ORIGINAL ARTICLE

Patient's personality predicts recovery after total knee arthroplasty: a retrospective study

Long Gong · Ji-Yuan Dong

Abstract

Background Increasing attention to psychological determinants may be useful in identifying patients undergoing total knee arthroplasty who may be at risk for poor postoperative outcome. However, little is known about the relationship between personality as a comprehensive reflection of stable psychological states and outcome after total knee arthroplasty. The purpose of this study was to describe the relationship between patients' diverse personalities and clinical outcomes.

Methods We recruited 387 patients undergoing primary total knee arthroplasty to complete the Eysenck Personality Questionnaire (EPQ) and collected demographic information before surgery. Prior to and 6 months after surgery, we used two validated functional instruments to assess satisfaction rate—the Short Form Health Survey of 36 questions (SF-36), and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Results Neuroticism, especially the classic type, tended to be displayed more frequently by women and younger patients. A statistically significant positive relationship was seen between outcome scores and extraversion levels in rating scales; there was a negative relationship between outcome scores especially from the SF-36 Mental Component Summary (MCS), WOMAC pain scores, and neuroticism subscales scores. Among four types of personality, sanguine patients displayed the best clinical outcomes and melancholic patients the worst. Despite good clinical outcomes, including in pain relief and functional improvement for choleric patients, satisfaction rate was unexpectedly the lowest.

Conclusions Our results may help clinicians identify patients at risk for poor postoperative clinical outcomes and thus proceed with better communication with patients. Also, our results may indicate conducting individual attention during the perioperative period based on patient personality determined according to the EPQ in order to help attain better recovery.

L. Gong · J.-Y. Dong (✉)
Department of Orthopedics, Chinese PLA General Hospital,
Beijing 100853, China
e-mail: Dongjiyuan81301@163.com

L. Gong
e-mail: Gonglong301@163.com

Introduction

When conservative treatments fail to alleviate knee pain and limitations in physical functioning, total knee arthroplasty (TKA) becomes a viable surgical option for patients with end-stage osteoarthritis [1]. Surgical techniques and prostheses have been improved in recent years. However, a subset of patients has lower postoperative improvement in pain, physical functioning, and quality of life (QoL) [2, 3]. These suboptimal results could not be completely explained by patient physical characteristics and surgical procedures but seem to be influenced by patient psychological factors [2, 3]. A long-term follow-up study conducted by Edwards et al. suggested that 1 year after TKA, up to one fourth of patients continue to report substantial pain and functional limitations without clear clinical causes [4]. Patients' subjective feelings are regarded as one of crucial effectiveness evaluations, as TKA itself serves as a surgical option with the aim of improving patients' QoL [5].

Increasing attention to psychological determinants, such as postoperative catastrophizing [4, 6, 7], negative mood [4, 8–11], and expectancy [12–15], may be useful in

identifying patients at risk for poor outcomes after TKA. To the best of our knowledge, the relationship between personality, which is comprehensive reflection of a person's psychological status, and clinical results after TKA have not thus far been studied.

Associations between psychological determinants and TKA results have been studied. Specifically, negative mood, mainly depressive and anxious states, has been shown to exacerbate pain [16, 17], which is the outcome most frequently associated with patients' evaluation of their TKA [5, 18, 19]. Consequently, negative mood is considered as being related to pain and emerged as a strong and reliable predictor of corresponding outcomes [20, 21]. Catastrophizing, which is a negative cognitive and affective response to pain, magnification of pain-related symptoms, excessive attentional focus on pain, and rumination about pain [22, 23], has repeatedly been shown to influence pain-related outcomes across a variety of domains. Finally, patients' expectations are also an important independent predictor of improved functional outcomes and satisfaction following TKA [13, 14]. Thus, a deeper and greater overall understanding of the relationship between psychological factors and TKA result may improve the process of care and functional outcomes [13–15].

Incorporating these psychological variables into predicting results of total joint arthroplasty (TJA) has certain limitations [24]. The heterogeneity of specific instruments for measuring the concerned determinants, as well as methodological quality, could limit the certainty level of conclusions to different degrees. Consequently, we refrained from relying on evidence that objectively suggests a relationship between patient satisfaction and psychological elements [24–26]. We believe comprehensive, broader measuring instruments are necessary to evaluate the influence of psychological determinants TKA results. All psychological determinants reported in previous studies can be considered as one part of the personality with the help of the Eysenck Personality Questionnaire (EPQ) [27]. Consequently, the aim of this study was to explore the following: (1) the relationship between diverse types of personality and results after TKA, and (2) how the characteristics of each personality type impact recovery. We hypothesized that diverse personality traits may distinctly affect rehabilitation status and subjective results, which would be helpfu to clinicians treating such patients.

