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Abstract

Among other factors, optimism has been shown to significantly influence the course of some diseases (cancer, HIV, coronary heart disease). This study investigated whether optimism of a patient before a total hip replacement can predict the functionality of the lower limbs 3 and 6 months after surgery. A total of 325 patients took part in the study (age: 58.7 years; w: 55%). The functionality was measured with the Western Ontario and McMaster Universities arthrosis index, and optimism with the Life Orientation Test. To analyse the influences of age, gender and optimism, general linear models were calculated. In optimistic patients, functionality improved significantly over time. The study showed a clear influence of dispositional optimism on the recovery after total hip replacement in the first 3 months after surgery.

Keywords

functionality, optimism, pessimism, recovery after total hip replacement, WOMAC

Introduction

Osteoarthritis (OA) is a highly prevalent disease. From a public health perspective, the condition must be regarded as extraordinarily important because of the related pain and physical disability as well as treatment costs (Günther et al., 2002). Approximately one in four adults is diagnosed with arthrosis in Germany (Federal Statistical Office, 1998). Apart from the spine and the hands, arthritis is found most frequently in the load-bearing joints (Günther et al., 2002). With approximately 1.3 million affected patients, hip OA is very common in Germany (The Mattson Jack Group, 2007). Among US adults, 30 years of age and older, symptomatic knee OA affects 6 per cent and symptomatic hip

OA occurs in roughly 3 per cent of the population (Corti and Rigon, 2003). Total hip replacement (THR) as a therapy for advanced hip OA is an established technique with few complications and high patient acceptance (Learmonth

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et al., 2007; Wollmerstedt et al., 2006). The indication for surgery is based on radiographic changes as well as the individual pattern of patients' complaints. The exact timing of surgery depends decisively on the subjective suffering of the patient (Hackenbroch, 1998) and his treating surgeon (Mancuso et al., 1996). Since the onset of hip replacement surgery in the 1960s, surgical treatment of hip OA has increased continuously. In recent years, 295.7 operations per 100,000 inhabitants were carried out in 2009 in Germany, 193.6 in Great Britain and 183.9 in the United States (Robert Koch Institut, 2013). Because of changes in the age structure of the population, hip replacement numbers are forecast to increase further in the future (Birrell et al., 1999; König and Kirschner, 2003).

The survival rate of implants is an important criterion in the medical assessment of THR. In the past years, however, as a result of patient-based outcomes research, additional evaluation criteria have increasingly been applied, which emphasize the subjective aspects of illness-related quality of life, that is, the psychosocial components of a therapy outcome.

Many studies on the potential influences on the clinical process after THR focus on factors that derive directly from the illness (level of functionality, severity of disability and pain) or those that result from the type of therapy (design of the prosthesis, timing of prosthesis implantation, mode of implant fixation). Thus, Röder et al. (2007), for example, examined the influence of the pre-operative level of functionality on the outcome of hip replacement surgery. They found that patients who were initially less handicapped at the functional level benefitted more from surgery. However, these patients are at risk of recognizing only a small treatment effect due to a ceiling effect of the used specific instruments, which measure functionality (e.g. Western Ontario and McMaster Universities arthrosis index (WOMAC)) (Marx et al., 2005).

Regarding psychological or psychosocial factors in the course of orthopaedic conditions, there is much less data available. Research has shown that psychological factors (depression,

anxiety, coping) are closely connected with patients' subjective perception of their impairment. Interestingly, these correlations are stronger than those with radiological indicators of OA severity (gamma rays permeability of the bone) (Brandt et al., 2000; Summers et al., 1988).

At the cognitive level, Scheier and Carver (1985, 1988) specified optimism/pessimism as one factor that influences treatment outcome, and Scheier and Bridges (1995) presented a model that integrated optimism/pessimism into an overall conceptual scheme. In a medical context, disease is then seen as a disrupter of life-goals and activities. Pessimism is characterized by the habitual expectation that a situation (e.g. the general state of one's health or the development of existing health problems) will change for the worse in the future leading to disengagement. On the basis of quantified optimism/pessimism, it is possible to predict the development and/or mortality of patients with coronary heart disease (Matthews et al., 2004; Sanjuán et al., 2012), cancer (Lebel et al., 2008; Schulz et al., 1996) and HIV (Reed et al., 1994) with significance. Review articles have indicated that optimism frequently contributes to a more positive outcome in many other medical settings (e.g. treatment for ischaemic heart disease, in vitro fertilization, treatment for breast cancer, bone marrow transplantation, coronary artery bypass surgery, coronary heart disease) (Carver et al., 2010; Rasmussen et al., 2006).

