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Improvement and prognosis of anxiety and depression after total knee arthroplasty

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This study aims to analyze the improvement and prognosis of anxiety and depression in patients with knee osteoarthritis after total knee arthroplasty. A retrospective questionnaire survey was conducted on 180 patients with knee osteoarthritis who underwent total knee arthroplasty. The questionnaire consisted of a general information questionnaire, the Zung Self-Rating Anxiety Scale (SAS) for anxiety, the Zung Self-Rating Depression Scale (SDS) for depression, the Visual Analog Scale (VAS), the Pittsburgh sleep quality Index (PSQI), and the American Knee Society Scores (AKSS). The same questionnaires were administered preoperatively and at 3, 6 and 12 months postoperatively, and the results were statistically analyzed. The prevalence of anxiety in preoperative knee osteoarthritis patients was 29.2% and the prevalence of depression was 37.5%. At 3, 6, and 12 months after total knee arthroplasty, anxiety and depression, pain levels, sleep disturbances, and functional status of the knee were significantly improved in patients with knee osteoarthritis compared with the preoperative period (all P<0.05). Patients with knee osteoarthritis have significant anxiety and depression before surgery, and total knee arthroplasty can significantly improve their anxiety, depression and prognosis, and should be performed as early as possible in patients with knee osteoarthritis.

Keywords: Knee osteoarthritis, anxiety, depression, total knee arthroplasty.

INTRODUCTION

Knee Osteoarthritis (KOA) is mainly characterized by chronic pain and limited activity of the knee joint, which may lead to joint stiffness and deformity in severe cases, and seriously affect the daily life of patients. Chronic pain, depression and anxiety usually occur together. In orthopedic clinics or rheumatology clinics, the prevalence rates of depression and anxiety symptoms ranged from 21% to 89%[1,2]. individuals with chronic pain are twice as likely to suffer from depression or anxiety disorders[2]. Besides, combined symptoms such as sleep problems and physical pain will increase the occurrence of negative emotions such as anxiety and depression[3]. Recent studies have shown that anxiety and depression have a negative role on hip and knee arthroplasty[4]. For end-stage KOA, the main radical treatment is total knee arthroplasty (TKA)[5]. Hence, the present study aimed to clarify the prevalence of depression and anxiety symptoms among KOA patients. The secondary aim was to examine the effect of these symptoms on preoperative sleep quality, pain and daily functions, and study the association between patients ' characteristics and preoperative symptoms of depression and anxiety. Finally, to explore whether improvement in depressive and anxiety symptoms could be due to improved outcomes at 3, 6 and 12 months after surgery.

MATERIALS AND METHODS

Inclusion and exclusion criteria

The research was structured according to the PICO(S) framework: (i) Participants (P): Individuals aged 60 years or older with a confirmed diagnosis of osteoarthritis, evaluate through radiographic imaging and clinical examination, and who showed no effect on conservative treatment for at least six months; (ii) Intervention (I): From January 2019 to January 2021, outstanding surgeons performed total knee arthroplasty (TKA) and well experienced medical teams provided rehabilitation training and discharge guidance; (iii) Comparison (C): Physicians evaluate patients' depression, anxiety, and clinical status

before and after surgery; (iv) Outcomes (O): Improve patients' outcomes related to depression, anxiety, and overall clinical condition; (v) Study protocol (S): A retrospective cohort study featuring a substantial sample size.

The exclusion criteria comprise: (i) patients unable to comprehend or respond to the questionnaire survey due to cognitive impairment.; (ii) Patients who received psychiatric treatment before visiting our orthopedic clinic; (iii) Inflammatory knee arthritis; (iv) Patients whose knee pain originated from conditions in other body regions, such as lumbar or hip disease; (v)Individuals with a history of prior knee surgery. All participants provided written informed consent.