Materials and methods

Study design

This was a retrospective study conducted by one professor of orthopedics, an attending physician, a physician, and two postgraduate students from January 2011 to November 2012 at the Chinese PLA General Hospital, Beijing. Data was collected from the Department of Joint Surgery and the Arthroplasty Center. Two time points were used: 1 week before and the sixth month after TKA. The latter was chosen because patients typically reach the recovering plateau in strength and function by that time [28, 29]. The study was approved by the Ethics Committee, and all patients were informed about the purposes of the study and gave their written consent.

Patients

We interviewed 500 patients between the age of 20 and 80 years for enrollment. The enrollment criterion was patients undergoing unilateral, primary TKA due to knee osteoarthritis. Exclusion criteria were patients with traumatic arthritis, rheumatoid arthritis, malignant disease, infection after surgery, chronic cardiovascular or cerebrovascular disease, amputation, existent psychopathology, or mental disorder.

Sample size

The sample size needed to detect a significant difference (two-sided, $P = 0.05$) of at least 20 % between groups using the Short Form Health Survey of 36 questions (SF-36) subscale with an assumed standard deviation (SD) of 20 % and a power of 0.8 was 38 patients per group. Considering a possible 15 % loss of patients between baseline and follow-up, at least 45 patients per group were required.

Surgery

Either epidural anesthesia or nerve block was used for the operation, and all TKAs were performed by one experienced surgeon. We routinely administered prophylactic antibiotics (vancomycin or cefotaxime) before skin incision. TKA was performed under tourniquet control. All prostheses were the Gemini, MK-II (Link, Ltd. Germany) in order to acquire homogeneity as much as possible to avoid differing surgical factors. The drainage tube was removed 24-h postoperatively. The SF-36 and the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) were completed 1 week before and 6 months after surgery, and the EPQ 1 week before surgery; a postgraduate student recorded the results.

Eysenck Personality Questionnaire (EPQ)

We used a Chinese translation of the original English version of the EPQ developed by Eysenck and colleagues. The EPQ has 48 questions with dichotomized answers;
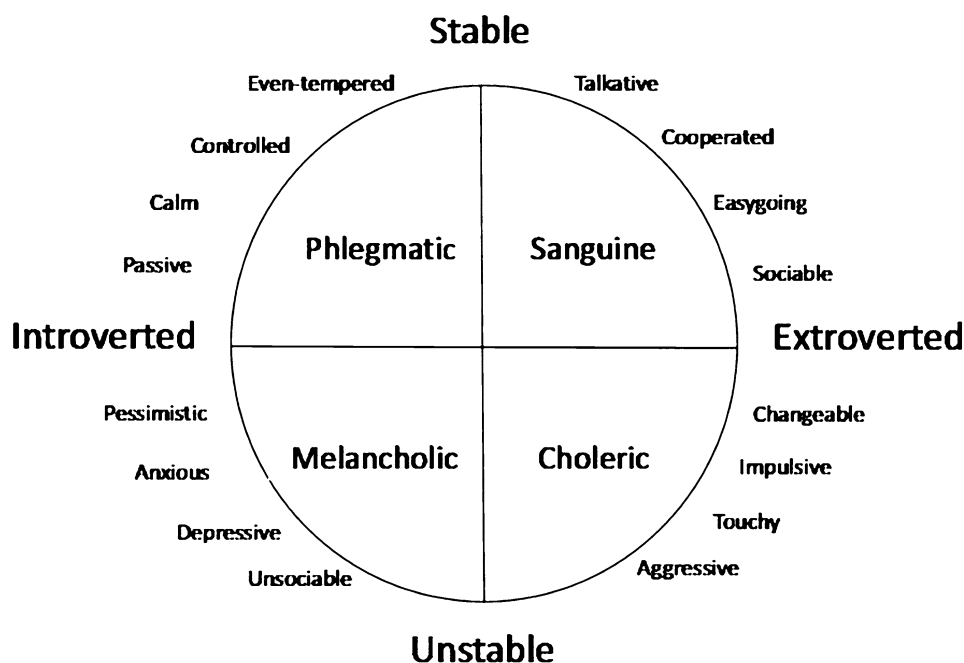
there are 12 questions for each of four personality subscales: extraversion, neuroticism, psychoticism, and lying. A greater tendency to possess one of these personality traits is indicated by higher scores on a range from 0 to 12. Extraversion represents sociability, liveliness, and surgency; neuroticism represents emotional instability and anxiousness; psychoticism represents tough-mindedness, aggressiveness, coldness, and egocentricity; lying represents unsophisticated dissimulation [27]. Each personality type was divided into three levels (middle, predisposition, classic) according to scores. However, we only analyzed each personality's classic type in this study for preoperative information. Due to the limited number of patients classified as classic, we compared the difference of four personality types, including three levels above in clinical outcomes after surgery. According to the levels of extroverted/introverted (measured by the extraversion subscale) and stable/unstable (measured by the neuroticism subscale) [27], study participants were divided into four personality types: choleric, sanguine, melancholic, and phlegmatic (Fig. 1).

