

Influence of fear of movement on total knee arthroplasty outcome



Ann. Ital. Chir., 2015 86: 148-155
pii: S0003469X15023386

Mirjana Kocic^{*/**}, Anita Stankovic^{*/**}, Milica Lazovic^{o/oo}, Lidija Dimitrijevic^{*/**},
Ivona Stankovic^{*/**}, Marija Spalević^{*/**}, Predrag Stojiljkovic^{**/oo§}, Marina Milenkovic^{§§},
Zorica Stojanović^{§§}, Dejan Nikolic^{oo/§§§}

^{*}Physical Medicine and Rehabilitation Clinic, Clinical Center Nis, Serbia

^{**}School of Medicine, University of Nis, Nis, Serbia

^oInstitut for Rehabilitation Belgrade, Belgrade, Serbia

^{oo}Faculty of Medicine, University of Belgrade, Belgrade, Serbia

[§]Clinic of Orthopaedic Surgery, Clinical Center Nis, Nis, Serbia

^{§§}College of Health Studies Cuprija, Cuprija, Serbia

^{§§§}Physical Medicine and Rehabilitation Department, University Children's Hospital, Belgrade, Serbia

Influence of fear of movement on total knee arthroplasty outcome

AIM: The aim of the study was to investigate the occurrence of postoperative fear of movement in total knee arthroplasty (TKA) patients and to determine the association of fear of movement with established outcome measures.

METHODS: A prospective study included 78 patients with primary TKA for osteoarthritis. The occurrence of fear of movement was assessed by Tampa Scale of Kinesiophobia (TSK). The patients were assessed at three time points: 2 weeks, 4 weeks and 6 months after the surgery. Pain and flexion were measured at all the three time points while function according to the Oxford knee score 1 was evaluated only at 6 month after surgery.

RESULTS: Fear of movement occurred in 17 patients (21.8%). Patients with a high degree of fear of movement showed significantly poorer results compared to those with a low degree in terms of pain, flexion and function. Improvement in pain and flexion over time was achieved in both groups but it was significantly greater in the low degree fear of movement group.

DISCUSSION: Our study showed that postoperative fear of movement was significantly associated with pain, flexion and function. Other authors found that preoperative level of fear of movement was a predictor of postoperative functional limitations.

CONCLUSIONS: Fear of movement occurred in a substantial proportion of patients after TKA and it was associated with knee pain, flexion and function. According to our results fear of movement may represent a risk for poor TKA outcome.

KEY WORDS: Fear of movement, Total knee arthroplasty

Introduction

Knee osteoarthritis is one of the most common causes of pain and disability in middle and older age. Total knee arthroplasty (TKA) is an effective surgical procedure widely accepted for relieving pain and improving physical function in patients with end stage knee osteoarthritis (OA)^{1,2}. Since early 1970s, the number of arthroplasties has increased and further expansion is expected due to aging of population^{1,3-5}. In the mean-

Pervenuto in Redazione Ottobre 2014. Accettato per la pubblicazione Dicembre 2014

Correspondence to: Mirjana Kocic, School of Medicine, University of Nis, Nis, Serbia, Physical Medicine and Rehabilitation Clinic, Clinical Center Nis, Nis, Serbia Blv. Zoran Djindjic 48, 18000 Nis Serbia (e-mail: kocicm60@gmail.com)

time, surgical techniques as well as implant properties and surgery results have been improved. Also, TKA was proven to be cost effective from a health care insurer's perspective ⁶.

Over the last 10 to 20 years a success of TKA has mainly been assessed from the patient's point of view ^{1,3,7}. Consequently a number of patient's self-reported questionnaires have been developed and validated for evaluation of the arthroplasty results ^{8,9}. One of these is the Oxford knee score (OKS), a disease-specific questionnaire designed exclusively for assessment of knee joint replacement in 1998 ¹⁰. It is a short and simple patient-administered instrument which quantifies knee pain and function. It has been validated in numerous studies and accepted in the orthopaedic community as a reliable disease-specific indicator of the outcome after TKR ^{8,11}. Although a great number of patients show a considerable improvement after TKA, a substantial number of individuals (up to 30 %) have poor results and report to feel moderate or severe pain and function limitation ^{1,9}. The reasons for such poor outcome are not fully understood. Besides the surgical technique and endoprosthesis design, medical comorbidities and psychological factors are stated as possible factors that can explain the poor outcome ^{1,4}. In recent years several studies have focused on identifying medical and psychological factors that contribute to poor outcomes after TKA ^{4,5,9,12-16}. Fear of movement represents a specific fear of physical movement and activity that is wrongly assumed to cause pain or reinjury ¹⁷. Kori et al., 1990 ¹⁸, were the first who described "an excessive, irrational and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury" and called it "kinesiophobia". Vlaeyn et al. ¹⁷ have pointed out that people who suffer fear from movement develop certain pattern of behavior which they called "fear-avoidance", because people avoid particular movements and activities. After a long period of time, fear-avoidance behavior can lead to the loss of function and disability ¹⁷.

