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Influencing Factors for Joint Awareness After Total Hip Arthroplasty: A Cross-Sectional Study

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Abstract

Objective: Total hip arthroplasty (THA) is a common procedure nowadays, with hospitals easily reaching hundreds of surgeries a year and considering the cross-sectional nature. Joint awareness (JA) is indicative of the patient's adaptation and satisfaction after THA. The current study investigated the relationship between joint awareness, joint position sense (JPS), mobility level, activities of daily living, and hip pain level in patients with THA.

Methods: This is a cross-sectional study involving 50 individuals with THA (31.48±55.14 weeks post-surgery; mean age was 54.32±18.28 years). Factors related to joint awareness were examined with linear regression analysis. Hip Joint position sense (JPS) was measured with a digital inclinometer, pain level was measured with a Visual Analog Scale (VAS), joint awareness was assessed with the Forgotten Joint Score-12, and mobility level was assessed with the Parker Mobility Index.

Results: The factors that have a statistically significant effect on the joint awareness are age, pain, mobility, and BMI ($p = 0.002$, $p = 0.040$, $p<0.001$, $p = 0.010$, and $p = 0.010$, respectively). According to the Beta coefficients, it is seen that the independent variables with the highest effect in absolute terms are mobility (Beta = 0.599) and age (Beta = 0.448).

Conclusion: According to our results, younger patients were less adaptive to the artificial joint following THA. The mobility level was also a strong predictive factor in joint awareness. Physiotherapy and rehabilitation programs should focus on joint awareness in terms of age and mobility level in patients with THA.

Keywords: Arthroplasty, Joint Awareness, Age, Mobility, Proprioception

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INTRODUCTION

Developing surgical techniques, patient satisfaction becoming a factor affecting the success of surgery, and the increase in the conscious patient population have increased interest in patient-based scales. 'Artificial joint forgetting' is a recently coined term that refers to the ability to forget about an artificial joint after joint arthroplasty surgery (1). This ability has been identified as a significant factor in joint arthroplasty surgery success and overall patient satisfaction (2-4). Current studies report that the primary goal of patients after total hip arthroplasty (THA) is to adapt to prostheses all over the world (5). The goal of THA is to have the patient perceive the artificial joint as a normal body limb and achieve the highest possible satisfaction. Post-surgical outcome assessments increasingly involve joint-specific parameters, such as patient satisfaction, joint awareness, pain, level of mobility, or joint position sense (JPS) (6). Adaptation to the artificial joint after THA is only possible with the improvement of hip perception and function. In the hip joint, structures such as joint capsule, chondral surface and labarum associated with JPS are removed during arthroplasty surgery (7). Following THA, joint position sense is provided by stimuli from receptors on the muscles and skin, the sense of sight, and the balance centre in the inner ear (8). Studies predict that hip joint awareness improves linearly over time after THA, like muscle strength and patient symptoms (2). Investigating the factors related to joint awareness will provide ideas for creating new strategies for prosthesis adaptation.

This study's main aim is to examine the factors associated with the joint awareness following THA. The hypothesis of the study was that joint position sense, pain, mobility level, body mass index, postoperative day and age would be a predictive role in joint awareness in patients undergoing THA.

METHODS

Study design

The present study is a prospective cross-sectional design was employed.

Study place and period

This study included individuals who received THA in the Private Acıbadem Orthopedia Hospital from May 2022 to July 2023.

Study population

Patients who could not understand the measurement method, could not complete the measurement, or had dementia were excluded. Patients who completed the sixth week after THA surgery, which was performed through the posterior approach, were included. The study was approved by the non-interventional clinical research ethics committee of Tarsus University (Decision number: 2022/07, Date: 10.05.2022). This cross-sectional study was conducted between 11 May 2022 and 1 July 2023. Power analysis was performed for

multiple linear regression analysis with the expectation of a correlation of at least 0.5-0.60 between the independent variables and the artificial joint score. When the R-square statistic was taken as 0.30, the calculated effect size was calculated as f-square = 0.429, and the sample size calculated for 5% Type I error, 80% power, and 9 independent variables was calculated as 46 people. Approximately fifty-one people were planned to be included in the study, with a loss rate of approximately 10% predicted. Power analysis was performed with G Power (version 3.1.9.6).