SF-36 Health Survey

To document the disease burden of osteoarthritis and the benefits of TJA, we used the SF-36 questionnaire, which assesses health-related QoL (HR-QoL) in relation to physical and social functioning and mental health, indicates clinical and subjective improvement after surgery, and more comprehensively indicates differences in patient opinion regarding their TKA. The SF-36 has two summary components: Physical Component Summary (PCS) and Mental Component Summary (MCS), which are valid and reliable in patients with osteoarthritis and are reported elsewhere. A higher score indicates better health status.

WOMAC Index

The WOMAC Index, a disease-specific measurement of outcome, contains three domains: pain (5 items), stiffness (2 items), and function (17 items). The answers are equally weighted and reported as sums; higher numbers indicate greater levels of symptom or disability. Subscale score values are : function, 0–68; pain, 0–20; stiffness, 0–8.

Patient satisfaction

Overall patient satisfaction was assessed using a 100-mm visual analog scale (VAS), which ranges from 0, highly dissatisfied to 100, completely satisfied.

Statistical analysis

Statistics are presented as mean ± SD for continuous variables and percentages for categorical variables. Satisfaction rate was compared using the chi-square test. A one-way ANOVA was performed to compare SF-36 and WOMAC subscale scores between groups, followed by Tukey's multiple comparison tests; $P < 0.05$ was considered to represent a statistically significant difference. Linear relationships between continuous variables were measured using Pearson's correlation coefficient (r). All

hypotheses were based on the assumption of normally distributed variables. All statistical analyses were performed using SAS software, version 9.1.

Results

Of the 500 patients who responded to the two questionnaires, we excluded 12 who had had cancer diagnosed before TKA. We further excluded 101 with traumatic arthritis, rheumatoid arthritis, malignant disease, infection after surgery, chronic cardiovascular and cerebrovascular disease, amputation, existent psychopathology, mental disorder, or deep vein thrombosis (DVT) postoperatively, as those negative events could adversely affect our results; 387 patients (M/F 109/278) remained in the final analysis (Table 1). Personality distribution is shown in Table 2. Through a radiographic evaluation following the surgery, the objective outcome, mainly referring to achieved mechanical axis, was not significantly different, and thus comparison among groups precluded operational factors.

Personality subscales, SF-36, WOMAC

There was a statistically significant positive association between extraversion/neuroticism and SF-36 PCS/MCS and WOMAC scores and a significantly negative association between extraversion/neuroticism and WOMAC and SF-36 PCS/MCS scores at the 6- month survey. Lying and psychoticism scores were not significantly associated with outcome scores (Table 3). All 387 patients were assessed as having a particular personality type according to the EPQ, and there was a significant difference in recovery progress between personality types after retrospective analysis (Table 4).