Fear of movement has been found in certain patients with chronic musculoskeletal pain including patients with OA in which it caused many consequences such as increased pain and functional disability ^{17,19-21}. It was also observed in patients with hip arthroplasty due to OA and it was associated with poor functional outcome ²². Regarding TKA, two studies examined the influence of psychological factors (including the preoperative fear of movement) to arthroplasty results ^{12,13}. A recent randomized study investigated the efficacy of functional rehabilitation targeted at managing postoperative fear of movement ²³.

Since 2007, TKA patients have been admitted to our rehabilitation unit for subacute rehabilitation. We noted that some of those patients had fear of knee movement. Based on this observation we decided to perform a study aimed to investigate the occurrence of fear of move-

ment in TKA patients for OA and to determine the association of postoperative fear of movement with established outcome measures.

Material and methods

We conducted a prospective longitudinal cohort study which included 100 patients admitted to postacute inpatient rehabilitation after primary unilateral TKA for OA, from May 2007 to October 2013. The exclusion criteria were: cognitive impairment, the previous lower limb surgery and neurological and musculoskeletal diseases that limit physical functioning.

After the exclusion, 79 patients remained. None of the patients refused to participate and all of them gave written informed consent. One patient was discharged from the rehabilitation unit before the first measurement due to the development of deep venous thrombosis, so that 78 patients remained. There were no dropouts from the first assessment to the follow-up examination 6 months after surgery. Flow chart of the patients in the study is shown in Fig. 1. Patients who had undergone the cemented TKA in the same orthopaedic unit were admitted to our rehabilitation unit between 7 and 13 days after surgery. None of the patients had clinical or radiographic abnormalities. They had 21 days of inpatient rehabilitation performed by the same clinical team. Rehabilitation followed the standard protocol individually adapted to each patient's tolerance level, that included cryotherapy, kinesitherapy and use of a continuous passive motion machine. Kinesitherapy was focused on range of motion, muscle strengthening, proprioception and gait. Also, patients

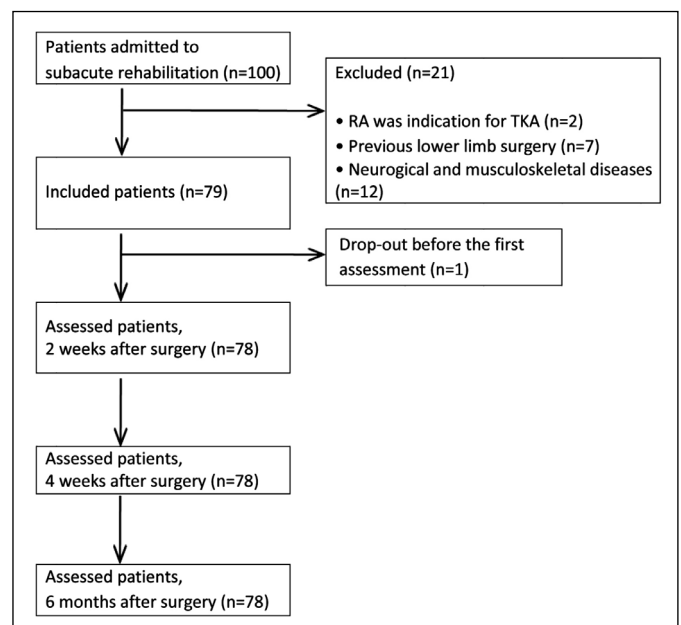


Fig. 1: Flowchart of TKA patients in the study.

were educated about the importance of regular exercise for better outcome during inpatient rehabilitation and after discharge from rehabilitation unit.

DEMOGRAPHIC AND HEALTH DATA

The demographic and health data that included age, sex, BMI value and comorbidities were recorded at the admission of the patients. For each patient, the total number of comorbidities was calculated.