Optimism is defined as the confidence that most factors of major importance to one's self will develop favourably in the future. This confidence relates to given circumstances as well as to the consequences of one's own actions. The positive correlation of optimism with patients' health has been demonstrated in various studies (Peterson and Bossio, 2001; Rasmussen et al., 2006; Smith et al., 2004). Numerous longitudinal studies showed positive effects of optimism on psychological as well as physical well-being. It was possible to predict lower levels of perceived pain and fewer indicators of arteriosclerosis in cardiovascular patients

(Mahler and Kulik, 2000; Matthews et al., 2004), as well as lower levels of stress after treatment in breast cancer patients (Carver et al., 2005; Trunzo and Pinto, 2003) on the basis of optimism. This correlation could be shown over several months or even years. A total of 8 months after surgery, optimistic patients showed more life satisfaction compared to the time before (Fitzgerald et al., 1993), which consisted in a similar study by Scheier et al. (1989) even up to 5 years.

As a possible explanation for this positive correlation with psychosocial adjustment, the Scheier–Carver research group suggested that optimism co-determines the choice of coping strategies (Carver et al., 2010; Rasmussen et al., 2006; Solberg Nes and Segerstrom, 2006). Patients with high dispositional optimism are assumed to deal with their illness in a more constructive way and try to discover positive aspects to their situation, in contrast to other patients. Furthermore, they devise plans for their future to a markedly larger extent than pessimists, who largely refuse to deal with their illness as well their future. Additionally, dispositional optimism may be associated with patients receiving more social support, which in itself contributes to improved health status (Brissette et al., 2002; Vollmann et al., 2007).

The above findings can be transferred to persons with surgical treatment due to musculoskeletal disorders, because the success of recovery after THR will also depend on the motivation, expectations and coping behaviour of the patient. Optimism as expectation is then one possible factor in the recovery.

The objective of this study was to examine to what extent optimism influences recovery after THR surgery. We postulate that recovery is hindered by low levels of optimism and that, therefore, pessimistic patients will attain the functional level of optimistic patients with measurable delay. This research question was addressed through a prospective design. A cohort sample was assessed at three measurement points: 4 weeks before surgery (t_0) and twice post-surgery, that is, 3 (t_1) and 6 months (t_2) after the operation.

Methods

Measurement functionality

The WOMAC was developed by Bellamy et al. (1988) as a disease-specific instrument to assess the functional state in hip and knee OA. WOMAC is a frequently used questionnaire for the assessment of OA-specific disease outcomes based on patients' perception (Wollmerstedt et al., 2006). The questionnaire comprises a total of 24 items relating to three different symptom areas affecting functionality. The first complex covers 5 items on pain, the second covers 2 items on stiffness and the third covers 17 items on activities of daily living (ADL). A German version of the WOMAC was presented and evaluated by Stucki et al. (1996).

In the original version, each question was answered manually on a visual scale, which was 10 cm in length. The German version uses a graduated scale with a value range from 0 to 10. A global score is formed by calculating an unweighted mean value after each scale is standardized by dividing the scale by the number of items. The value of the global score can thus range from 0 to 100 with high scores representing higher functionality. Apart from this global evaluation, analogue calculations of scores for the sub-scales pain and stiffness and ADL are possible.

Optimism

In order to assess dispositional optimism, the Life Orientation Test (LOT; Scheier and Carver, 1985) was used in its revised form (LOT-R). The test has been used in various studies that deal with the impact of dispositional optimism on behaviour, emotions and physical health, and its reliability and validity have been established (Scheier et al., 1994). They operationalized optimism by the sum of six items. High values indicate a high level of optimism; low values indicate pessimism. The shortness of the instrument (10 items) makes it widely useable. The LOT-R allows the assessment of dispositional optimism (three items) and dispositional pessimism (three items) as a polar construct; four additional statements are filler items. In the

present study, the German version of the revised LOTs as presented by Hoyer et al. (2004) was used. For the German version, studies have confirmed the reliability of LOT-R (Cronbach's alpha for optimism = .69 and for pessimism = .68) as well as its factor validity (Herzberg et al., 2006). Norm values for the German version of the LOT-R (*t*-scores and percentiles) on the basis of a large sample of 4,938 participants are available (Glaesmer et al., 2008).

