



Return to sport after total or unicompartmental knee arthroplasty: An informative guide for residents to patients

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- Knee arthroplasty survival rate — either UKA or TKA — is currently 95%, greater than it was ten years ago, but has not been specifically evaluated in very active patients practicing sport at a high intensity.
- The terms and conditions of return to physical activities are decided by the surgeon, the rehabilitation or Sports Medicine doctor, who needs to make sure that postoperative rehabilitation has been conducted optimally. Specifically, range of movement must be complete, muscular strengthening has to be sufficient and balance must be recovered by proprioception. Only after this stage (i.e. three to six months after surgery) can physical activities be resumed.
- Return to sport must be gentle and progressive, with moderate activities limited to short sessions. Progressively the patient will be able to return to intermediate activities, provided that he/she possesses the adequate level of technique for the sport.
- This up-to-date review for young surgeons and residents aims to provide an informative guide for patients regarding sport following knee arthroplasty.

Keywords: knee arthroplasty; return to sport; rehabilitation; patient information

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Introduction

Total knee arthroplasty (TKA) confers significant mid- and long-term benefits for quality of life – particularly regarding pain and function – and is associated with a high level of satisfaction for the patient.¹ While TKA is expected to

increase by more than 670% by 2030,² patients' requirements and expectations have evolved towards being able to participate in recreational activities or sports following their knee surgery.^{3,4} Surgeons have long remained cautious, forbidding the practice of high-impact physical activities in order to prevent premature failure of implants. Such caution is nowadays being questioned, given the increasing functional demands desired by patients themselves, and with recent data from the literature bringing controversy to the debate. Indeed, implant integrity in physically active patients is reported not to be restricted.⁵

Return to activity following knee arthroplasty – be it sports or other activities – is of concern to every patient. We know that practising physical activity from low to moderate intensity is safe, increasing standards of living through higher physical and social mobility and better cardiovascular performance. Furthermore, and from a public health perspective, this reduces costs related to treatments in this population.^{6–8} Some authors have even reported the benefits of knee arthroplasty to general health⁹ and sports performance.¹⁰ However, returning to sports activity after knee arthroplasty is not as well studied as other aspects of functional recovery. This review aims at raising awareness of the question of return to sports for TKA and unicompartmental knee arthroplasty (UKA) patients. Drawing on recent literature, this review seeks to identify factors which influence resumption of sports activity in order to guide patients using a more personalized approach.

Which factors influence return to sport?

Several elements influence return to sport after TKA. As this arthroplasty is not a replica of a healthy knee, it has its own limitations. Each patient has functional expectations

Table 1: Results of unicompartmental knee arthroplasty (UKA) in the recent literature

Authors	Year	Study	Follow-up	Number	Results
Argenson et al ¹	2002	Retrospective study	66 mths	147 (160 UKA)	Survival : 94% at 10 years
Pennington et al ²¹	2003	Retrospective study	11 yrs	41 (46 UKA)	Survival : 92% at 11 years
Price et al ²²	2005	Comparative study	10 yrs	52 < 60 yrs 512 ≥ 60 yrs	Survival : 91% at 10 years Survival : 96% at 10 years
Fisher et al ¹⁸	2006	Retrospective study	18 mths	76	Return to sport : 93%
Epinette et al ¹⁵	2012	Multicentre study		418 failed UKAs	Revision: 19% at one year, 48.5% at five years Etiology: loosening 45%; arthrosis 15%; wear 12%; technical failure 11.5%

Table 2: Results of unicompartmental (UKA) and total knee arthroplasty (TKA) in recent comparative studies

Authors	Year	Study	Follow-up	Series	Return to sport	Time to sport	Sport level	Sport time	Number of sports
Witjes et al ²⁴	2017	Systematic review, meta-analysis		TKA	3261	36% to 89%	13 wks		0.2 to 1
				UKA	662	75% to 100%	12 wks		1.1 to 4.2
Hopper and Leach ²⁵	2009	Cohort study	22 mths	TKA	76				
Walton et al ²⁶	2006	Cohort study	1 yr	UKA	34	better	shorter	longer	
				TKA	120		no difference		
				UKA	150	better			

and different resources which can lead to personalized objectives in terms of return to sporting activities.¹¹

Implant design: TKA versus UKA

The impact of sports on prosthesis integrity is a crucial element to take into account. Cadaveric studies have confirmed the correlation between the intensity of the physical activity and wear rate for TKA, as well as between body weight and volumetric wear.⁵ These findings have further been verified by *in vivo* studies highlighting the adverse effects of some sports on implants, and emphasizing the importance of both surgical technique and the biomechanical properties of the bearing materials, especially polyethylenes.^{12–14} As these results are generally not considered in current practice, one should remain cautious and supervise the practice of physical activities after TKA. TKA remains superior to other prosthesis types in terms of functional results or implant wear rate.