The *Tampa Scale of Kinesiophobia* (TSK) was also administered to patients in order to assess the occurrence of fear of movement¹⁸. The TSK is a self-reported questionnaire with 17 statements, each provided with a 4-point Likert scale with scoring alternatives ranging from "strongly disagree" to "strongly agree." Out of the original 17 items, four (items 4, 8, 12 and 16) are reverse-worded statements and thus reverse scored. The total scores ranges from 17 to 68, with cut-off of > 37 indicating a high degree of fear of movement¹⁷. The TSK score is used to classify patients with a high or low degree of fear of movement.

OUTCOME MEASURE

The patients were assessed at three time points: at 2 and 4 weeks after surgery (during inpatient rehabilitation) and at 6 months after surgery, during an in-person visit for follow-up assessment. Pain and flexion were measured at all three assessments, while function was evaluated only at the follow-up examination.

1. *Pain*: Pain intensity was evaluated using the 21-point Numerical Rating Scale (NRS), ranging from 0 (no pain at all) to 10 (the worst imaginable pain). The patients were asked to rate the highest intensity of pain during the previous 24 hours on NRS²⁴.

2. *Flexion*: Active knee flexion was measured using the

standard full-circle handheld goniometer in a supine position with the contralateral extremity fully extended. Flexion was recorded in degrees according to the method suggested by the American Academy of Orthopedic Surgeons 1988²⁵. The same investigator measured flexion at all assessment time points.

3. *Function*: Function assesment was done using the validated knee joint specific questionnaire, Oxford knee score (OKS)¹⁰, which assesses specific disabilities in the last 4 weeks. OKS consists of 12 questions, five of which refer to pain and seven to function. The updated version 0-48 was used, where the highest score represents the best function¹¹.

The questionnaires (TSK and OKS) were filled out by the patients without assistance of an investigator or caregiver. When the administration was done, one of the investigators checked whether all fields were filled in and in case they were not, the questionnaire was immediately handed back to supply the missing answers.

Statistical analysis

The continuous variables were described by means $\pm$ standard deviations and by medians. For the dichotomous variables, absolute numbers and percentages were given. The distributions of the continuous variables were assessed for normality by Shapiro-Wilk test. The differences between independent groups were analyzed by an unpaired t-test in case of a normal distribution or by Mann-Whitney U-Test if a distribution of data was not normal. A paired t-test was used in case of two related observations with a normal distribution, and Wilcoxon Signed-Ranks if a distribution of data was not normal. Depending on the distribution of normality Pearson (r), or Spearman (r) correlation coefficients were used to analyze associations between continuous variables. A chi-square test was used to compare proportions of categorical variables between groups. The level of significance was set at 0.05. The calculations were carried out using the SPSS statistical package version 16.0.

TABLE I - Demographic and health characteristics of patients

	High degree of fear of movement n=17 patients	Low degree of fear of movement N=61 patients	p value
Age	68.12 $\pm$ 8.78 (67.00)	68.62 $\pm$ 7.24 (68.00)	0.8089
Sex (Male/Female)	6/11	13/48	0.2379
Body mass index (BMI)	30.57 $\pm$ 5.80 (28.20)	30.99 $\pm$ 5.63 (31.30)	0.7897
Comorbidity number	1.88 $\pm$ 0.99 (2.00)	1.92 $\pm$ 0.99 (2.00)	0.9295
Number of patients with:			
Heart disease	5 (29.41%)	22 (36.07%)	0.6124
Diabetes	5 (29.41%)	23 (37.70%)	0.5311
Hypertension	15 (88.24%)	54 (88.52%)	0.9738
Other comorbidities	8 (47.06%)	19 (31.15%)	0.2256

Note: Data are given as absolute numbers - n, means $\pm$ SD (medians), frequencies and percentages; High degree of fear of movement is defined as >37 on Tampa scale of kinesiophobia, which ranges from 17 to 68, with lower score indicating less severe symptoms.

TABLE II - Outcome measures (in terms of pain, flexion and function)

	High degree of fear of movement n=17 patients	Low degree of fear of movement N=61 patients	p value
Pain			
2 weeks	6.09±1.33 (6.00)	5.03±1.54 (5.00)	0.0123*
4 weeks	5.00±1.49 (5.00)	3.12±1.23 (3.00)	0.0000***
6 months	3.24±1.98 (3.00)	1.81±1.50 (1.50)	0.0035**
Flexion			
2 weeks	47.35±14.48 (54.00)	65.98±14.51 (65.00)	0.0000***
4 weeks	57.65±14.80 (60.00)	88.20±15.11 (90.00)	0.0000***
6 months	83.53±14.77 (90.00)	105.33±12.34 (110.00)	0.0000***
Function			
Oxford knee score (6 months)	25.82±6.90 (28.00)	34.48±7.93 (36.00)	0.0003***