Table 1 Baseline characteristics of the study population

Variable	Value
Number	387
Age (years)	59.6 (7.2)
Sex (M/F)	109/278
BMI (kg/m^2)	27.8 (4.6)
SF-36 PCS	38.6 (7.5)
SF-36 MCS	28.6 (6.8)
WOMAC pain	11.8 (3.5)
WOMAC stiffness	4.2 (1.9)
WOMAC function	28.8 (10.1)

BMI body mass index, *SF-36* Short-Form Health Survey of 36 questions, *PCS* Physical Component Summary, *MCS* Mental Component Summary, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index

Satisfaction rates

Chi-square-test analysis revealed that the satisfaction rate between the four personality types showed a significant difference. The percentage of sanguine and choleric types was the highest and lowest, respectively (Fig. 2).

Discussion

This retrospective study demonstrates the following:

1. Based on patients' baseline characteristics, we concluded that neuroticism traits, especially the classic type, tended to be displayed in younger and female patients (Table 1).

2. There existed a significant relationship between personality subscale scores and outcome scores, which is worthy of attention: a statistically significant positive relationship between outcome scores and extraversion level; a statistically significant negative relationship between outcome scores—especially SF-36 MCS and WOMAC pain scores—and neuroticism level.

3. The difference in SF-36 and WOMAC scores between the four personality types was significant; specifically, sanguine and melancholic personalities displayed the best and worst functional outcomes, respectively.

4. Despite positive clinical outcomes in relation to pain relief and functional improvement, the satisfaction rate for choleric personalities was surprisingly the lowest.

Previous studies focused on associations between psychological states [4, 10, 11] or related concepts, such as postoperative catastrophizing [4, 10, 11] and expectancy [12–15]; however, those studies only considered parts of patients' psychological status. Clinicians specializing in arthroplasty must clearly understand that the procedure itself is aimed at improving a person's QoL. That QoL includes diverse, subjective feelings, thoughts, and cognitions, which are closely associated with psychological status. Consequently, it is necessary to understand the significance of personality traits in the broader assessment of stable psychological status. In this study, each of the four personality types was introduced into our evaluation of TKA rehabilitation outcomes, and we found associations between them.

In general, extraversion is characterized by positive emotion, sociability, being active, and being cooperative. Postoperative exercise requires patients' cooperation and timely communication with clinicians when a related problem is encountered. Therefore, patients with higher extraversion (choleric and sanguine types) present higher functional outcomes. Neuroticism, on the other hand, reflects greater negative affect, emotional instability, and depressive symptomatology. Such patients are usually

Table 2 Personality distribution

Variable	Choleric			Sanguine			Melancholic			Phlegmatic			P value
	MT [N = 26, (SD)]	PT [N = 30 (SD)]	CT [N = 21 (SD)]	MT [N = 30 SD)]	PT [N = 38 (SD)]	CT [N = 30 (SD)]	MT [N = 38 (SD)]	PT [N = 41 (SD)]	CT [N = 32 (SD)]	MT [N = 31 (SD)]	PT [N = 38 (SD)]	CT [N = 32 (SD)]	
Age (years)	61.8 (6.2)	57.5 (5.6)	59.6 (7.3)	56.8 (8.2)	61.3 (6.8)	57.2 (6.5)	59.4 (6.5)	61.2 (7.8)	52.6 (5.6)	61.2 (6.5)	65.3 (7.5)	59.2 (6.6)	0.0002*
Sex (M/F)	8/18	6/24	7/14	8/22	9/29	12/18	9/29	11/30	7/25	8/23	11/27	13/19	0.046*
BMI (kg/m²)	28.1 (5.2)	27.3 (4.8)	29.5 (5.0)	27.6 (4.2)	28.8 (5.3)	30.7 (4.4)	29.4 (4.7)	29.5 (5.2)	29.8 (4.3)	29.2 (3.1)	28.1 (4.2)	30.1 (4.7)	0.7991
SF-36 PCS	39.2 (8.2)	40.3 (7.3)	39.0 (7.1)	38.7 (8.1)	37.6 (7.5)	42.6 (7.6)	37.9 (7.1)	38.2 (7.8)	34.5 (6.2)	38.2 (8.0)	37.7 (7.2)	40.2 (6.9)	0.0001*
SF-36 MCS	30.2 (5.8)	31.2 (6.3)	32.1 (6.6)	29.3 (6.2)	26.6 (6.4)	37.3 (6.8)	28.9 (6.1)	28.6 (5.3)	26.2 (6.8)	28.4 (5.9)	29.0 (6.5)	32.5 (7.1)	0.0001*
WOMAC pain	11.2 (3.2)	12.2 (3.5)	13.2 (4.6)	10.9 (3.2)	11.8 (3.5)	10.2 (3.6)	11.6 (3.6)	12.9 (3.4)	14.4 (3.9)	11.7 (3.6)	11.9 (3.3)	12.9 (3.3)	0.0004*
WOMAC stiffness	4.6 (1.8)	4.5 (2.1)	4.0 (1.5)	4.5 (1.8)	3.9 (2.0)	3.8 (1.1)	4.2 (1.9)	4.8 (1.9)	4.3 (1.1)	4.2 (2.1)	4.7 (2.0)	3.9 (1.3)	0.4156
WOMAC function	31.9 (9.8)	28.8 (10.2)	27.1 (6.9)	29.8 (10.2)	29.7 (9.6)	26.5 (9.2)	28.3 (11.6)	29.5 (10.3)	28.2 (8.4)	27.2 (10.0)	29.0 (9.4)	27.2 (7.9)	0.8773