Data on physical properties

Age height weight gender recorded. The body mass index was obtained by dividing the weight by the square of the height.

Evaluation of pain

The intensity of pain was evaluated with a visual analog scale. The patient was asked to give a value between zero to ten for the pain he felt during the activity. This method is reliable and valid (9).

Evaluation of joint awareness

The FJS-12 (Forgotten Joint Scale) is a 12-item questionnaire that assesses joint awareness, including questions about the hip joint during daily activities (10, 11). Scores on the scale range from 0 to 100, with higher scores indicating better joint awareness. A high value reflects the ability of the patient to forget about the affected/ replaced joint. It is valid and reliable for hip arthroplasty (Cronbach's alpha ranging from 0.70 to 0.95 was adequate) (11).

Evaluation of hip joint position sense (hip proprioception)

A digital inclinometer (Baseline ® Digital Inclinometer, Jtech Medical Industries, Inc., Salt Lake City, Utah) was used to evaluate joint position sense. It is a valid and reliable tool for hip joint (ICC value is 0.92-0.97) (12). Measurements were taken while the participants were in the supine position and in a calm and quiet environment. Only the affected sides of participants who had undergone surgery were evaluated (13). Individuals were instructed to move their hip to 50% of their current range (target position) and hold for five seconds. Then they actively moved their hip to the target position and performed flexion and abduction movements. The amount of deviation from the target angle was recorded. This measurement was made for both hip flexion and abduction.

Evaluation of mobility level

The patient's mobility level was used to evaluate the Parker Mobility Index. It is valid and reliable tool for hip joint (95% confidence interval: 0.696–0.773) (14). The Parker Mobility Index is a 3-point scale that is often preferred by orthopaedic surgeons as it is convenient in assessing patient function.

Statistical Analysis

According to the referenced article (literature review), correlation statistics of 0.60 between

artificial joint score and mobility and 0.70 with VAS were reported (15). In this context, power analysis was performed for multiple linear regression analysis with the expectation of a correlation of at least 0.5-0.60 between the independent variables and the artificial joint score. When the R-square statistic was taken as 0.30, the calculated effect size was calculated as f-square = 0.429, and the sample size calculated for 5% Type I error, 80% power, and 9 independent variables was calculated as 46 people. Approximately fifty-one people were planned to be included in the study, with a loss rate of approximately 10% predicted. Power analysis was performed with G Power (version 3.1.9.6). Multiple linear regression analyses were performed to analyse the relationship between the artificial joint score and independent variables such as BMI, hip proprioception, mobility level, gender, age, postoperative, pain. Descriptive data was given as mean standard deviation. The backward elimination approach was preferred as the variable selection method. According to this approach, after the model is established with all independent variables, the one that contributes the least to the model (that is, the independent variable with the largest p) is removed from the model, and the model is rebuilt. This process is repeated until the p value for the independent variables is less than 0.10 and the final model is reached. Among these variables, the standardized regression coefficient (Beta) was examined to determine the variable that had the highest effect on the artificial joint score. The data were analyzed with the SPSS 22 package program. Demographic data are expressed as percentages and numbers. Tests were performed in accordance with normal distribution.

RESULTS

Fifty patients with THA (thirty-four females, sixteen males) were included in the study (Table 1). The mean age of THA patients was 54.32±18.28 years. The mean body mass index (BMI) of THA patients was 27.27±3.6 kg/m2. All physical properties of the participants are presented in detail in Table 1.

Independent variables in first step: BMI, hip position sense, parker mobility index, sex, age, postop, pain, hip abduction position sense. (R=0.838 R-sqr=0.702, Adj-Rsqr=0.661, F(df1=6, df2=43)=16.915, p<0.001. The regression model obtained for the artificial joint score-dependent variable is presented below, (Table 2). The resulting model was found to be statistically significant (F(df1=4, df2=45)=21.063, p<0.001), and approximately 60–65% of the variability in the dependent variable of the artificial joint score was explained by the model (R-sqr=0.652, Adj-Rsqr=0.621). According to the obtained model, the independent variables that have a statistically significant effect on the artificial joint score are age, pain, mobility, and BMI (p = <0.001, p = 0.038, p = 0.001, and p = 0.030,