Note: Data are given as absolute numbers - n, means±SD (medians); High degree of fear of movement is defined as >37 on Tampa scale of kinesiophobia, which ranges from 17 to 68, with lower score indicating less severe symptoms; Oxford knee score, a version 0-48, a higher score represents a better outcome; *** - $p<0.001$, ** - $p<0.01$, * - $p<0.05$

Results

The study included 78 patients, 59 female and 19 male. According to the cut-off score >37 on TSK, suggested by Vlaeyen et al.¹⁷, the patients were divided into two groups: the group with high and the group with low degree of fear of movement. In the high degree fear of movement group there were 17 patients (21.8%) with the average TSK score 43.12 ± 5.44 and median value 41.00, while in the low degree fear of movement group there were 61 patients with an average TSK value 28.64 ± 5.08 and median value 28.00.

The demographic and health data of patients in relation to the fear of movement are summarized in Table I. There were no significant differences between the groups at admission to the rehabilitation unit in terms of age, sex, values of body mass index (BMI), average number of comorbidities and presented types of comorbidity (Table I).

OUTCOME MEASURE IN RELATION TO FEAR OF MOVEMENT

The patients with a high degree of fear of movement showed significantly poorer results compared to those with a low degree. Pain intensity was significantly greater in the high degree of fear of movement group than in the low degree of fear of movement group at all assessment time points: 2 weeks ($p<0.05$), 4 weeks ($p<0.001$) and 6 months ($p<0.01$) after surgery. Flexion was significantly lower in the high degree of fear of movement group compared to the low degree of fear of movement group at all assessment points ($p<0.001$), so was OKS at the 6 months follow-up ($p<0.001$) (Table II).

IMPROVEMENT IN PAIN AND FLEXION OVER TIME

A statistically significant improvement in terms of pain reduction and increased flexion was found between 2

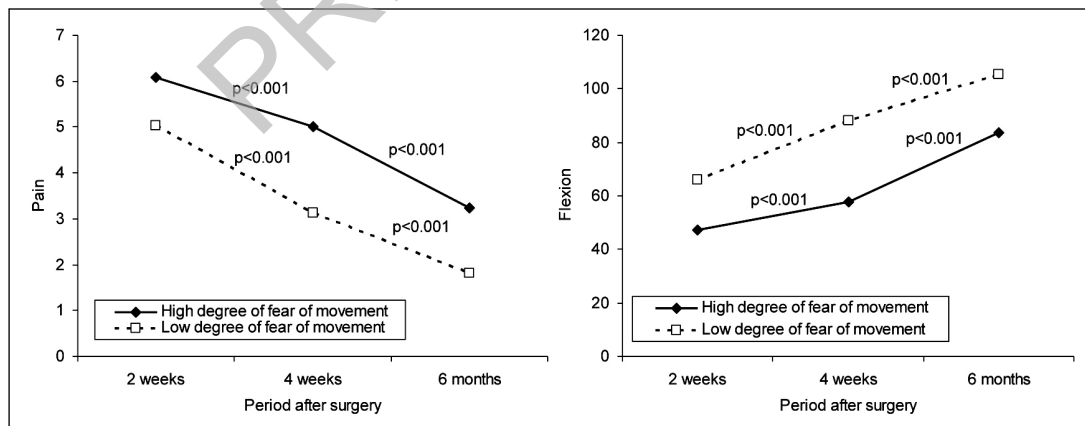


Fig. 2: Pain reduction and flexion increase over time in examined groups.

TABLE III - Pain and flexion changes between assessment time points

	High degree of fear of movement N=17 patients	Low degree of fear of movement n=61 patients	p value
<i>Pain changes</i>			
2-4 weeks	1.09±0.44 (1.00)	1.91±0.87 (2.00)	0.0002***
4 weeks - 6 months	1.76±1.09 (1.50)	1.31±1.02 (1.50)	0.2975
<i>Flexion changes</i>			
2-4 weeks	10.29±2.78 (10.00)	22.21±4.43 (25.00)	0.0000***
4 weeks - 6 months	25.88±5.07 (25.00)	17.13±4.61 (15.00)	0.0003***

Note: Data are given as absolute numbers - n, means±SD (medians); High degree of fear of movement is defined as >37 on Tampa scale of kinesiophobia, which ranges from 17 to 68, with lower score indicating less severe symptoms; *** p<0.001