One of the great advances in knee surgery is the management of unicompartmental arthritic damage by use of UKA (Table 1).^{1,15,18,21,22} For UKA, wear rate is a major long-term issue and represents one of the principal causes of failure.^{12,15} Again, implant wear can be reduced greatly by improving the design of polyethylene and by improving surgical techniques.^{16,17} The main limiting factor of return to sports remains the increased theoretical risk of wear and tear in young, active patients.

In terms of return to physical activities, Fisher et al¹⁸ report a 93% rate for UKA after successful rehabilitation, whereas Bradbury et al¹⁹ report only a 63% rate for TKA. Regarding the survival of UKAs, similar results were found compared with other arthroplasties, with an average

survival rate of more than 90% after ten years.^{20–22} Price et al²² studied the influence of age on UKA survival and found a slightly lower rate of survival for patients under 60 years of age related to higher participation in activities and associated with a significant increase in functional scores. Studies evaluating UKA survival at long term are, however, still lacking. As a reminder, we note that in 1997 Diduch et al⁸ presented a series of 108 TKAs with a survival rate between 87% and 94% at 18 years follow-up, and in 2014 Long et al²³ reported a survival rate of more than 80% at 25 years follow-up from the same series.

Several studies compared the functional results of unicompartmental prostheses with total knee prostheses from which we can summarize the following (Table 2): the rate of return to sports activities for UKAs is greater,^{24–26} as well as the postoperative performances,²⁶ duration of sessions²⁵ and the variety of activities.²⁴ Regarding recovery time, results are overall mixed but seem to point toward a trend of faster recovery for UKAs compared with TKAs (about one month). Generally, return to light physical activities is achieved from the third month after surgery.

It seems that certain high impact sports are still practicable with a UKA.^{5,25} However, one should remain cautious as these studies have an insufficient perspective and do not allow us to draw a correlation between sustained physical activity and the long-term survival rates of implants.^{5,27,28} Finally, UKAs and TKAs relate to two different populations with different characteristics which influence return to sports and are tightly linked to the criteria of operative indications. On one hand, UKA patients are younger and more active due to the limited joint damage and function. On the other hand, TKA patients show

Table 3: Patient-related factors affecting return to sport after knee arthroplasty in the literature

Authors	Year	Inclusion number	Follow-up	Sport before surgery	Motivation	Age	Sex	Body mass index	Other
Bradbury et al ¹⁹	1998	160	5 yrs	✓		-	-	-	-
Iorio et al ³³	2006	511	Review	✓	✓	✓	✓	-	-
Dahm et al ³⁸	2008	1206	5.7 yrs			✓	✓	-	-
Bonnin et al ³⁵	2010	347	44 mths	✓	✓				
Golant et al ⁷	2010		Review	✓	✓	-	-	-	-
Williams et al ³²	2012	736	11 mths	✓		✓	✓	✓	
Jassim et al ⁵	2014		Review	✓		✓			sport level

greater comorbidity and less ambitious postoperative objectives in terms of functional recovery.²⁴

Patient-related factors

Among the patient's expectations, return to sports ranks variably (Table 3).^{5,7,19,32,33,35,38} The patient may be over-optimistic regarding the functional outcomes of the prosthesis resulting in a mismatch with the actual possible outcomes. This leads to higher dissatisfaction rates (about 20%) in patients with acceptable postoperative functional results.^{29,30} It is thus essential to identify the patient's expectations before surgery in order to provide adequate information and prevent any inadequacy between these expectations and the possible results. Therefore, all patient-related factors which can affect return to sports must be identified during the postoperative examination.

