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Original Article

Incidence and predictors of total knee arthroplasty following knee arthroscopy

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ABSTRACT

Objective: The purpose of this study was to determine the effectiveness of knee arthroscopy (KA) in patients with symptomatic meniscal tears or mechanical symptoms and OA, by using conversion to TKA as a final outcome measure.
Methods: Retrospective review of all patients with OA who underwent KA in our practice.
Results: 1215 KAs were reviewed; 3.9% underwent conversion to TKA at an average of 3.2 years.
Conclusion: KA plays a role in delaying TKA in knees with meniscal tears and mechanical symptoms with concurrent OA.

1. Introduction

Arthroscopic knee meniscectomy is the most commonly performed orthopaedic procedure,[1] but the indications have been called into question following the publication of several large randomized control trials.[2,3] The results of these trials have suggested that KA in the setting of moderate or severe OA is of no benefit compared to physical and/or medical therapy. Based on the well publicized papers by Moseley et al., Kirkley et al., and the Cochrane Review of the literature before 2006,[4] routine KA is not recommended in the setting of severe OA.[5] However, despite recent evidence, the number of arthroscopies for OA has not decreased,[6] as many orthopaedic surgeons continue to advocate for its role in certain settings, such as when patients suffer from mechanical symptoms, or in isolated medial compartment OA.[7] While arthroscopy does not cure OA, many point to evidence in the literature that arthroscopy has a temporizing effect upon patients' symptoms,[8] and may potentially delay more invasive surgery, such as total knee arthroplasty (TKA).[9] Although it is generally accepted that patients with advanced OA do not benefit from KA, patients with mild to moderate OA, meniscal pathology, or loose bodies show improvement when treated with KA.[10] Currently there is a lack of consensus regarding the benefit of KA in the treatment of degenerative medical tears and mechanical symptoms in the presence of knee OA.

In a recent systematic review of the literature, Barlow et al.[11] question why the recent evidence against arthroscopy has not yet been met with widespread acceptance, pointing out that the methodological flaws in the paper by Moseley et al.[2] were corrected for by Kirkley et al.,[3] who demonstrated similar results. Barlow et al.[11] conclude that although widespread use of KA for the treatment of OA is contraindicated, there remains a body of evidence that suggests that certain groups of patients still benefit from the procedure. Katz et al.[10] compared arthroscopic debridement and lavage to physical therapy in patients with mild to moderate osteoarthritis and a meniscal tear, and found no difference in outcomes after 6 and 12 months, however, 30% of patients crossed over from the non-operative group to the operative group before 6 months. The study therefore counselled that an initial nonoperative course was appropriate for this patient population, but cautioned that physical therapy alone might not suffice in a subset of patients. The paper by Hubbard et al.[7] provides some information about which subset of patients with OA may benefit from arthroscopy. In their study, those patients with isolated Outerbridge 3 or 4 lesions of the medial femoral condyle showed improvement in pain relief with KA. Although there was deterioration of this effect within the first two years post-operatively, 65 percent of patients were still pain free at five year follow-up.

Steadman et al.[12] also attempted to clarify which patients with OA benefit from KA. They identified that younger (< 70) patients with mechanical symptoms, low-grade OA, limited mal-alignment, and no tibial osteophytes showed improvements with KA. They also pointed out that only 20 percent of patients return to higher-impact sport (squash, tennis, jogging) after TKA, and the majority only return to low-impact activities such as bicycling. For those patients seeking to

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maintain a higher activity level, while temporizing their symptoms of OA, KA proved to delay TKA for up to 5 years in 70 percent of patients with KL grade 3 OA. Even at 10 year follow-up, 40 percent of patients had still avoided TKA, although it is unclear whether these patients were still maintaining a high activity level.

There have been few studies examining the long-term outcomes of KA in patients with degenerative meniscal tears and mechanical symptoms in the presence of OA. In addition, there has been little consensus on the specific clinical, intra-operative, and radiographic findings related to favourable outcome following KA. The purpose of this study was to further investigate the effectiveness of KA by using conversion to TKA as a final outcome measure, as well as to identify specific patient, intra-operative, and radiographic factors that might be predictive of successful management of OA-related symptoms (meniscal tears, or mechanical symptoms), with KA.