TABLE IV - Correlation of TSK score with values of pain, flexion and OKS

Pain 2 weeks	Pain 4 weeks	Pain 6 months	Flexion 2 weeks	Flexion 4 weeks	Flexion 6 months	OKS 6 months
0.45***	0.69***	0.40***	-0.54***	-0.69***	-0.55***	-0.35**

TSK: Tampa scale of kinesiophobia, which ranges from 17 to 68, with lower score indicating less severe symptoms; OKS- Oxford knee score, a version 0-48, a higher score represents a better outcome; *** - p<0.001, ** - p<0.01

and 4 weeks assessments as well as between 4 weeks and 6 months assessments for both groups of patients (p<0.001) (Fig. 2).

By comparing the changes between the groups regarding pain and flexion from the 2 to 4 weeks assessments, a significantly greater improvement, both in flexion and pain, was achieved in the low degree of fear of movement group (p<0.001). Also, between the 4 weeks and 6 months assessments, the size of the changes was significantly greater in the low degree fear of movement group regarding flexion (p<0.001) but not significant regarding pain (Table III).

CORRELATION OF FEAR OF MOVEMENT WITH OUTCOME MEASURES

There was a strong and significant negative correlation of TSK score with flexion at all assessment time points (p<0.001). TSK score positively and significantly correlated to pain (p<0.001). The correlation was very strong in terms of pain at 4 weeks and moderate at 2 weeks and 6 months after surgery. The correlation of TSK score with Oxford knee score 6 months after surgery was moderate, negative and significant (p<0.01) (Table IV).

Discussion

Patients with chronic musculoskeletal pain such as back and neck pain, fibromyalgia, OA, chronic anterior knee pain as well as patients after spinal surgery for a lumbar and cervical degenerative condition or disc herniation and patients after THA for OA can have a fear of movement^{17,19-22,26,27}. Our results showed that postoperative fear of movement also occurred in TKA patients for OA. We found that fear of movement is significantly

associated with pain, flexion and function at all assessment time points.

We did not find any study that examined association of postoperative fear of movement with results after TKA. Only one study assessed the level of postoperative fear of movement. Unlike our study, that one did not examine correlation of the fear of movement with the outcome measures after TKA²³. The authors examined the effect of home-based functional exercises in management of fear of movement and improvement of the TKA outcome²³.

The two studies investigated the correlation of preoperative psychological disorders (depression, generalized anxiety disorder) and health related beliefs such as self-efficacy, pain catastrophizing and fear of movement with the TKA outcome^{12,13}. Sullivan et al. showed that preoperative level of pain catastrophizing was in correlation with postoperative pain severity and that preoperative level of fear of movement was a predictor of postoperative functional limitations¹². Opposite to the study of Sullivan et al. other authors concluded that pain catastrophizing was the only factor that had a consistent correlation with poor pain outcome after TKA, but not with poor function outcome¹³.

The present study showed that patients with a high degree of fear of movement had more pain and worse ROM than patients with a low degree at all assessment time points. However, patients in both groups experienced substantial improvements in terms of pain and the range of motion from 2 to 4 weeks and from 4 weeks to 6 months examination which is consistent with the other authors findings that the recovery after knee arthroplasty is time-dependent²⁸⁻³⁰. The size of these changes between all assessment time points was significantly greater in the high degree than in the low degree fear of movement group regarding both flexion and pain

except for pain from 4 weeks and 6 months. A possible explanation for this is that in the course of time in the high fear of movement group fear was reduced but we did not assess it on the follow-up examination. Also, worse results in the high fear of movement group regarding pain and flexion at the first assessment may indicate that these patients had fear of movement preoperatively having in mind that many patients with chronic OA suffer from fear of movement¹⁹. Significant improvement regarding pain and flexion in both groups could point to the positive effects of the applied rehabilitation treatment in overcoming fear of movement.

In our study the follow-up outcome assessment was performed 6 months after surgery because it was expected that patients would achieve most of improvement in all examined parameters by that time^{3,7,28-31}. When we started the study a recommended period for outcome assessment was 6 months after TKA³¹ and it was used in many studies^{9,10,13,14,29}. Recent studies have shown that a certain degree of improvement happened in the period between 6 and 12 months after surgery, therefore it is recommended to use 12-month outcome data for evaluation of TKA results⁷.

