# The relationship of pain severity with anxiety, depression, somatic symptoms, personality, and alexithymia in the early period after total knee arthroplasty

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## ABSTRACT

**Objectives:** This study aims to investigate the relationship between pain severity in the early postoperative period and preoperative psychometric factors in individuals undergoing total knee arthroplasty (TKA).
**Methods:** This research was designed as a cross-sectional and descriptive study. Fifty participants undergoing TKA were inpatients at a private hospital's Orthopedics and Traumatology Clinic were included in the study. The same anesthesia protocol (spinal anesthesia) and the same surgical technique were performed on all patients. In data collection, Visual Analogue Scale (VAS), Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Somatic Amplification Scale (SAS), Toronto Alexithymia Scale (TAS), Eysenck Personality Questionnaire Revised-Abbreviated (EPQR-A), and Sociodemographic Data Form were used.
**Results:** The mean age of the participants in the study was $64.80 \pm 8.70$ years, and 45 of the cases (90.0%) were women. Considering the Single Factor ANOVA Analysis, only psychoticism subscale scores were observed to be statistically significant in the change in VAS-Static scores. When all psychometric properties were controlled, the significant change in VAS-Dynamic scores was shown to continue at low effect.
**Conclusions:** According to these findings, the psychoticism dimension was concluded to be more associated with an antisocial personality disorder or aggressive patients, and the high level of pain in these patients may be related to low levels of serotonin and cortisol from a neurobiological point of view.
**Keywords:** Knee arthroplasty, pain, depression, anxiety, alexithymia, personality, somatic symptoms

Total knee arthroplasty is one of the most commonly performed orthopedic surgical procedures today; however, postoperative pain control is still one of the most significant issues [1]. Although postoperative pain occurs in all operated patients, it cannot be of the same severity in all. Whether there are individual psychological factors underlying different postoperative pain levels in patients undergoing the same surgical procedure by the same surgeon seems to be an issue that should be investigated.

According to the International Association for the Study of Pain (IASP), acute pain is a sensory and emotional experience that occurs with tissue damage [2]. Chronic pain is defined as pain that lasts longer than

3-6 months. Pain seen in psychiatric disorders is chronic pain. Autonomic physiological arousal, activation of proinflammatory processes, and the stress response of the hypothalamic-pituitary-adrenal system play a crucial role in pain occurring in somatoform disorders and depression [3]. This leads to increased sensation of existing pain or increased sensitivity to somatic sensation [4].

The relationship between postoperative pain severity and preoperative psychological factors has been studied in the literature, and conflicting results have been obtained. Some studies indicate that approximately 25% of patients undergoing total joint arthroplasty experience psychological symptoms in the pre-operative period [5].

Although the relationship between preoperative anxiety and depression symptoms and the pain was insufficient in one study, other studies found a significant relationship between anxiety, depression symptoms, and postoperative pain, which has been proven in different surgical disciplines [6, 7].

Alexithymia is defined as the inability to identify one's own and other people's emotions and has been reported to increase pain sensitivity [8]. It has also been associated with somatization, depression, and anxiety [9]. Recent studies have revealed new data that patients' personality traits may be associated with postoperative pain severity [10]. In the current study, we have tried to find an answer to the question of why the severity of pain in the early postoperative period is different, although the same surgical technique and the same anesthesia method were performed by the same physician. In this study, the hypothesis that preoperative psychological factors play an significant role in the prediction of early postoperative severe pain in patients undergoing total knee arthroplasty was tested. We think that severe post-operative pain can be predicted by determining the psychometric risk factors before the operation and can be improved with an individual-specific treatment approach.