respectively). If the obtained unstandardized coefficients are to be interpreted, A one unit increase in the age variable results in a 0.919 unit increase in the artificial joint score. A one-unit increase in the VAS pain variable resulted in a 4.767-unit decrease in the artificial joint score. A one-unit increase in the parquet mobility variable results in a 14,796-unit increase in the artificial joint score. A one-unit increase in the BMI variable results in a 2,485-unit increase in the artificial joint score. If it is desired to determine the variable that has the highest effect on the artificial joint score among these variables, the standardized regression coefficient (Beta) should be examined. According to the beta coefficients, it is seen that the independent variables with the highest effect in absolute terms are mobility (Beta = 0.599), age (Beta = 0.448), pain (Beta = -0.252), and BMI (Beta = -0.252), (Table 2).

Table 1. Demographic and clinical characteristics of the participants (n=50).

		THA (n=50)
Age, years (Mean±SD)		54.32±18.28
Sex, n (%)	Female	34 (68)
	Male	16 (32)
Prosthesis indication (%)	Osteoarthritis	%40
	avascular necrosis	%26
	femoral head and neck fracture	%18
	Hip dysplasia	%12
	Missing value	%4
BMI, kg/m^2(Mean±SD)		26.56±4.15
Post op. Time (week)		31.48±55.14

n: Number, SD: Standard Deviation, THA: Total hip arthroplasty, BMI: Body mass index, op: operation

Table 2. Findings from multiple linear regression analysis for artificial joint score.

	Unstandardized Coefficients		**Standardized Coefficients**			**95.0% Confidence Interval for B**	
	B	**Std. Error**	**Beta**	**t**	**p**	**Lower Bound**	**Upper Bound**
(Constant)	-104.431	44.214		-2.362	0.023	-193.597	-15.264
Sex	-16.448	9.079	-0.206	-1.812	0.077	-34.757	1.861
Age	0.685	0.209	0.333	3.284	0.002	0.264	1.105
Pain	-4.486	2.113	-0.237	-2.123	0.040	-8.748	-0.224
Mobility	18.223	2.942	0.738	6.194	<0.001	12.290	24.157
BMI	2.914	1.079	0.238	2.701	0.010	0.739	5.090

Dependent variable: Joint Awareness, Independent variables in first step: BMI, hip position sense, parker mobility index, sex, age, postop, pain, hip abduction position sense. R=0.838 R-sqr=0.702, Adj-Rsqr=0.661, F(df1=6, df2=43)=16.915, p<0.001

DISCUSSION

The present study found that the patient's younger age and low mobility level were the most important and negative factors affecting joint adaptation after hip replacement. Also, high pain levels and a high BMI affect patients' joint adaptation negatively. The low prosthetic adaptation of young patients suggests that arthroplasty should be considered as the last option in treatment for these patients. Adaptation to the prosthesis brings happiness and success in treatment. According to the literature, orthopaedists prefer to perform hip replacement surgery on THA (16). Another important result of this study is that the mobility level is related to joint awareness. From a clinical perspective, any application that will

increase the patient's mobility level after arthroplasty facilitates the adaptation process to the prosthesis. It increases the patient's adaptation and, therefore, satisfaction. It is extremely important to motivate the patient to be physically active and rehabilitate after arthroplasty. Joint position sense was not found to be a factor affecting joint awareness. The reason of this fact that, the patients included in the study were in the chronic phase. A rapid recovery is achieved in patients who complete the sixth week after surgery. Re-establishment of intra-articular negative pressure and the recovery of the muscles provides joint stabilization. It has been proven in the literature that patients in the chronic period have more advantages than individuals with osteoarthritis or those with arthroplasty in the acute phase in mobility, function, pain, and other areas. Joint position sense and joint awareness are not related is evidence of recovery for patients in the chronic phase. The fact that age is one of the most crucial factors affecting joint awareness is a very striking issue and needs to be investigated. This result shows that it is more difficult for young individuals to adapt to the arthroplasty than older individuals. The reasons for this may be higher expectations, physical fitness level, and prosthesis-related depression in young individuals, but more research with wider age ranges is needed on these topics. Hip replacement surgeries are mostly performed on young individuals, which has limited the studies in this field. In fact, a very wide age range was not studied in our study (17).