Six months after surgery, the mean pain intensity in our whole sample was mild, which is similar to other studies^{1,30}, but less than pain intensity in the study by Pinto et al.⁵. In the high fear of movement group average pain intensity was 3.2 which represented the intensity that interferes significantly with daily living activities⁵. The mean flexion in our whole sample was 101 degrees which is similar to the mean flexion in some studies^{30,28,23}. Also, the high fear of movement group patients did not achieve functional range of knee motion because the mean flexion in this group was 83 degrees. Miner et al.³² stated that for normal knee function patients should achieve at least 95 degrees of knee flexion and according to Rowe et al. even 110 degrees³³. In our whole sample OKS was higher than in other studies^{10,14}, while in the high fear of movement group OKS was 24 which is considered as a poor outcome³⁴.

It is known that some of patients factors might contribute to poor TKA outcome such as female gender, older age, higher BMI, higher number of comorbidities, psychological factors, heart disease, hypertension, diabetes and poor preoperative status^{1,2,4,9,15,16,35,36}. Considering the fact that in our sample in relation to demographic parameters, BMI and comorbidities there were no significant differences between the groups poor outcome in the high fear of movement group can be partially explained by higher degree of fear of movement in this group.

This study has some *strengths and limitations* that should be considered when interpreting the results. The strength is that apart from self-reported questionnaires, we also used an objective parameter such as range of motion. In addition, there was not any dropout from

the first assessment to the 6-months after surgery examination. This can be attributed to the fact that the sample of patients in the study included only people from the surrounding geographical area. Furthermore, all TSK and OKS questionnaires were completed in full, so there were no unanswered items.

The main limitation is that we had no information about pre-operative pain and functional status. It is already well known that pre-operative pain and function are the factors that have very high influence on postoperative outcome for pain, range of motion and OKS^{5,8,9,11,12,16} but these alone do not explain the great variability in postoperative outcomes¹⁶. Second, we had no information regarding pre-operative scores of fear of movement. Additionally, except the fear of movement, we did not study the influence of other psychological factors such as catastrophization, anxiety and depressive symptoms, which could be associated with poor TKA outcome^{2,4,5,9,12,13,14,16}. Moreover, the type and extent of joint damage as well as operative factors were not included either. Another limitation was that the cohort consisted of small sample size. However, during the 6-year period all admitted patients after primary TKA who met the inclusion criteria were included.

In order to reduce the risks of TKA poor results patients with end-stage OA, after setting indications for TKA, should be screened prior to surgery in order to identify those with high degree of fear of movement. These patients should be informed about the risk of poor outcome and sent to the targeted rehabilitation treatment in order to reduce fear of movement prior to surgery. Being a potentially modifiable factor, fear of movement can be overcome by the use of the appropriate multidisciplinary rehabilitation program, consisting of education and the appropriate exercise protocol. The protocol implies a gradual increase in specific exercises and activities, which helps (should help) patients to successfully habituate to activities or movements that they might normally avoid because of pain^{20,23}. Considering the results obtained in our study, early postoperative fear of movement can be associated with poor outcome after TKA and we propose that those patients should also be screened postsurgically in order to have proper rehabilitation protocol.

In conclusion, the results indicate that high degree of postoperative fear of movement occurred in approximately 1/5 of patients after TKA. Strong to moderate association of fear of movement with knee pain, flexion and function during the first month and 6 months after surgery was found.

On that basis, we believe that fear of movement needs to be considered in TKA patients because it may represent a risk for poor outcome. Future larger cohort studies are needed to determine the role of preoperative and postoperative fear of movement as well as other psychological and medical factors aiming at improving TKA outcome.

Riassunto

Lo scopo dello studio è quello di verificare l'incidenza del timore postoperatorio ai movimenti nei pazienti sottoposti ad artroplastica totale del ginocchio (TKA) e di determinare l'associazione di questo timore con i provvedimenti da adottare.

Lo studio prospettico riguarda 78 pazienti sottoposti ad TKA primaria per osteoartrite. L'incidenza di timore al movimento è stata determinata con l'uso della Tampa Scale of Kinesiophobia (TSK). I pazienti sono stati valutati in tre fasi temporali: 2 settimane, 4 settimane e 6 mesi dopo l'intervento chirurgico. In tutte e tre le fasi sono stati valutati il dolore e l'entità della flessione, mentre l'aspetto funzionale è stato preso in considerazione soltanto sei mesi dopo l'intervento, secondo la Oxford knee score 1.