Participants

Zung Self-Rating Depression Scale (SDS)Initially, 223 patients were assessed for eligibility. However, several were excluded from the study: 12 declined to participate, 7 had undergone prior knee surgery, and 24 had follow-up periods shorter than 12 months. Ultimately, data were gathered from 180 patients, comprising 78 men and 102 women, with 81 left knees and 99 right knees involved. The average age of the patients at the time of surgery was 65.3 ± 9.8 years, and the mean BMI was 27.1 ± 3.2 kg/m². Regarding demographics, 22.2% of the patients reported having a high school education or lower, 83.3% were covered by public insurance, and 17.5% lived alone. The average duration of symptoms prior to surgery was 27.0 ± 8.8 months.

Survey tools

Zung Self-Rating Depression Scale (SDS)[6]

The Zung Self-Rating Depression Scale (SDS) was employed to evaluate depressive symptoms before and after operative[6]. It can systematically reveal the short-term/long-term effects of surgery on patients' mental health, providing evidence-based support for developing psychological intervention strategies. The scale consists of 20 items, with each item scored on a 4-point Likert scale ranging from 1 (seldom, very little time, rarely) to 4 (almost always). The raw score, which can range from 20 to 80 points, is then adjusted by multiplying it by a factor of 1.25 to obtain the final score. The severity of depression is categorized as follows: total scores between 70 and 100 indicate severe depression, 60 to 69 indicate moderate depression, 50 to 59 indicate mild depression, and 25 to 49 fall within the normal range[6].

Zung Self-Rating Anxiety Scale (SAS)[7]

The Zung Self Rating Anxiety Scale (SAS) is a classic psychological assessment tool developed by Chinese scholar William W.K. Zung in 1971 to quantify an individual's subjective experience and severity of anxiety symptoms[7]. The SAS scale consists of 20 items, each rated on a 4-point scale: 1 point represents rarely or seldom, 2 points represents occasionally or sometimes, 3 points represents mostly or frequently, and 4 points represents almost always.The original total score of SAS rating ranges from 20 to 80 points, and the final score is converted to 100 points[7]. The interpretation of the total score is as follows: 70-100 points indicates severe anxiety; 60-69 points indicates moderate anxiety; 50-59 points indicates mild anxiety; and 25-49 points falls within the normal range[7].

Pittsburgh sleep quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) was a widely adopted tool for assessing sleep quality., which is suitable for assessing sleep quality in patients with sleep disorders, mental disorders, and the general population. This self-report questionnaire evaluates the patient's sleep quality over the past month and reflects their sleep status in the past month. The PSQI includes 19 self-assessment questions, which divided into seven parts: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, sleep medication use, and daytime dysfunction[8]. The total score of PAQI is 21 points, divided into 7 items, and each item is scored according to the scoring criteria of 0, 1, 2, and 3. Higher scores reflect poorer sleep quality. A threshold score of 5 or higher was applied to identify participants with poor overall sleep quality[8].

The Visual Analog Scale (VAS)[9]

The Visual Analog Scale (VAS) score range is from 0 to 10. 0 represents no pain, 1, 2, 3 points represent mild pain, 4, 5, 6 points represent moderate pain, and 7, 8, 9, 10 points represent severe pain. VAS is widely used in clinical practice to measure the intensity of pain in patients.

The American Knee Society Scores (AKSS)

The AKSS is a surgeon-assessed score developed by the consensus of the Knee Society. It is mainly used to evaluate the functional condition of patients before and after undergoing TKA. It consists of 2 parts, the Knee score and the Functional score. The Knee score assesses pain, stability, and range of motion and deducts flexion contracture, extension lag, and malalignment.

The maximum score of 100 is attributed to a painless, well-aligned knee with 125° of range of motion and no anteroposterior and mediolateral instability. The Functional score assesses the walking distance and stair climbing and deducts the use of a walking stick or crutches. The maximum score of 100 is assigned to individuals who can walk unlimited distances and go up and down stairs normally[10].

Survey methods

The questionnaire survey method was adopted. After admission, the investigators first explained the purpose and method of the survey to the patients, and promised to keep all the information provided by the patients confidential. After obtaining the informed consent form of the patient, the patient fills in the questionnaire independently, which consists of SAS, SDS, VAS, PSQI and AKSS scales. The same questionnaire was used for follow-up evaluation at 3, 6 and 12 months after operation. A total of 223 patients were investigated, and 180 valid questionnaires were recovered, with the recovery rate of 80.72%.