One-way analysis of variance (ANOVA) used for among-group difference of the classic type of each personality. Chi-square test used for sex difference

BMI body mass index, *SF-36* Short-Form Health Survey of 36 questions, *PCS* Physical Component Summary, *MCS* Mental Component Summary, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index, *SD* standard deviation, *MT* middle type, *PT* predisposition type, *CT* classic type

* Statistically significant difference between groups

more negatively inclined to postoperative exercise and even inclined to catastrophizing. In this study, they displayed a lower level of functional recovery. Clinicians can take measures to improve QoL and rehabilitation of such patients by providing greater communication, concern, and guidance. As for personality traits that reflect socialization and creativity, these seem not to negatively impact recovery after TKA; that accorded with our results. According to a person's personality—stable or unstable, extraverted or introverted, that person can be classified as choleric, sanguine, melancholic, and/or phlegmatic [26, 27]. Sanguine patients are stable and extraverted, readily cooperate, readily communicate their recovery status, and actively follow related guidance from their physician. Melancholic patients are unstable and introverted and tend to respond negatively when faced with a setback (pain, quadriceps weakness during postoperative exercise). Collectively, we found that stable and extraverted patients recovered better than unstable and introverted patients. In addition, choleric (unstable and extroverted) and phlegmatic (stable and introverted) patients showed moderate functional outcomes. In particular, choleric patients (impulsive, changeable, touchy) find it difficult to be satisfied. If necessary, psychological intervention is advisable for patients with severe neuroticism and psychoticism.

Determining why a certain percentage of patients do not benefit well from TKA remains a challenge and finding an answer is difficult and complicated. We applied the SF-36, WOMAC, and EPQ questionnaires in an attempt to better understand the possible reasons. Despite a small number of study participants, we believe our findings will, to a certain extent, help clinicians identify patients at risk for poor postoperative TKA outcome. The advantage of this study is that a quantitative dimensional model of human personality traits, the EPQ, was for the first time introduced into functional evaluation of TKA. The conclusions summarized in the first paragraph of this section may help clinicians provide patients with a targeted guidance protocol that provides an individualized bio-psycho-social-medical model. Such a model can provide patients with information on how to recover better by helping them understand and cope with corresponding problems inclined to appear in their particular personality characteristics.

However, we found certain limitations in our study that must be acknowledged: The retrospective nature precludes causal inference but provides valuable direction for future investigations. In addition, there were variations in patient characteristics. There existed a lack of analysis on the relationship between early recovery status after TKA and personality type. These aspects must be the focus of future studies.

Table 3 Correlation (r) between personality subscales and clinical outcome

Variable	Extraversion		Neuroticism		Psychoticism		Lying	
	r	P value	r	P-value	r	P-value	r	P-value
SF-36 PCS	0.62	0.040*	−0.62	0.018*	0.23	0.982	0.11	0.524
SF-36 MCS	0.53	0.025*	−0.72	0.036*	0.21	0.786	0.21	0.657
WOMAC pain	−0.64	0.018*	0.71	0.025*	0.31	0.928	0.13	0.287
WOMAC stiffness	−0.49	0.028*	0.38	0.018*	0.13	0.683	0.15	0.475
WOMAC function	−0.57	0.035*	0.61	0.032*	0.22	0.723	0.16	0.652