2. Materials and methods

We reviewed the records of all patients with OA who underwent KA in our practice. Detailed operative notes and arthroscopic records were reviewed that provided an Outerbridge score, and the percentage size and location of cartilage damage in all compartments of the knee, as well as the size and side of a meniscal tear. In addition, on radiographs, the pre-operative Kellgren and Lawrence (KL) grade was calculated for all patients.

All intra-operative findings and pre-KA radiographs of patients that did not convert to TKA (KA-only group) were reviewed, and compared with a 2:1 age matched selection of patients who converted to TKA.

2.1. Statistical analysis

For descriptive statistics, comparisons were made across knee scores using Student *t*-tests. Time to failure was analyzed using the method of Kaplan and Meier.[13] Failure was defined as conversion to TKA. Significance was defined at $p < 0.05$.

2.2. Source of funding

This study was funded by the Insall Scott Research Foundation. Funds were used to pay for the salaries for a research assistant and a biostatistician and for supplies and mailings.

Institutional review board approval was obtained for this study.

3. Results

Between the years 2005 and 2012, 1215 KAs were performed by one of two senior authors (Table 1). These patients were followed for a mean of 6 (minimum 2) years. The incidence of conversion to TKA was 3.9 percent (46 patients) at an average time interval of 3.2 years (range 2–8 years). The mean patient age was 51.3 years for the KA-only group and 56.4 for the TKA group. There were more females in the TKA group (67.3 percent compared to 32.7 percent in the KA-only group).

3.1. Percentage of compartment and meniscus affected

When comparing the KA-only to the TKA group with a 2:1 age matched selection of patients, a statistically significant difference was found when examining for the affected surface areas of each respective knee compartment, with worse wear identified in the TKA group (Table 2). This difference was most pronounced in the medial femoral condyle (MFC), with the KA-only group showing only 19.2 percent involvement compared to 35.4 percent involvement in the TKA group ($p < 0.001$).

In the KA-only group, the mean size of the tear within the medial meniscus was 13.7 percent of the total area. In the TKA group, the mean size of the tear was 20.2 percent of the total area of the medial meniscus ($p = 0.016$). The size of the tear relative to the total area of the medial meniscus was significantly greater in the TKA group (Table 2). The results of a two sided *t*-test did not find a significant difference in lateral meniscal tears between the two groups ($p = 0.485$).

Table 1
Patient demographics, and average scores for percentage involvement, and Outerbridge grade, in each compartment.

	KA-only	TKA
N	1169	46
Male (%)	49.0	32.7
Female (%)	51.0	67.3
Age	51.3	56.0
Size MM Tear	17.7	20.2
Size LM Tear	9.5	9.4
Grade MT	2.2	3.2
Size MT (%)	19.8	31.3
Grade LT	2.8	3.4
Size LT (%)	23.6	35.1
Grade MFC	2.4	3.5
Size MFC (%)	20.6	35.4
Grade LFC	1.3	2.4
Size LFC (%)	13.8	23.7
Grade Troch	2.4	3.3
Size Troch (%)	25.2	35.9
Grade PAT	2.9	3.5
Size PAT (%)	25.7	31.8
Time to TKA	NA	3.2
Converted to TKA (%)		3.9

*KA − Knee arthroscopy, **TKA − Total knee arthroplasty.

3.2. Outerbridge grade

When comparing the KA-only to the TKA group with a 2:1 age-matched selection of patients, a statistically significant difference was found between the Outerbridge scores in almost all respective compartments of the knee, with worse scores found in the TKA group (Table 3). The greatest difference was seen in the MFC, where the KA-only group averaged 2.6 compared to 3.5 in the TKA group. The exception was the patellar (PAT) articular surface; in the KA-only group the mean Outerbridge grade was 3.3 compared to 3.5 ($p = 0.262$) in the TKA group.

3.3. Kellgren and Lawrence grade

The mean Kellgren and Lawrence (KL) grades of the two groups were compared with a 2:1 age-matched selection of patients. The mean KL grade of the KA-only group was 1.5. Of the 46 patients that underwent TKA, the mean KL grade was 2.5. The mean KL grade of the TKA group was found to be significantly greater than the mean KL grade of the KA only group, with a $p < 0.001$ (Table 4).