Sociodemographic status of patients

The following sociodemographic data were collected: age, gender, marital status, religious affiliation, education, professional status, weekly working hours, length of hospital stay, type of implant and number of serious adverse events during surgery or post-surgery.

Data collection and analysis

The study was approved by the Ethics Committee of the Medical Faculty of the Dresden University of Technology. Data collection was integrated into regular administrative procedures of the participating orthopaedic hospital. The data for 3 and 6 months were collected through follow-up examinations. All patients participating in the study gave their written informed consent.

The collected data were analysed using the statistical software Statistical Package for the Social Sciences (SPSS) 20.0. The hypothesis that recovery would be impeded by low optimism was tested using general linear models (type III). Covariates were age, optimism, the interaction age $\times$ optimism and WOMAC t_0 . In the following analyses, the functionality and the three subscales: pain, stiffness and daily activities at the time of 3 and 6 months after the surgical treatment were the outcome variables. To investigate the increase between t_1 and t_2 , the corresponding value of t_1 was introduced as a covariate.

Participants

For this study, only patients aged 18 years or older at the time of surgery who underwent

primary THR (no revision surgeries) were included. Further inclusion criteria were good cognitive orientation regarding time and place, fluency in German, physical and psychological ability to fill in the questionnaires as well as written informed consent to participate in the study and a signed data privacy waiver.

The inclusion period for generating the sample was calculated at 9 months in the project application. A yield of up to $N=450$ eligible participants in this period was anticipated. At an assumed dropout rate of approximately 35 per cent of eligible patients due to refused participation, insufficient reliability, death, relocation or similar factors, we expected a final sample of approximately $N=300$ participants.

During the data collection period, a total of 594 patients fulfilled our inclusion criteria. A total of 325 patients consented to participate in the study; complete data sets were obtained from $n=317$ patients. $N=175$ (55%) patients were female, $n=142$ (45%) male. The average age was 58.7 years, with the youngest patient aged 18 years and the oldest 88 years. In terms of civil status, $n=206$ (65%) patients were married, $n=34$ single, $n=28$ divorced or separated, $n=30$ widowed and $n=12$ lived in a non-marital relationship. $N=226$ (72%) of the participants had no religious affiliation. Of the total sample, 33 per cent had completed compulsory education, 46 per cent middle school or comparable schooling of the former German Democratic Republic (GDR). A further 20 per cent had completed high school. A great majority of the participants had completed vocational or professional training; only 2 per cent had no vocational training at all. A total of 64 persons (20%) had completed college or university. Just under half of the participants ($n=145$, 46%) were retirees at the time of the study. A total of $n=114$ persons (36%) were employed; $n=28$ (9%) were self-employed. Their average weekly working hours were 40 hours. A total of $n=25$ persons (8%) were unemployed.

The patients were hospitalized for an average of 8 days. A total of 44 per cent of the participants received an uncemented implant; the remaining patients either hybrid or fully

cemented implants. Serious adverse events during surgery or post-surgery were observed in 8 per cent of the treated patients.

A total of 45 per cent ($n=269$) of eligible patients did not participate because of refusal or cognitive/physical impairment. The most frequent reason for non-participation was refusal after receiving information on the study procedure ($n=117$). Further reasons were non-fulfilment of inclusion criteria ($n=30$) or organizational difficulties ($n=30$).

Lost-to-follow-up statistic

Of the $N=317$ patients who participated in the initial interview (t_0), $n=268$ patients yielded complete data sets at the time of the first follow-up interview (t_1 : 3 months after surgery). At the time of the final data collection (t_2 : 6 months after surgery), complete data sets were obtained for $n=292$ patients. Thus, the response rate after 3 months was 85 per cent, and 92 per cent after 6 months. Patients who dropped out of the study did not differ from the remaining participants regarding the sociodemographic variables age and sex. Likewise, both patient groups were comparable in terms of the outcome variable functionality.