SF-36 Short-Form Health Survey of 36 questions, *PCS* Physical Component Summary, *MCS* Mental Component Summary, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index

* Statistically significant difference between groups

Table 4 Quality of life and functional outcome

Variable	Choleric [$N = 77$ (SD)]	Sanguine [$N = 98$ (SD)]	Melancholic [$N = 111$ (%)]	Phlegmatic [$N = 101$ (%)]	P value
SF-36 PCS	49.2 (9.0)	52.1 (8.8)	42.2 (6.9)	48.3 (8.5)	<0.0001*
SF-36 MCS	48.3 (7.2)	50.3 (7.8)	43.2 (8.3)	47.5 (7.5)	<0.0001*
WOMAC pain	3.0 (1.8)	2.8 (1.6)	3.8 (1.8)	3.4 (1.7)	0.0002*
WOMAC stiffness	1.6 (0.5)	1.5 (0.6)	1.7 (0.4)	1.6 (0.4)	0.0289*
WOMAC function	17.6 (6.5)	16.5 (6.9)	19.8 (7.2)	17.3 (7.5)	0.0058*

One-way analysis of variance (ANOVA) used for all statistical analyses

SF-36 Short-Form Health Survey of 36 questions, *PCS* Physical Component Summary, *MCS* Mental Component Summary, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index

* Statistically significant difference between groups
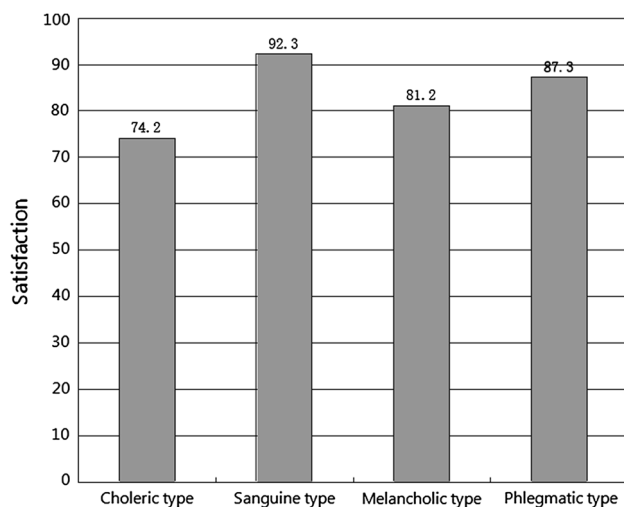
Fig. 2 Satisfaction rate among the four personality types

Conclusions

Our results may help clinicians identify patients at risk for poor postoperative clinical outcomes following TJA by providing them with better communication and individual treatment strategies during perioperative periods. Such strategies would be based on patients' personality traits identified prior to the procedure by applying the EPQ. This would give patients an opportunity for better recovery.

Conflict of interest There is no conflict of interest in this study.

References

1. Rasanne P, Paavolainen P, Sintonen H, Koivisto AM, Blom M, Ryynanen OP. Effectiveness of hip or knee replacement surgery in terms of quality-adjusted life years and costs. Acta Orthop. 2007;78:108–15.
2. Wylde V, Dieppe P, Hewlett S, Learmonth ID. Total knee replacement: is it really an effective procedure for all? Knee. 2007;14:417–23.
3. Vissers MM, Bussmann JB, Verhaar JA, Busschbach JJ, Bierma-Zeinstra SM, Reijman M. Psychological factors affecting the outcome of total hip and knee arthroplasty: a systematic review. Semin Arthritis Rheum. 2012;41:576–88.
4. Edwards RR, Haythornthwaite JA, Smith MT, Klick B, Katz JN. Catastrophizing and depressive symptoms as prospective predictors of outcomes following total knee replacement. Pain Res Manag. 2009;14:307–11.
5. Brander VA, Stulberg SD, Adams AD, Harden RN, Bruehl S, Stanos SP. Predicting total knee replacement pain: a prospective, observational study. Clin Orthop Relat Res 2003;(416): 27–36.
6. Forsythe ME, Dunbar MJ, Hennigar AW, Sullivan MJ, Gross M. Prospective relation between catastrophizing and residual pain.

Following knee arthroplasty: two-year follow-up. Pain Res Manag. 2008;13:335–41.