Age

Younger patients have a higher functional demand and usually desire a quick return to physical activities. Generally, three out of four patients return to sports with a lower performance level, which results in lower satisfaction rates compared with older patients.³¹⁻³³

Motivation

Patients' motivation is a key element influencing several aspects of the return to sports such as recovery time, frequency of participation and performance level.³⁴ We also know that younger patients are often the most motivated.³⁵ Postoperative expectations to return to sport significantly condition the subjective postoperative results, but do not correlate with the objective results.^{11,36}

Postoperative sports practice

Patients engaging in regular physical activities at a good level usually return more easily to sport after surgery.³¹ Certain sports, however, demand that the patient has had sufficient experience prior to the operation to be resumed postoperatively. Three out of four patients who practised physical activities one year prior to arthroplasty will return to sports but at a lower performance rate. Conversely,

patients with no preoperative physical activities will not likely be able to start practising sport.^{7,19,37}

Body weight

Being overweight and obesity are known risk factors associated with poor results in terms of satisfaction, functional results and return to sport.³² Furthermore, body weight affects polyethylene wear.^{12,33} Nevertheless, a higher functional gain for patients with normal body mass index is usually reported.

Gender

Male patients seem to show better postoperative results in terms of functional scores and activity rate,^{32,33,38} although these results are not universal.³¹

Surgeon-related factors

There is a sometimes a clear mismatch between the patient's and the surgeon's expectations in terms of functional results.³⁵ The surgeon wishes to get activity and functional recovery which appears more satisfactory for the patient. Numerous surgeons tend to slow patients down in their will to return to 'risky' physical activities. It is, however, unrealistic to restrain a patient whose arthroplasty was motivated by the ambition of a return to sport.³⁹ The surgeon therefore must help the patient to set the postoperative objectives within personalized yet realistic standards.

Current recommendations in the literature review

The evidence regarding the influence of physical activity

Current recommendations for return to sport after knee arthroplasty are reported in Table 4.⁴²⁻⁴⁴ Actually, the benefits of regular physical activity to health are irrefutable. Every patient who has indications for knee arthroplasty can gain benefits from physical activity after surgery. Data from the literature clearly demonstrate a reduction of risks of at least 20% to 30% of more than 25 chronic conditions and early mortality.⁴² We also know that older patients who remain active extend their functional independence.

Table 4: Current recommendations for return to sport after knee arthroplasty

Authors	Year	Follow-up	Results
Jones ⁴²	2011	Review	Low or intermediate intensity level of activity Recovery time: 3 to 6 mths post-operatively Discourage high-impact/violent sports Educate rather than deter patients
Kuster and Stachowiak ⁴³	2002	Review of literature	Benefits to general health Bone quality benefits/implants' fixation/limits unsealing Multi-weekly endurance activity Low-impact activity (cycling, swimming, walking) High-load activity if practised at low intensity Do not start a technically-demanding activity
Clifford and Mallon ⁴⁴	2005	Review	Slight benefit of sports to all patients Light sports if balance recovery and proprioception Intermediate sports if healthy and experienced patient Discourage injury risk/violent sports

Physical activity and exercising should not be promoted in an isolated fashion, but should rather be addressed for each patient using a global approach aiming at improving performance.³¹

Return to sport in practice: how soon?

The minimum postoperative recovery time before returning to sports is three months.²⁷ However, TKA patients return to sport on average after six months.^{37,38,40} Young, motivated patients return to sport more quickly. Low-intensity sports with low technical requirements can be resumed more quickly. In any case, return to sport must be progressive and in agreement with the surgeon, and must follow a well-conducted rehabilitation.¹⁵ The recovery time thus depends on the type of sport but also on patient-related factors such as age, motivation or the type of activities after surgery.

Return to sport in practice: which patients?

Every TKA patient will eventually resume physical activity.⁶ Postoperative rehabilitation must be sufficient in terms of muscular strengthening and proprioception. Some activities require the patient to have a special technical level in order to avoid difficulties.³⁹ For patients with comorbidities, the terms of return to sport must be discussed with all the rehabilitation staff from the therapeutic care team and decided jointly.

Return to sport in practice: which sports?