Statistical analysis

Statistical analysis was conducted using SPSS software (Version 23.0; IBM SPSS, Chicago, Illinois, USA). The general characteristics are reported as mean ± standard deviation ($\bar{x}\pm s$). Data collected at baseline, 3, 6, and 12 months were analyzed using repeated measures. Specifically, the changes from baseline to 3 months, from 3 months to 6 months, and from 6 months to 12 months were evaluated, and the impact of these changes on the results was statistically analyzed[11].

T-test be used to evaluate the changes in these variables for normally distributed data, some data for anxiety, depression, sleep disturbance, VAS, and AKSS scores exhibited non-normal distribution, the Wilcoxon signed-rank test was utilized to assess the changes in these variables. A linear logistic regression analysis was conducted to identify the characteristics associated with preoperative anxiety or depression symptoms in patients, as well as to evaluate the influence of changes in anxiety or depression on subsequent clinical outcomes. Statistical significance was set at a p-value threshold of < 0.05.

RESULTS

General results

The operation was successful in all 180 cases. The mean operation time was 68.3±8.4 min. No wound infection was found. The mean hospital length of stay was 3.8±1.2 days.

Table I. — Overall preoperative and during 3, 6 and 12 months postoperatively change outcomes (N=180 patients)#.

Variable	Preoperative	3 months	6 months	12 months
SDS	36.29±14.15	32.97±12.27a	29.91±9.46ab	28.83±8.51abc
SAS	37.25±14.66	32.96±10.03a	29.61±9.28ab	29.08±8.34abc
PSQI	6.44±2.39	5.65±2.38a	4.53±1.6ab	4.3±1.3abc
VAS	5.33±2.65	3.27±2.17a	2.06±1.22ab	1.5±1.2abc
AKSS	57.11±3.76	85.53±4.03a	87.02±3.29ab	90.22±3.42abc

Abbreviations: SDS, Zung Self-Rating Depression Scale; SAS, Zung Self-Rating Anxiety Scale; PSQI, Pittsburgh Sleep Quality Index; VAS, Visual Analogue Scale; AKSS: The American Knee Society Scores. (aP<0.05 vs preoperative. bP<0.05 vs postoperative 3 months. cP<0.05 vs postoperative 6 months.) Values are mean±standard deviation(range). #The Wilcoxon matched-pairs signed rank test.

Table II. — Pearson correlation between anxiety and depression improvement and clinical outcome score changes in 180 patients 3 months after the TKA aP<0.001.

Variable	SDS	SAS	PSQI	VAS	AKSS
SDS	1	0.79a	0.379a	0.641a	0.358a
SAS	0.79a	1	0.478a	0.654a	0.338a
PSQI	0.379a	0.478a	1	0.428a	0.069
VAS	0.641a	0.651a	0.428a	1	0.422a
AKSS	0.358a	0.338a	0.069	0.422a	1

Table III. — Pearson correlation between anxiety and depression improvement and clinical outcome score changes in 180 patients 6 months after the TKA aP<0.001.

Variable	SDS	SAS	PSQI	VAS	AKSS
SDS	1	0.877a	0.845a	0.877a	-0.695a
SAS	0.877a	1	0.909a	0.894a	-0.744a
PSQI	0.845a	0.909a	1	0.903a	-0.715a
VAS	0.877a	0.894a	0.903a	1	-0.741a
AKSS	-0.695a	-0.744a	-0.715a	-0.741a	1

Table IV. — Pearson correlation between anxiety and depression improvement and clinical outcome score changes in 180 patients 12 months after the TKA aP<0.001.