4. Discussion

The use of KA as a treatment for degenerative meniscal tears, or mechanical symptoms in the presence of OA is controversial. Small randomized controlled trials[2,3,14] have recommended restricting its use, but many continue to advocate for KA in specific subsets of patients with OA. In their meta-analysis, Spahn et al.[15] identify that KA successfully treats OA in a “middle-term” time interval (good or excellent results after 5 years), but they point out that information is lacking to guide proper patient selection. Our study identifies several patient, intra-operative, and radiographic factors that are predictive of successful treatment of OA-related symptoms with KA, and also demonstrates the temporizing effect of KA, as it delayed TKA in these patients at an average follow up of 6 years.

This study reviewed the data from 1215 KA’s, and identified a rate

Table 2
Differences in area affected between KA-only and TKA groups (2:1 age-matched patient selection).

T-test − Comparison of Percentage of Chondral Surface Affected or Meniscus Resected							
	Intervention	N	Mean	Std. Deviation	95% CI		Sig. *(p < 0.05)*
					Lower	Upper	
MM	KA-only	101	13.7	14.668	−11.677	−1.209	0.016
	TKA	46	20.2	13.854			
LM	KA-only	101	7.8	12.791	−6.121	2.921	0.485
	TKA	46	9.4	12.162			
MT	KA-only	101	18.8	10.872	−16.812	−8.212	< 0.001
	TKA	46	31.3	15.035			
LT	KA-only	101	21.4	16.769	−20.372	−6.974	< 0.001
	TKA	46	35.1	23.345			
MFC	KA-only	101	19.2	11.635	−20.946	−11.508	< 0.001
	TKA	46	35.4	16.727			
LFC	KA-only	101	15.0	1.593	−14.721	−2.571	0.006
	TKA	46	23.7	2.922			
PAT	KA-only	101	26.2	11.476	−10.233	−0.827	0.022
	TKA	46	31.8	16.657			
TRO	KA-only	101	26.1	19.247	−16.981	−2.699	0.007
	TKA	46	35.9	22.500			

*KA − Knee arthroscopy, **TKA − Total knee arthroplasty.

of conversion to TKA of only 3.9 percent (46 patients) at an average 6 year follow up (range 2–8 years). This study also included a detailed intra-operative assessment of the patients who underwent KA-only, and those converted to TKA, and this data is presented in a 2:1 age-matched selection of patients. We identified Outerbridge scores in the six different surfaces of the knee, the percentage of wear of those same surfaces, and the percentage of meniscus torn. Patients eventually converted to TKA exhibited worse scores and percentages in most areas (with the exception of the patellar articular surface), and important intra-operative findings were identified that might predict successful treatment of symptoms with KA. The most significant difference in Outerbridge scores between the two groups was found in the medial femoral condyle (MFC), with the KA-only group averaging 2.6, and the TKA group averaging 3.5 ($p < 0.001$). In addition, the greatest difference in the percentage of area damaged between the two groups was also found in the MFC, with the KA-only group averaging only 19.2 percent compared to 35.4 percent in the TKA group ($p < 0.001$).

Comparatively, Shannon et al.[16] demonstrated 82 percent good/excellent results following KA in patients mechanical symptoms, and Outerbridge grade 1 or 2 OA, compared to only 57 percent good/excellent results in patients with Outerbridge 3 or 4 OA, but their study failed to specify which surfaces in the knee were primarily affected. The study by Hubbard et al.[7] included only those patients with isolated MFC OA, and randomized them to receive either arthroscopic debridement or a washout. Those that underwent debridement showed significantly improved pain and modified Lysholm scores at 5 years postoperatively compared to those that underwent washout alone, which like our study suggests that the grade of MFC OA can predict if patients will benefit from KA. In their retrospective study of arthroscopic treatment of patients with KL grade 3 or 4 OA, Steadman et al.[17] additionally provided the Outerbridge scores in all different compartments of the knee, and reported worse outcomes (conversion to TKA) in patients with "kissing

Table 4
T-test analysis of KL grades between KA-only and TKA groups (2:1 age matched patient selection).