Results

Functionality

In their subjective assessment of functionality (WOMAC function), patients suffered from significant pre-surgical impairment ($M=45.45$, standard deviation (SD)=14.48). At this time, a significant difference was found between women and men ($F(302)=9.04$; $p<0.003$): women reported more severe impairment than men ($M=43.19$, $SD=13.79$ vs $M=48.17$, $SD=15.09$), mainly due to a higher degree of pain ($p<0.001$) and more difficulty doing everyday activities ($p<0.01$).

A total of 3 months after surgery, significant improvement in functionality was observed. The average score for WOMAC function increased by approximately 29 counts to 74.33

($SD=15.90$). A total of 6 months after surgery, the average score increased once more to a mean value of 83.29 ($SD=15.11$) ($F(2/204)=497.24$; $p<0.0001$). During the post-operative follow-up time, there was no difference between men and women at either measurement point.

The three scales pain, stiffness and the daily activities significantly changed after 3 and 6 months ($p<0.01$): pain decreased after surgery: $M_{t_0}=45.39$, $M_{t_1}=82.32$; $M_{t_2}=87.54$, and also did stiffness $M_{t_0}=41.78$, $M_{t_1}=68.25$; $M_{t_2}=77.89$. The ADL increased: $M_{t_0}=42.45$, $M_{t_1}=73.84$; $M_{t_2}=82.42$.

Optimism

The results for optimism as a psychological variable, measured in LOT-R, were for the total sample $M=15.91$ ($SD=3.37$), for women $M=15.95$ ($SD=3.42$) and for men $M=15.85$ ($SD=3.32$). Our patients' scores were in line with the average score of the general population in Germany ($M=14.18$; $SD=3.54$) (Glaesmer et al., 2008). Moreover, there was no significant difference between men and women in the sample, which is also consistent with data from the general population.

Influence of optimism on functionality

Our question was whether the post-operative recovery is influenced by optimism. In order to determine the influence of optimism, age and the interaction age $\times$ optimism on the treatment outcome WOMAC 3 and 6 months after surgery, we performed generalized linear model (GLM) univariate procedures with the covariates WOMAC t_0 , age, optimism and the interaction age $\times$ optimism (see Table 1). In the testing of the increase between t_1 and t_2 , WOMAC t_1 was introduced as covariate.

The influence of optimism on the functionality, the pain, the stiffness and the ADL was significant 3 months after the surgery. Optimism explained 39 per cent of the variance with functionality, age 24 per cent and the interaction 22 per cent. This represents a small to medium effect for optimism. Pain, stiffness and ADL

Table 1. GLM-regression on WOMAC (and subscales pain, stiffness, ADL) after 3 and 6 months by age, optimism, the interaction age $\times$ optimism and WOMAC t_0 /WOMAC t_1 .

WOMAC	3 months (t_0-t_1)			6 months (t_1-t_2)		
	Beta	$p(F)$	Part. Eta ²	Beta	$p(F)$	Part. Eta ²
WOMAC pre/ t_1	0.36	<0.01	.10	0.68	<0.01	.47
Age	0.71	<0.01	.24	0.50	<0.01	.17
Optimism	4.58	<0.01	.39	2.10	<0.01	.14
Age $\times$ optimism	-0.06	<0.01	.22	-0.03	<0.01	.11
Pain						
Pain pre/ t_1	0.30	<0.01	.09	0.50	<0.01	.31
Age	0.88	<0.01	.29	0.68	<0.01	.23
Optimism	4.73	<0.01	.40	2.94	<0.01	.21
Age $\times$ optimism	-0.06	<0.01	.21	-0.04	<0.01	.15
Stiffness						
Stiffness pre/ t_1	0.19	<0.01	.04	0.59	<0.01	.27
Age	0.76	<0.01	.20	0.51	<0.01	.09
Optimism	4.85	<0.01	.38	2.44	<0.01	.09
Age $\times$ optimism	-0.07	<0.01	.19	-0.03	<0.01	.05
ADL						
ADL pre/ t_1	0.34	<0.01	.10	0.69	<0.01	.49
Age	0.72	<0.01	.24	0.48	<0.01	.16
Optimism	4.64	<0.01	.39	2.04	<0.01	.13
Age $\times$ optimism	-0.06	<0.01	.22	-0.03	<0.01	.10