Variable	SDS	SAS	PSQI	VAS	AKSS
SDS	1	0.944a	0.922a	0.896a	-0.541a
SAS	0.944a	1	0.949a	0.889a	-0.536a
PSQI	0.922a	0.949a	1	0.943a	-0.585a
VAS	0.896a	0.889a	0.943a	1	-0.519a
AKSS	-0.541a	-0.536a	-0.585a	-0.519a	1

Improvement in Anxiety, Depression and Change in Clinical Outcome Scores in Patients with KOA (depicting results based on tabular data)

The changes in anxiety, depression, and clinical outcome scores (VAS, PSQI, and AKSS) among postoperative TKA patients were evaluated using the Wilcoxon signed-rank test. Comparing the scores at 3, 6, and 12 months postoperatively with the preoperative scores, significant reductions were observed in patients' SAS, SDS, VAS, and PSQI scores ($P < 0.001$), while the AKSS scores showed a significant increase ($P < 0.001$). These findings indicate a significant alleviation in postoperative anxiety, depression, pain levels, and sleep disturbances, as well as a notable improvement in knee joint function among the patients. Please refer to Table I for further details.

Among the 180 patients, 45 (37.5%) had depression, defined as SDS depression score of 50 or more. Regarding anxiety symptoms, as indicated by the SAS score, 35 (29.2%) of patients scored 50 or more. In total, 20 (11.11%) of patients have some level of both depression and anxiety.

The mean SDS and SAS scores significantly decreased from 38.3±17.2 points preoperatively to 34.7±12.5, 29.8±9.0, 28.5±8.0 and 27.6±5.7 points at 3,6 and12 months, respectively, after surgery, for SDS; and from 39.0±14.6 points preoperatively to 32.4±10.2,30.3±9.6,28.6±8.2, and 27.1±4.2 at 3,6,12 and 24 months, respectively, for SAS ($P<0.05$ for both, Table I).

Relationship between improvement in anxiety and depression and changes in clinical outcome scores in patients with KOA

Improvement in postoperative anxiety and depression in KOA patients was positively correlated with changes in VAS and PSQ scores ($p < 0.05$) and negatively correlated with changes in AKSS scores. See Tables II, III, and IV.

The relationship between the improvement in postoperative depression and anxiety among KOA patients and the changes in clinical outcome scores was further examined using a linear regression model. The changes in clinical outcome scores (VAS, PSQI, and AOFAS scores) were considered as dependent variables, while the changes in depression and anxiety scores among KOA patients were treated as

Table V. — Linear regression analysis of anxiety and depression improvement and clinical outcome scores in 180 KOA patients 12 months after the TKA.

Variable	PAQI				VAS				AKSS			
	β	t	P	95%CI	β	t	P	95%CI	β	t	P	95%CI
SDS	0.246	3.551	<.001	0.032-0.113	0.519	5.406	<.001	0.104-0.223	-0.321	-1.689	0.093	-0.067-0.005
SAS	0.716	10.317	<.001	0.157-0.232	0.4	4.161	<.001	0.061-0.170	-0.233	-1.225	0.222	-0.054-0.013

independent variables in the linear regression model.

The results revealed that the improvement in depression and anxiety symptoms from preoperative to 12 months postoperative were positively associated with the severity of pain and sleep quality ($P < 0.05$). Specifically, for every 1-point improvement (reduction) in SDS/SAS scores, there was an improvement (reduction) of 0.246/0.716 in PSQI scores, 0.519/0.4 in VAS scores, and 0.14/0.15 in PSQI scores. These findings indicate that the improvement in depression and anxiety symptoms had a positive impact on the reduction of pain severity, enhancement of sleep quality, and improvement in perceived pain levels as measured by the VAS and PSQI scores.

Please refer to Table V for specific details related to these associations.

DISCUSSION

Analysis of Anxiety and Depression in Patients with Knee Osteoarthritis

Recent studies have indicated that depression and anxiety are associated with persistent pain and decreased patient satisfaction following TKA. This study aims to assess the prevalence of depression and anxiety symptoms in KOA patients and evaluate the impact of these symptoms on pain and functional scores. Lastly, the study aims to evaluate the effect of improvement in depression and anxiety symptoms on postoperative pain, functional outcomes, and patient satisfaction.

