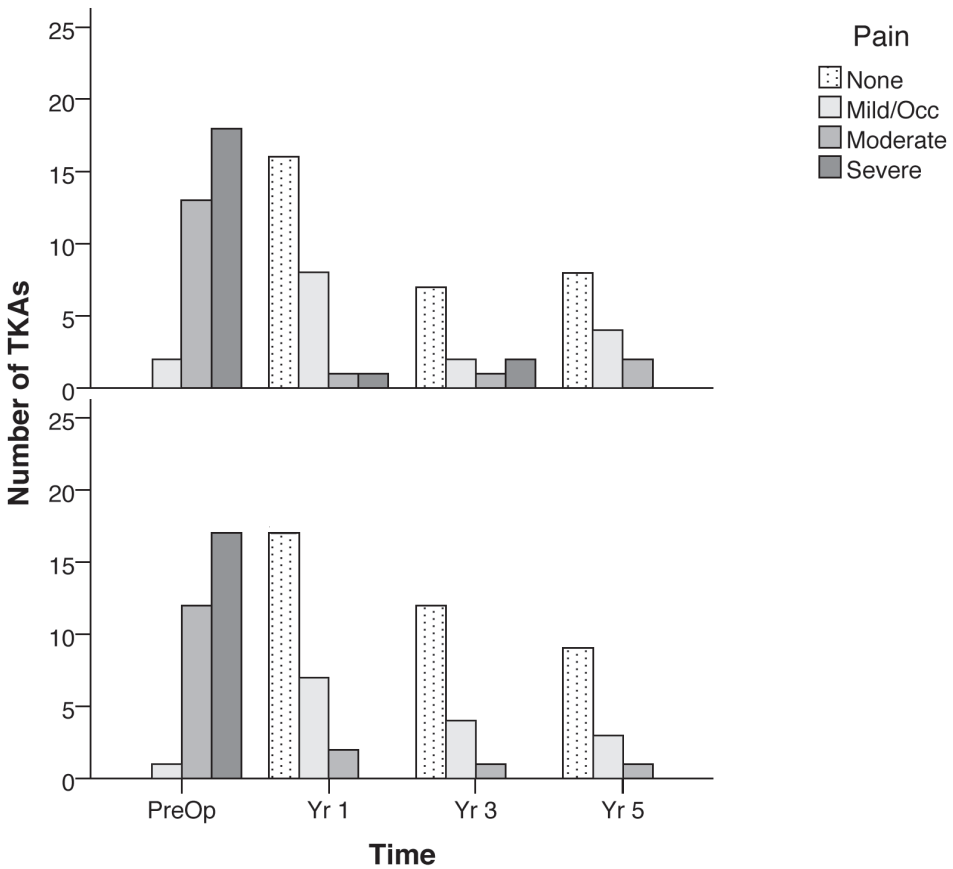

Fig. 2. — Bar graphs of pain scores by time of review and group. Upper graph : Control Group ; lower graph : Parkinson disease.

largest study published previously (*3*) we found no significant improvement in functional status following TKA in patients with Parkinson's' disease. Differences in KSFS between groups in our study were not statistically significant and this is likely to reflect low statistical power. Duffy *et al* reported that worse functional outcome was seen in patients whose Parkinson's disease severity had progressed at latest follow-up (*3*). Unfortunately, classification of Parkinson's disease was not routinely documented in our series and we were therefore not able to correlate Parkinson's disease severity with outcomes following TKA. We accept that this is one of the weaknesses of our study.

When analysed as an independent variable, we noted improved RoM in both groups following TKA and although trends suggested greater improvement in the control group (*3*) we found no significant improvement in function; this did not reach statistical significance. Although the total number of complications and implant revisions in both groups was low, extensor mechanism disruption (*3,9,12*) and posterior dislocation of the tibia (*4*) have been reported previously in relation to patients with Parkinson's disease.

We acknowledge several weaknesses and limitations in our study. The retrospective nature of the analysis meant that some criteria, such as Parkinson's disease classification pre-operatively and at follow-up, were not available. Despite the prevalence of Parkinson's disease in the community, disproportionately few patients with confirmed Parkinson's disease underwent TKA in our region. We do not know if this reflects selection bias or the fact that severe pain from osteoarthritis of the knee is less common in patients with Parkinson's disease.

However, we found that patients with Parkinson's disease benefited from excellent short term pain relief that was comparable with pain relief in an age-matched control group. Consistent with previous reports, functional improvements were not demonstrated. This is presumably a reflection of the impaired functional ability resulting from Parkinson's disease. It seems likely that there is a close relationship between functional outcome following TKA and the severity and progression of Parkinson's disease. This relationship requires evaluation in larger, prospective outcome studies where Parkinson's disease is classified routinely during follow-up.

We conclude that Total Knee Arthroplasty provides excellent short term pain relief in patients with Parkinson's disease with an acceptable complication profile, although knee function is unlikely to improve.

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