T-test − Comparison of KL grades of Arthroscopy and TKA Group						
	n	Mean	SD	95% Confidence Interval		Sig. (2-tailed)
				Lower	Upper	
KA-only	101	1.5	1.045	0.630	1.350	< 0.001
TKA	46	2.5	0.890			

*KA − Knee arthroscopy, **TKA − Total knee arthroplasty.

Table 3
Differences in grades between No TKA and TKA groups (2:1 age-matched patient selection).

T-test − Comparison of Grades							
	Intervention	N	Mean	Std. Deviation	95% CI		Sig. *(p < 0.05)*
					Lower	Upper	
MT	KA-only	101	2.4	1.321	−1.207	−0.327	p = 0.001
	TKA	46	3.2	1.065			
LT	KA-only	101	2.8	1.217	−0.934	−0.141	p = 0.004
	TKA	46	3.4	0.897			
MFC	KA-only	101	2.6	1.353	−1.333	−0.482	p < 0.001
	TKA	46	3.5	0.816			
LFC	KA-only	101	1.8	1.524	−1.170	−0.103	p = 0.001
	TKA	45	2.4	1.465			
PAT	KA-only	101	3.3	0.726	−0.447	0.122	p = 0.262
	TKA	46	3.5	0.956			
TRO	KA-only	101	2.6	1.519	−1.192	−0.187	p = 0.008
	TKA	46	3.3	1.209			

*KA − Knee arthroscopy, **TKA − Total knee arthroplasty.

lesions" (Outerbridge grade 3 or 4 OA on adjacent surfaces). Our study showed that the Outerbridge grade, and the percentage of the joint surface affected in the MFC was highly predictive of successful treatment of OA-related symptoms with KA, and timing of conversion to TKA.

From a radiographic standpoint, in our 2:1 age-matched selection of patients, our data demonstrate a statistically significant difference in the KL scores between the KA-only group and the TKA group (1.5 vs. 2.5, $p < 0.001$). Therefore, despite the radiographic presence of mild to moderate OA in the KA-only group, several symptomatic patients were able to avoid TKA for up to 6 years by treatment with KA alone. Aaron et al.[18] showed similar results in their study, as 90 percent of patients with mechanical symptoms and KL grade 2 OA or below had good results at an average of 3 years post KA, whereas good results were only found in 53 percent of patients with KL grade 3 OA. Crevoisier et al.[19] similarly reported 81 percent good results at 2 years follow-up in patients with KL grade 1 or 2 OA, compared to 55% good results in patients with KL grade 3 or 4 OA. While these findings would seem to indicate that a KL grade < 2 is predictive of successful outcome with KA, other studies have shown successful results in patients with greater degrees of radiographic OA. Buldu et al.[20] evaluated 33 patients with a median KL grade of 3, all of whom were suffering from mechanical symptoms, and found a significant improvement in the Oxford and Lysholm scores, and Visual Analog Scores (VAS) in their patients at an average 24 months follow up post KA. In their retrospective review of patients aged 65 years or older with varying degrees of OA at time of KA, Raajmaakers et al.[21] found a 47.8 percent conversion rate to TKA in patients with KL grade 4 OA at 48 months post KA, compared to only a 20.7, and 29.1 percent conversion rate in patients with KL grade 2, and 3 OA respectively, suggesting that KA was of benefit to patients with KL grade > 2 OA. Because our study provided a longer follow up (average 6 years), we believe our data provides a more reliable indicator of the KL grade predictive of successful treatment of OA-related symptoms with KA. Our data show successful temporization of OA-related symptoms by KA at 6 years postoperatively in patients with a KL grade < 2, using conversion to TKA as the outcome measure.

5. Conclusion

This study demonstrates that KA can be an effective treatment for symptomatic knee OA in select patients with degenerative meniscal tears and mechanical symptoms, while providing important additional prognostic indicators for both the surgeon and patient. Many patients who had significant OA in our study, both at time of arthroscopy (medial femoral condyle with Outerbridge grade 2.6) and on radiographs (average KL score of 1.5) and had managed to avoid TKA at an average of 6 years post KA. Therefore the radiographic and arthroscopic grade and location of cartilage damage can be used to determine prognosis. KA continues to have an important role in the treatment of symptomatic knees with mechanical symptoms and meniscal tears, despite the presence of OA, and our findings help better identify those patients best suited to this treatment option.

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