Several studies have attempted to establish recommendations to rank the different types of sports activities.^{6,41} Usually, three categories of physical activities are defined for

TKAs in ascending order: a) authorized recommended sports (walking, stationary bicycle, soft gymnastics, golf, swimming, dance, bowling, gardening); b) authorized sports with experience (road bike, hiking, skiing, doubles tennis, sailing, working out, rowing, canoeing); and c) unauthorized sports (football, basketball, handball, volleyball, jogging, singles tennis, racquetball, bouldering, gymnastics). This gradation underlines the need to have sufficient experience to practise sports at intermediate intensity. High-intensity sports must be advised against, although evidence of increased injury risks or mechanical complications (early damage, unsealing, periprosthetic fracture) is lacking. Sports with intermediate intensity can be authorized for a certain group of patients in good physical condition and with prior experience of these types of sports. Finally, low-intensity sports can be recommended for all patients – at least after sufficient recovery time – as soon as rehabilitation has been sufficient to regain balance and proprioception of the lower limb.^{6,7,39}

Discussion

Few studies have focused on return to sport after knee arthroplasty. Surgeons have long advocated for the restriction and even the prohibition of certain sports activities without having scientific proof of the effect of sports on implant survival rate. To our knowledge, previous studies investigating the link between physical activity and wear are mostly experimental. These results were not found in clinical practice because series from the literature did not have sufficient hindsight to draw conclusions.⁵ Prosthesis survival rate – for either UKA or TKA – is currently 95%, greater than it was ten years ago, but has not been specifically evaluated in very active patients practising sport at a high intensity rate.^{9,20–22}

According to studies from the Norwegian Arthroplasty Register, a higher risk of revision was found for male patients and for those aged younger than 65 years following TKA.⁴⁵ For UKAs, patients aged younger than 65 years had also a higher risk of revision.⁴⁵ This result is supported by the increasing incidence in younger TKA or UKA patients in the 2005 to 2015 period.^{45,46} TKA and UKA revisions resulting from aseptic loosening and polyethylene wear/breakage are related to younger patients with high-level activity and participation in contact sports. The use of more 'patient-specific' new materials in accordance with the level of physical activity may help to reduce the risk of loosening in younger patients. While implant design, surgical technique, polyethylene manufacturing and patient factors all influence the rate and volume of polyethylene wear, the use of highly cross-linked polyethylene (HXLPE) inserts in knee arthroplasty could improve wear rates according to promising short-term results.⁴⁷ The increase in the use of HXLPE inserts in TKA is reported

since biomechanical data suggest improved wear characteristics for HXLPE inserts over conventional PE in TKA.⁴⁷

In the absence of any consensus, precautionary principles have been applied largely by limiting sports activities.⁷ Even at low intensity, patients truly benefit from regular physical activity in terms of functional performance, physical and mental health.⁹ Patients are nowadays younger and more active, a situation which can lead to a mismatch between surgeons' and patients' postoperative functional objectives. This mismatch contributes to an average dissatisfaction of 15% in patients with good functional scores.⁴⁸ The demographic evolution of the population suggests a future increase of knee arthroplasty procedures. This increase allows for the development of more efficient implants both in their design and biomechanical properties, as well as for better, less traumatizing surgical techniques. These technical and industrial advances are promising, but a larger number of studies are needed in order to authorize motivated patients to practise intense activities.

Surgeons can evaluate the factors influencing return to sport as early as the preoperative examination. Several aspects of the implant should be taken into account, such as constraint, patellar resurfacing or prosthesis fixation type. It is also essential to detect any patient-related factor which could lead to lower functional results, such as age, being overweight, lack of motivation or physical activity one year prior to the surgical procedure.¹⁹

Only with these elements will the surgeon be able to set more realistic objectives with the patient. Thus, personalized and adapted information can be provided to the patient during the preoperative examination. This information will in turn most likely increase the patient's satisfaction rate.

Following the procedure, the terms and conditions of return to physical activities are decided by the surgeon. The latter needs to make sure that postoperative rehabilitation has been conducted optimally. Specifically, the ranges of movement must be complete, muscular strengthening has to be sufficient and balance must be recovered by proprioception. Only after this stage (around three to six months after surgery) can physical activities be resumed. Return to sports must be gentle and progressive, with moderate activities associated with short sessions. Progressively the patient will be able to return to intermediate activities provided that he/she possesses the adequate level of technique for the sport.

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