## METHODS

This study is a prospective clinical study. Fifty participants fulfilling the study criteria and undergoing total knee arthroplasty as inpatients at the Orthopedics and Traumatology Clinic of a private hospital were in-cluded in the study. As a result of orthopedic examination and knee radiographic imaging of the participants, patients diagnosed with primary osteoarthritis and advanced stage gonarthrosis, having surgical intervention indication, being over 18 years old, being literate, signing the consent form to participate in the study, and undergoing TKA under spinal anesthesia were included. Patients, having mental retardation, neurological disease history, severe mental disorder, acute or chronic pain situations, more than 20 degrees flexion contractures before surgery, less than 90 degrees knee flexion and more than 20 degrees varus alignments, secondary osteoarthritis, inflammatory arthritis, and patients in whom spinal anesthesia is not performed were excluded from the study. Patients with epidural catheters or general anesthesia, a history of uncontrolled diabetes, a history of deep vein thrombosis or severe venous insufficiency, chronic polyneuropathies in the lower extremities or neurologic deficits, undergoing peripheral nerve block for pain control, and receiving intravenous or epidural patient-controlled analgesia were also in the exclusion group. The same anesthesia protocol (spinal anesthesia) was managed, and a standard medial parapatellar arthrotomy was performed followed by arthroplasty using the same prosthesis with a fixed insert cutting the posterior cruciate ligament for all patients. The patella was not changed in any patient. The periarticular modified Ranawat cocktail was given to all patients during surgery. After coming patients out of anesthesia, all were mobilized and early rehabilitation was started. IV Paracetamol 1gr (three times per day) was administered in routine analgesia. At the 2nd, 4th, 8th, 12th, 24th, and 48th hours after the operation, the pain intensity of patients was evaluated by the service nurse using the Visual Pain Scale (VAS), during rest (static) and while exercising (dynamic) managed by the healthcare personnel. 1mg/kg pethidine was added to routine treatment in patients with VAS > 5. The narcotic analgesic needs of the them were also recorded.

Our study was approved by the local ethics committee on July 7th, 2021 with the number 2011-KAEK-25 2021/07-17.

### Assessment Tools

Psychometric questionnaires were conducted on the participants in the preoperative period. The Visual Analogue Scale (VAS) was used to measure the pain

intensity of the participants. The psychometric characteristics of the participants were evaluated with the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), The Somatosensory Amplification Scale (SAS), Toronto Alexithymia Scale (TAS), and Eysenck Personality Questionnaire Revised-Abbreviated (EPQR-A). The sociodemographic characteristics of the participants were determined using the Sociodemographic Data Form prepared by the authors.

### Beck Depression Inventory (BDI)

It was developed by Beck *et al*. [11]. in 1988 to measure the risk and severity of depression in individuals. BDI is a self-reporting scale consisting of twenty-one Likert-type questions, in which each question is scored between 0-3. The total score of BDI is between 0-63. As the scores increase, the severity of depression increases. The Cronbach alpha value of the scale is 0.86. The validity and reliability study in our country was conducted by Hisli in 1988 [12].

### Beck Anxiety Inventory (BAI)

BAI was developed to measure the presence and severity of anxiety in individuals. BAI is a self-reporting scale consisting of twenty-one Likert-type questions, and each question is scored between 0-3. The total score of BAI is between 0-63. The Cronbach's alpha value for BAI was specified as 0.93. As the scores increase, the severity of anxiety also increases. The validity and reliability study in our country was conducted by Ulusoy *et al*. [13].

### The Somatosensory Amplification Scale (SAS)

To measure an individual's sensitivity to somatic sensation, it was developed by Barsky *et al*. [14]. This scale aims to measure the tendency of the individual to amplify the physical symptoms noticed in his/her body. The scale, a five-point Likert-type scale with 10 items, questioned somatic sensations, not indicating a particular disease. The amplification score is obtained by summing the score for each item and there is no cutoff score. The Turkish reliability study was performed by Güleç *et al*. [15].

### Toronto Alexithymia Scale (TAS-20)

It was developed by Bagby *et al*. [16,17]. in 1994 to evaluate alexithymia characteristics in individuals.

The questions of the 20-item Likert-type self-report questionnaire, are scored between 1-5. An increase in the scores obtained from the scale means that the level of alexithymia also increases. The validity and reliability study of the scale in Turkey was carried out by Güleç *et al*. [18]. The total scale Cronbach's alpha value was found to be 0.78, and the subscales were between 0.57 and 0.80.

### Visual Analogue Scale (VAS)

To determine the severity of pain in patients, it was developed by Price *et al*. [19]. The test is easy to perform. The patient is asked to mark the point corresponding to the pain on a 10 cm long line. With this scale, the numerical equivalent of pain is determined. It is a reliable test performed all over the world.