THA involves the sacrifice of the joint capsule and its mechanoreceptors. However, studies have also shown that the sensory and proprioceptive role of the joint capsule is compensated by the activity of muscle mechanoreceptors. After undergoing THA, patients who forget about their artificial joint during everyday life tend to report higher satisfaction and functional participation. Therefore, mobility and joint awareness are in a mutual relationship in hip arthroplasty patients. An individual adapted to his artificial joint may be more mobile. Another thought is that the physical fitness level of the patient with high mobility will be better, thus joint awareness will also be positively affected. Studies in the literature have found a relationship between functional scales and joint awareness. Since functional outcome scales are commonly used after hip arthroplasty surgery, there are fewer publications on mobility in the literature. Although functional results and mobility level seem to be similar, mobility is a more comprehensive concept.

Pain was found to be a major factor influencing joint awareness, as patients with higher levels of pain tended to have a lower sense of joint awareness. Studies in the literature support these results (1, 15, 18). Previous studies have reported that pain sensation is associated with proprioception and that it reduces receptor

sensitivity and impairs efferent sensory input (19).

When the studies on mobility are examined, there are studies reporting that the ability to forget the artificial joint and mobility develop according to osteoarthritis after both knee and THA surgery (20, 21). The time passed over arthroplasty is directly proportional to the improvement in the perception of artificial joints. In the literature, randomized controlled research was shown that no difference in joint awareness after total knee arthroplasty which have different types of fixations (22). In patients with advanced osteoarthritis, the attachment surface is impaired and there is no accurate sensory input. It has been reported that in advanced osteoarthritis, intra-articular oedema, pain, cartilage erosion, ligament damage, immobility and many other factors impair movement perception in patients with osteoarthritis. The artificial joint not only offers a solution to the impaired function, but also corrects motion perception and sensory input.

Studies in the literature show that; The patient's happiness and success in activities of daily living are related to the ability to forget the artificial joint (23). It is not a generalizable result that patients with a higher body mass index have better adaptation to the artificial joint. First, the patient's daily living activities may be limited or may cause severe pain before arthroplasty. It has been proven in the literature that a high body mass index is a condition that worsens the prognosis of osteoarthritis.

Patients who completed the acute period (6 weeks post-op) were included in the study. The wide interval between the post-operative period has created an advantage in terms of evaluating whether the post-operative period influences adaptation to the joint (joint awareness). In fact, it was observed that the post-operative period was not related to the ability to adapt to the joint. We can say that the patient has adapted to a joint that has gone through the acute phase, has created intra-articular negative pressure, and has overcome the inflammatory processes such as pain and oedema. Different results may occur in the acute phase or in more problematic surgeries, such as revision surgery. However, if we talk about the chronic period, we can say that the physiological improvement in the joint facilitates adaptation.

Limitations and strengths

The study would have been much more valuable if the preoperative and acute period evaluation results of the patients included in the study could have been followed. However, the subject of the study is current, and the results are thought to be interesting. Many surgical techniques can be used in hip surgery (anterior/anterolateral approach). Since the muscle group incised in the posterior surgical intervention used in the study was different from the muscle groups incised in other interventions, the results of the study can only

be stated for patients who underwent the posterior approach. This is a limitation. Joint awareness is a topic that has been talked about for the last 10 years and whose importance is increasing day by day. This study is original in terms of the idea it examines. In future studies, a comparative examination of the joint awareness of hip prosthesis patients in the acute-subacute and chronic periods will contribute to science.

CONCLUSION

After THA, age, mobility, pain and BMI are factors that interact with joint awareness. It is easier for older patients to adapt to arthroplasty. Considering the healing process that occurs in the joint, joint position sense is no longer a factor affecting joint awareness for a patient in the chronic period.

Ethics Committee Approval: Ethic Approval: Ethics committee approval was received for this study from Tarsus University Non-Invasive Clinical Research Ethics Committee. (Decision number: 2022/07, Date: 10.05.2022).

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