Il timore al movimento è stato registrato in 17 pazienti (21,8%). Quelli con maggiore entità di timore hanno dimostrato di conseguire risultati significativamente meno buoni in termini di dolore, grado di flessione e funzionalità rispetto a quelli con limitata paura. Miglioramento del dolore e della flessione sono stati progressivamente conseguiti nel tempo in entrambi i gruppi, ma i risultati migliori vengono raggiunti nel gruppo con minore paura al movimento.

Lo studio ha dimostrato che la paura postoperatoria alla motilità si associa significativamente con il dolore, l'entità della flessione e la funzionalità del ginocchio. Altri Autori hanno rilevato che il timore preoperatorio alla motilità del ginocchio fa prevedere limitazioni funzionali postoperatorie. In conclusione il timore della motilità si rileva in una significativa proporzione dei pazienti dopo TKA e si associa con gonalgia, e minore flessione e funzionalità, e dunque questa paura rappresenta un rischio di scarsi risultati dopo artroplastica totale del ginocchio.

References

- Wylde V, Dieppe P, Hewlett S, Learmonth ID: *Total knee replacement: Is it really an effective procedure for all?* Knee, 2007; 14(6):417-23.
- Singh JA, Lewallen DG: *Depression in primary TKA and higher medical comorbidities in revision TKA are associated with suboptimal subjective improvement in knee function.* BMC Musculoskelet Disord, 2014; 15:127.
- Wylde V, Blom AW, Whitehouse SL, Taylor AH, Pattison GT, Bannister GC: *Patient-reported outcomes after total hip and knee arthroplasty: Comparison of midterm results.* J Arthroplasty, 2009; 24(2):210-16.
- Singh JA, Lewallen DG: *Medical and psychological comorbidity predicts poor pain outcomes after total knee arthroplasty.* Rheumatology (Oxford), 2013; 52(5):916-23.
- Pinto PR, McIntyre T, Ferrero R, Almeida A, Araújo-Soares V: *Risk factors for moderate and severe persistent pain in patients undergoing total knee and hip arthroplasty: A prospective predictive study.* PLoS One, 2013; 8(9):e73917. doi: 10.1371/journal.pone.0073917.
- Krummenauer F, Wolf C, Gunther KO, Kirschner S: *Clinical benefit and cost effectiveness of total knee arthroplasty in the older patient.* Eur J Med Res, 2009; 14:76-84.
- Browne JP, Bastaki H, Dawson J: *What is the optimal time point to assess patient-reported recovery after hip and knee replacement? A systematic review and analysis of routinely reported outcome data from the English patient-reported outcome measures programme.* Health Qual Life Outcomes, 2013; 11:128.
- Williams DP, Blakey CM, Hadfield SG, Murray DW, Price AJ, Field RE: *Long-term trends in the Oxford knee score following total knee replacement.* Bone Joint J, 2013; 95-B(1):45-51.
- Judge A, Arden NK, Cooper C, et al.: *Predictors of outcomes of total knee replacement surgery.* 2012; 51(10):1804-813.
- Dawson J, Fitzpatrick R, Murray D, Carr A: *Questionnaire on the perceptions of patients about total knee replacement.* J Bone Joint Sur (Br), 1998; 80: 63-69.
- Murray DW, Fitzpatrick R, Rogers K, et al.: *The use of the Oxford hip and knee scores.* J Bone Joint Sur (Br), 2007; 89-B:1010-14.
- Sullivan M, Tanzer M, Stanish W, et al.: *Psychological determinants of problematic outcomes following Total Knee Arthroplasty.* Pain, 2009; 143(1-2):123-29.
- Riddle DL, Wade JB, Jiranek WA, Kong X: *Preoperative pain catastrophizing predicts pain outcome after knee arthroplasty.* Clin Orthop Relat Res, 2010; 468(3):798-806.
- Blackburn J, Qureshi A, Amirfeyz R, Bannister G: *Does preoperative anxiety and depression predict satisfaction after total knee replacement?* Knee, 2012; 19(5):522-24.
- Singh JA, Lewallen DG: *Diabetes: A risk factor for poor functional outcome after total knee arthroplasty.* PLoS One, 2013; 8(11):e78991. doi: 10.1371/journal.pone.0078991.
- Hanusch BC, O'Connor DB, Ions P, Scott A, Gregg PJ: *Effects of psychological distress and perceptions of illness on recovery from total knee replacement.* Bone Joint J, 2014; 96-B(2):210-16.
- Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H: *Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance.* Pain, 1995; 62: 363-72.
- Kori SH, Miller RP, Todd DD: *Kinesiophobia: A new view of chronic pain behavior.* Pain Management, 1990; 3:35-43.
- Heuts PH, Vlaeyen JW, Roelofs J, et al.: *Pain-related fear and daily functioning in patients with osteoarthritis.* Pain, 2004; 110(1-2):228-35.
- Koho P, Orenius T, Kautiainen H, Haanpää M, Pohjolainen T, Hurri H: *Association of fear of movement and leisure-time physical activity among patients with chronic pain.* J Rehabil Med, 2011; 43(9):794-99.
- Doménech J, Sanchis-Alfonso V, Espejo B: *Changes in catastrophizing and kinesiophobia are predictive of changes in disability and pain after treatment in patients with anterior knee pain.* Knee Surg Sports Traumatol Arthrosc, 2014; 22(10):2295-300.
- Sengul YS, Unver B, Karatosun V, Gunal I: *Assessment of pain-related fear in patients with the thrust plate prosthesis (TPP): Due to*