In our study, many patients exhibited symptoms of depression and anxiety prior to surgery. Among the 180 KOA patients included in this study, the prevalence of anxiety was found to be 29.2%, while the prevalence of depression was 37.5%, indicating a high occurrence of anxiety and depression in KOA patients. Previous research has also reported varying rates of anxiety and depression in KOA patients, ranging from 21% to 89%, which aligns with the findings of our study. Additionally, the coexistence of anxiety and depression at a certain level was observed in 11.11% of the patients, indicating that some patients experienced both anxiety and depression simultaneously. It is common for patients with anxiety to also experience symptoms of depression, and vice versa. Symptoms such as poor sleep quality and lack of concentration are often shared between anxiety and depression.

In this study, it was found that patients experiencing severe pain with symptoms of depression or anxiety had lower levels of physical and social functioning and poor sleep quality compared to patients without such symptoms. Furthermore, as the scores on the Self-Rating Depression Scale (SDS) and Self-Rating Anxiety Scale (SAS) increased, the severity of pain and sleep disturbances also increased, and the levels of physical and social functioning decreased. In this study, we assessed the correlation between preoperative depression and anxiety symptoms and patient characteristics and found that the duration of symptoms was associated with preoperative depression.

Therefore, our findings, along with those of previous research, highlight the high prevalence of depression and anxiety in KOA patients and the significance of diagnosing and addressing these symptoms prior to surgery. Healthcare professionals should pay attention to mood changes in KOA patients before surgery and take necessary intervention measures to prevent or alleviate negative emotions in order to promote patients' mental well-being.

Improvement of Anxiety and Depression in KOA Patients after Total Knee Arthroplasty

This study found that KOA patients experienced significant improvement in anxiety and depression symptoms at 3 months, 6 months, and 12 months after TKA. Concurrently, there was a significant improvement in pain levels, sleep quality, and knee joint function.

An international study identified that patients with a duration of pain exceeding 6 months were more than four times more likely to experience depressive symptoms compared to pain-free individuals. In other words, the longer the duration of KOA, the higher the probability of developing psychological issues. This study discovered that TKA effectively alleviated chronic pain and psychological problems in KOA patients.

This study found that patients with depression or anxiety symptoms showed significantly greater improvement in pain levels, sleep quality, and knee joint function at preoperative, 3 months, 6 months, and 12 months postoperative compared to patients without depression or anxiety symptoms. TKA was found to effectively alleviate chronic pain and psychological issues in KOA patients, highlighting the importance of early surgical treatment.

To explore the temporal relationship between the improvement of depression and anxiety symptoms and patient-reported outcomes, regression models were used to analyze depression and anxiety symptoms. It was found that the changes in depression and anxiety

symptoms from preoperative to 12 months postoperative were closely associated with sleep disorders and severity of pain, emphasizing the intimate relationship between depression, anxiety, and pain severity.

The study also indicated a relationship between anxiety, depression, postoperative pain, and clinical outcomes following TKA. The findings of this study revealed that over time after the surgery, the improvement in anxiety and depression symptoms among KOA patients had a positive correlation with pain levels and sleep quality. In other words, the alleviation of anxiety and depression in KOA patients contributed to the relief of pain and sleep disturbances. However, there was no significant correlation between the improvement of anxiety and depression and the functional status of the knee joint after TKA.

This study has the following limitations: Firstly, the sample size of this study was small, thus it is necessary to replicate the study with a larger dataset to enhance reliability. Secondly, although the questionnaires used in this study underwent appropriate reliability and validity tests and have been widely used, they were self-administered by the patients. Patients' subjective perceptions may lead them to consider their symptoms to be more severe than they actually are. Future studies can incorporate objective clinical measures to improve the objectivity of the research.

In summary, anxiety and depression symptoms are prevalent among KOA patients, and psychological issues deserve attention from healthcare professionals and patients' families. It is important to emphasize the assessment and treatment of anxiety and depression in KOA patients, ensuring that patients receive maximum postoperative benefits to improve pain levels, sleep disturbances, and knee joint function, thereby enhancing patients' quality of life.

CONCLUSION

According to our results, Patients with knee osteoarthritis have significant anxiety and depression before surgery, and total knee arthroplasty can significantly improve their anxiety, depression and prognosis, and should be performed as early as possible in patients with knee osteoarthritis.

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