### Eysenck Personality Questionnaire Revised-Abbreviated (EPQR-A)

It is one of the scales developed to measure personality traits and was developed by Eysenck [20]. Following the personality theory created by Eysenck [20], the scale evaluating the characteristics within the scope of the theory was revised by Francis *et al*. [21], reduced to 24 items, and named Eysenck Personality Inventory-Revised Abbreviated Form. The Turkish validity and reliability study was performed by Karancı *et al*. [22]. The scale consists of 4 sub-dimensions: extraversion, psychoticism, neuroticism, and lie. Each sub-dimension consists of 6 items and a maximum of 6 points can be obtained from each sub-dimension.

### Sociodemographic Data Form

The form was created by the researchers to evaluate sociodemographic characteristics such as age, gender, education level, marital status, employment and social status, and clinical characteristics such as pain regions and duration of pain.

### Statistical Analysis

Demographic and clinical characteristics of the cases participating in the study were evaluated with descriptive statistical methods such as number, percentage, mean, and standard deviation. The change in VAS scores was analyzed by Single Factor ANOVA Analysis for Repeated Measures. Besides, the results of the Greenhouse Geisser Analysis were used in the

study by the reason of the unequal change between VAS score measurements (Static and Dynamic). The effect of EPQR-A, TAS, BDI, and BAI scores on the change in VAS scores was analyzed using ANOVA Analysis. The significance level for all analyzes was determined as $p < 0.05$. The hypothesis for normal distribution was confirmed in the Single Factor ANOVA Analysis for Repeated Measures. The conformity of the data to the normal distribution was evaluated considering the kurtosis and skewness coefficients ($\pm 1.5$). IBM SPSS 22.0 program was used for the analysis.

## RESULTS

### Sociodemographic Characteristics
The mean age of the cases evaluated in the study was 64.80±8.70 years, and 45 cases (90.0%) were women. Forty-four (88.0%) of the cases were primary school graduates, 4 (8.0%) secondary school, and 2 (4.0%) high school graduates. Of the cases, 2 (4.0%) were single, 39 (78.0%) were married, and 9 (18.0%) were divorced. Of the cases, 47 (94.0%) were not working, 11 (22.0%) had a low monthly income, 33 (66.0%)

**Table 1.** Sociodemographic characteristics of the participants

| | | |
|---|---|---|
| **Gender, n (%)** | **Female** | **45 (90.0)** |
| | **Male** | **5 (10.0)** |
| **Education Level, n (%)** | **Primary school graduate** | **44 (88.0)** |
| | **Secondary school graduate** | **4 (8.0)** |
| | **High-school graduate** | **2 (4.0)** |
| | **University graduate** | **0 (0.0)** |
| **Marital status, n (%)** | **Single** | **2 (4.0)** |
| | **Married** | **39 (78.0)** |
| | **Divorced** | **9 (18.0)** |
| **Employment status, n (%)** | **Employee** | **3 (6.0)** |
| | **Nonemployee/student** | **47 (94.0)** |
| **Monthly Income, n (%)** | **Low** | **11 (11.0)** |
| | **Medium** | **33 (66.0)** |
| | **Good** | **6 (12.0)** |
| | **High** | **0 (0.0)** |
| **Place of residence, n (%)** | **City Center** | **24 (48.0)** |
| | **District Center** | **22 (44.0)** |
| | **Village Center** | **4 (8.0)** |
| **Habits, n (%)** | **No** | **47 (94.0)** |
| | **Smoking** | **1 (2.0)** |
| | **Alcohol consumption** | **0 (0.0)** |
| | **Substance-use** | **0 (0.0)** |
| | **Narcotic analgesic** | **1 (2.0)** |
| | **Smoking +alcohol consumption** | **1 (2.0)** |
| **Analgesic consumption, n (%)** | **No** | **50 (100.0)** |
| | **Yes** | **0 (0.0)** |
| **BMI (kg/m$^2$) (mean $\pm$ SD)** | | **33.97±6.00** |
| **Duration of the joint disorder (days) (mean $\pm$ SD)** | | **8.56 $\pm$ 5.12** |