- hip fracture and hip osteoarthritis*. Arch Gerontol Geriatr, 2011; 53(2):e249-52. doi: 10.1016/j.archger.2011.05.007.
23. Monticone M, Ferrante S, Rocca B, et al.: *Home-based functional exercises aimed at managing kinesiophobia contribute to improving disability and quality of life of patients undergoing total knee arthroplasty: A randomized controlled trial*. Arch Phys Med Rehabil, 2013; 94(2):231-39.
24. Jensen MP, Miller L, Fisher LD: *Assessment of pain during medical procedures: A comparison of three scales*. Clin J Pain, 1998; 14:343-49.
25. American Academy of Orthopaedic Surgeons. *Joint motion: method of measuring and recording*. Edinburgh, London, Melbourne and New York: Churchill Livingstone, 1988:12-5.
26. Archer KR, Seebach CL, Mathis SL, Riley LH 3rd, Wegener ST: *Early postoperative fear of movement predicts pain, disability, and physical health six months after spinal surgery for degenerative conditions*. Spine J, 2014; 14(5):759-67.
27. Svensson GL, Lundberg M, Ostgaard HC, Wendt GK: *High degree of kinesiophobia after lumbar disc herniation surgery: A cross-sectional study of 84 patients*. Acta Orthop, 2011; 82(6):732-36.
28. Nerhus TK, Heir S, Thornes E, Madsen JE, Ekeland A: *Time-dependent improvement in functional outcome following LCS rotating platform knee replacement. A prospective longitudinal study in 50 patients*. Acta Orthop, 2010; 81(6):727-32.
29. Crosbie J, Naylor J, Harmer A, Russell T: *Predictors of functional ambulation and patient perception following total knee replacement and short-term rehabilitation*. Disability and Rehabilitation, 2010; 32(13): 1088-98.
30. Harmer AR, Naylor JM, Crosbie J, Russell T: *Land- versus water-based rehabilitation following total knee replacement: A randomized, single-blind trial*. Arthritis Care Res, 2009; 61:184-91.
31. Browne J, Jamieson L, Lewsey J, van der Meulen J, Black N, Cairns J, Lamping D, Smith S, Copley L, Horrocks J: *Patient Reported Outcome Measures (PROMs) in elective surgery*. Report to the Department of Health, UK; December 2007. [http://www.lshtm.ac.uk/php/hsrp/research/proms_report_12_dec_07.pdf] webcite
32. Miner AL, Lingard EA, Wright EA, et al.: *Knee range of motion after total knee arthroplasty: How important is this as an outcome measure?* J Arthroplasty, 2003; 18:286-94.
33. Rowe PJ, Myles CM, Walker C, Nutton R: *Knee joint kinematics in gait and other functional activities measured using flexible electrogoniometry: How much knee motion is sufficient for normal daily life?* Gait Posture, 2000; 12(2):143-55.
34. Kalairajah Y, Azurza K, Hulme C, et al.: *Health outcome measures in the evaluation of total hip arthroplasties: A comparison between the Harris hip score and the Oxford hip score*. J Arthroplasty, 2005; 20:1037-41.
35. Roth JS, Buchler KC, Shen J, Naughton M: *Patient factors predict functional outcomes after cruciate retaining TKA: A 2-year follow-up analysis*. J Arthroplasty, 2013; 28(8):1321-26.
36. Fisher DA, Dierckman B, Watts MR, Davis K: *Looks good but feels bad: factors that contribute to poor results after total knee arthroplasty*. J Arthroplasty, 2007; 22(6 Suppl 2):39-42.