7. Riddle DL, Wade JB, Jiranek WA, Kong X. Preoperative pain catastrophizing predicts pain outcome after knee arthroplasty. Clin Orthop Relat Res. 2010;468:798–806.

8. Badura-Brzoza K, Zajac P, Kasperska-Zajac A. Psychological and psychiatric factors related to quality of life after total hip replacement: preliminary report. Eur Psychiatry. 2009;24:119–24.

9. Lingard EA, Riddle DL. Impact of psychological distress on pain and function following knee arthroplasty. J Bone Joint Surg Am. 2007;89:1161–9.

10. Salmon P, Hall GM, Peerbhoy D. Influence of the emotional response to surgery on functional recovery during 6 months after hip arthroplasty. J Behav Med. 2001;24:489–502.

11. Riediger W, Doering S, Krismer M. Depression and somatisation influence the outcome of total hip replacement. Int Orthop. 2010;34:13–8.

12. Sullivan M, Tanzer M, Stanish W, Fallaha M, Keefe FJ, Simmonds M. Psychological determinants of problematic out comes following total knee arthroplasty. Pain. 2009;143:123–9.

13. Engel C, Hamilton NA, Potter PT, Zautra AJ. Impact of two types of expectancy on recovery from total knee replacement surgery (TKR) in adults with osteoarthritis. Behav Med. 2004;30:113–23.

14. Mannion AF, Kampfen S, Munzinger U, Kramers-de Quervain I. The role of patient expectations in predicting outcome after total knee arthroplasty. Arthritis Res Ther. 2009;11:R139.

15. Mahomed NN, Liang MH, Cook EF, Daltroy LH, Fortin PR, Fossel AH. The importance of patient expectations in predicting functional outcomes after total joint arthroplasty. J Rheumatol. 2002;29:1273–9.

16. Sullivan MJL, Rodgers WM, Kirsch I. Catastrophizing, depression and expectancies for pain and emotional distress. Pain. 2001;91:147–54.

17. Banks SR, Kerns RD. Explaining high rates of depression in chronic pain. A diathesis-stress hypothesis. Psychol Bull. 1996;119:95–110.

18. Kreder HJ, Grasso P, Williams JI. Provider volume and other predictors of outcome after total knee arthroplasty: a population study in Ontario. Can J Surg. 2003;46:15–22.

19. Morrison RS, Magaziner J, McLaughlin MA. The impact of post-operative pain on outcomes following hip fracture. Pain. 2003;103:303–11.

20. Sullivan MJL, Rodgers WM, Kirsch I. Catastrophizing, depression and expectancies for pain and emotional distress. Pain. 2001;91:147–54.

21. Roth ML, Tripp DA, Harrison MH, Sullivan M, Carson P. Demographic and psychosocial predictors of acute perioperative pain for total knee arthroplasty. Pain Res Manag. 2007;12:185–94.

22. Edwards RR, Bingham CO III, Bathon J, Haythornthwaite JA. Catastrophizing and pain in arthritis, fibromyalgia, and other rheumatic diseases. Arthritis Rheum. 2006;55:325–32.

23. Sullivan MJ, Thorn B, Haythornthwaite JA. Theoretical perspectives on the relation between catastrophizing and pain. Clin J Pain. 2001;17:52–64.

24. Vissers MM, Bussmann JB, Verhaar JA, Busschbach JJ, Bierma-Zeinstra SM, Reijman M. Psychological factors affecting the outcome of total hip and knee arthroplasty: a systematic review. Semin Arthritis Rheum. 2012;41:576–88.

25. Eysenck HJ. The biological basis of personality. Springfield: Thomas; 1967.

26. Upmanyu VV, Bhardwaj S, Singh S. Word-association emotional indicators: associations with anxiety, psychoticism, neuroticism, extraversion, and creativity. J Soc Psychol. 1996;136(4):521–9.

27. Eysenck HJ, Eysenck SBG (1991) Manual of the Eysenck Personality Scales, Hodder & Stoughton, London, 1991.31.C.

28. Mizner RL, Petterson SC, Snyder-Mackler L. Quadriceps strength and the time course of functional recovery after total knee arthroplasty. J Orthop Sports Phys Ther. 2005;35:424–36.

29. Aarons H, Hall G, Hughes S, Salmon P. Short-term recovery from hip and knee arthroplasty. J Bone Joint Surg Br. 1996;78:555–8.