BMI = Body mass index.
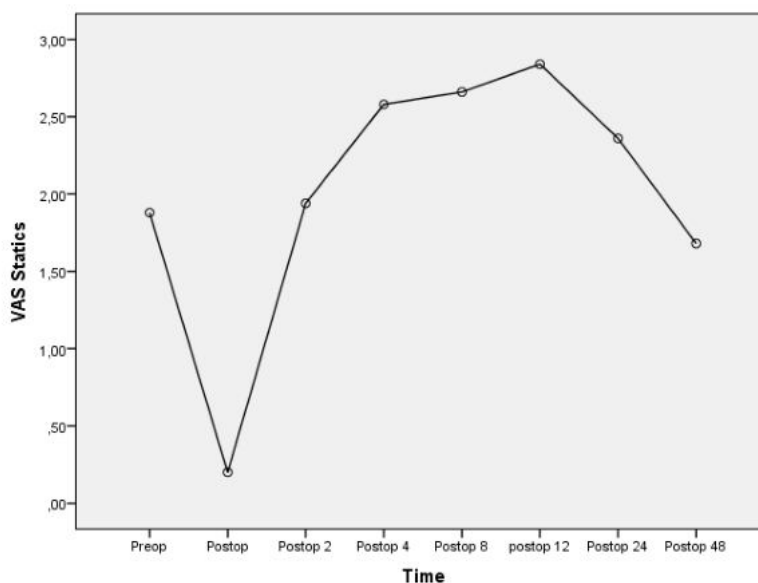
**Fig. 1.** The change in VAS-Static scores. (VAS = Visual Analogue Scale, Preop = Preoperative, Postop = Postoperative, F = 40.40, p < 0.001, η2 = 0.45).

had a medium income, 6 (12.0%) had a good income. Twenty-four (48.0%) of them were living in the city center, 22 (44.0%) in the district center, and 4 (8.0%) in the village center. Besides, 1 (2.0%) was a smoker, and 1 (2.0%) stated to use cigarettes and alcohol. Twenty-seven (54.0%) of the participants evaluated in the study were determined to have comorbidities, the mean BMI for all was 33.97 ± 6.00, and the mean duration of joint disease was 8.56 ± 5.12 years. The sociodemographic characteristics of the patients were summarized in Table 1.

*Clinical Characteristics*

Results Related to VAS Scores: Considering the Single-Factor ANOVA Analysis for Repeated Measures, the VAS-Static score means were found to show a statistically significant change (F = 40.40, $p < 0.001$) (Fig. 1) (Table 2).

According to the Single-Factor ANOVA Analysis for Repeated Measures, the scores of Extraversion (F = 0.28, $p = 0.962$), Lie (F = 0.41, $p = 0.896$), Neuroticism (F = 0.76, $p = 0.622$), Psychoticism (F = 1.32, $p = 0.242$), TAS (F = 1.45, $p = 0.182$), BDI (F = 1.15, $p$

**Table 2.** The efficiency of psychometric properties in the change in VAS-Static scores

|  | F | p value | η2 |
|---|---|---|---|
| Extraversion | 0.28 | 0.962 | 0.007 |
| Lie | 0.41 | 0.896 | 0.010 |
| Neuroticism | 0.76 | 0.622 | 0.018 |
| Psychoticism | 1.32 | 0.242 | 0.031 |
| TAS | 1.45 | 0.182 | 0.034 |
| BDI | 1.15 | 0.332 | 0.027 |
| BAI | 0.72 | 0.658 | 0.017 |
| SAS | 0.79 | 0.599 | 0.019 |
| Duration of the joint disorder | 1.66 | 0.119 | 0.039 |