GLM: generalized linear model; WOMAC: Western Ontario and McMaster Universities arthrosis index; ADL: activities of daily living.

were affected in the first 3 months after surgery in the same way by optimism (Eta² = .40, .38 and .39, respectively). The influences of age and the interaction age $\times$ optimism were significantly lower. The increases in functionality, pain, stiffness and ADL from t_1 to t_2 were influenced by optimism only slightly (Eta² = .14, .21, .09 and .13, respectively).

Discussion

The mean post-operative increase in functional score values after hip replacement surgery followed a logistic function. While improvements immediately after surgery were minor, there was a marked functional improvement between hospital discharge and 3 months after surgery. Between 3 and 6 months after surgery, the rate of improvement decreased as the curve approaches an asymptotic value. Based on this

observation, the main functional recovery can be expected during the first 3 months after surgery. In the 3 months thereafter, changes were relatively small.

This outcome was found in women as well as in men. No differences in functionality were observed between women and men at 3 and 6 months after surgery. This is in line with the findings of Wollmerstedt et al. (2006), but in contradiction to McGuigen et al. (1995).

The influence of age must also be taken into account because significant influences were found 3 months after surgery. This confirms the findings of the research groups of Kirschner et al. (2004) and Brinker et al. (1996, 1997) that function scores of older patients are markedly lower after surgery than of younger patients. The influence of the level of pre-operative function or pain on post-operative functional improvement has been shown in previous

studies (Röder et al., 2007; Waidelich, 2007; Wollmerstedt et al., 2006). In the present study, the functionality before hospitalization had only a small influence on the WOMAC scores 3 months post-surgery. The influences were much higher 6 months after surgery. This confirms partially the findings of Röder et al. (2007), who found that patients with less compromised functionality before surgery benefited more from the procedure.

In the model of Scheier and Bridges (1995), the attainment of life-goals is disrupted through illness:

People's responses to the adversity of goal disruption depends to a great extent on the nature of their expectations with respect to obtaining the goals toward which they are striving. People who expect to overcome the problems confronting them stay engaged in life's activities. In contrast, people who expect to be unsuccessful in the attainment of their goals disengage from their goal-directed efforts. (p. 261)

This model is well established for the occurrence of diseases as well as the adaption to a disease.

In this study, patients underwent a progression of disease over a longer period of time, which leads to bodily impairment. The aim of the hip replacement surgery is the restoration of function and therefore general health improvement of the patient. In our study with patients with hip replacement surgery, optimism had a significant influence on functionality, pain, stiffness and ADL. Optimistic patients reached faster a level of functionality in the first 3 months post-surgery than patients with lower levels of optimism. This influence was in the following 3 months significantly less strong.

From the findings of this study we can conclude that for patients with hip replacement surgery, the psychological variable of optimism is clearly connected with functionality 3 months and weaker 6 months after surgery.

The results show that after a surgery, dispositional optimism also plays a role in the recovery of daily activities. This confirms the results

of Scheier et al. (1989) of optimistic male patients after a coronary artery bypass surgery, who in contrast to pessimistic patients recovered faster could leave the hospital faster and were able to return to work and to sport activities earlier. Studies also reported that optimism is related to social support in that way that compared to pessimists, optimists are more attractive, and as a result, they receive more social support (Bozo et al., 2009).

For clinical practice in orthopaedics, the findings could suggest to request the domain-specific and global expectations (optimism) of the patients. This would allow us to identify patients with pessimistic expectations. For those patients, a short cognitive behavioural intervention for reducing the pessimism and increasing optimism could be performed prior to surgery. The goal of intervention is to make negative thoughts more positive, to develop a positive perspective (Riskind et al., 1996) and to train the patients in stress-management techniques (Antoni et al., 2001).

Limitations

The findings of the study are limited by several factors in the statement. First, we only studied the influence of optimism on the recovery. It is conceivable that other variables may play a role (e.g. depression, anxiety). Second, also variables of OA could have been used to control the output level. Third, it was difficult to determine and control the influence of physiotherapy on the recovery of activities.

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