VAS = Visual Analogue Scale, TAS = Toronto Alexithymia Scale, BDI = Beck Depression Inventory, BAI =Beck Anxiety Inventory, SAS = Somatosensory Amplification Scale
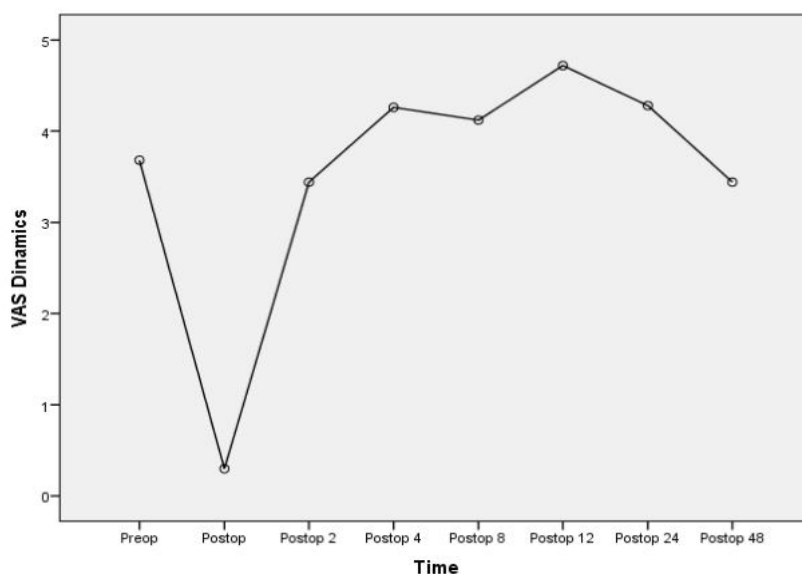
**Fig. 2.** The change in VAS-Dynamic scores. (VAS = Visual Analogue Scale, Preop = Preoperative, Postop= Postoperative, F = 79.19, p < 0.001, η2 = 0.618).

= 0.332), BAI (F = 0.72, *p* = 0.658), and SAS (F = 0.79, *p* = 0.599) were found not to be statistically significant due to the non-homogeneous distribution of the data for the change in VAS-Static scores. Besides, when the effects of these psychometric properties were controlled, the change in VAS-Static scores was found not to be statistically significant (F = 1.66, *p* = 0.119).

According to the Single Factor ANOVA Analysis for Repeated Measurements, the VAS-Dynamic mean score was showed a statistically significant change (F = 79.19, *p* < 0.001) (Fig. 2) (Table 3).

According to the Single-Factor ANOVA Analysis for Repeated Measures, only psychoticism subscale scores were found to have a statistically significant effect on the change in VAS-Static scores (F = 2.39, *p* = 0.040), but the level of this effect was around 5.5%. Moreover, considering the controlled psychometric properties evaluated in the study, the significant change in VAS-Dynamic scores was detected to continue (F = 2.95, *p* = 0.014), however, the effect size of the variation decreased from 61.8% to 6.7%.

## DISCUSSION

In this study, there was found not to be a significant relationship between the psychometric characteristics of the patients before the surgical intervention and the

VAS levels in the early postoperative period.

The relationship between preoperative psychometric factors and postoperative pain level has been analyzed in the literature, but conflicting results have been reported. A total of 37 articles of medium quality were examined in the systematic review study of Hernández *et al*. [23]. A strong correlation was found between postoperative pain and female gender, lower socioeconomic status, higher preoperative pain, comorbidities, low back pain, poor preoperative functional status, and psychological factors (depression, anxiety).

In a prospective study with 124 participants undergoing knee and hip arthroplasty, Pinto *et al*. [24] analyzed the demographic characteristics, clinical status, and psychological factors of the patients. They assessed pain levels, anxiety, and analgesic consumption 24 hours before and 48 hours after surgery. As a result, using a multivariate model, psychological factors were stated to be determinative in the prediction of pain at the 48th hour after surgery.

In the systematic review by Vissers *et al*. [25], 35 studies were examined. High preoperative pain scores have been reported to affect postoperative pain in patients undergoing total knee arthroplasty, on the other hand, the effect of psychological factors has been reported to be limited, has given contradictory results, or there is no evidence of its effectiveness.

In the current study, preoperative anxiety, depres-

**Table 3.** The efficiency of psychometric properties in the change in VAS-Dynamic scores

|  | F | p value | η2 |
|---|---|---|---|
| Extraversion | 0.39 | 0.854 | 0.09 |
| Lie | 0.73 | 0.602 | 0.017 |
| Neuroticism | 0.58 | 0.712 | 0.014 |
| Psychoticism | 2.39 | **0.040** | 0.055 |
| TAS | 1.97 | 0.086 | 0.046 |
| BDI | 1.62 | 0.157 | 0.038 |
| BAI | 0.63 | 0.673 | 0.015 |
| SAS | 1.43 | 0.184 | 0.036 |
| Duration of the joint disorder | 2.95 | **0.014** | 0.067 |

VAS = Visual Analogue Scale, TAS = Toronto Alexithymia Scale, BDI = Beck Depression Inventory, BAI =Beck Anxiety Inventory, SAS = Somatosensory Amplification Scale

sion, somatosensory amplification, alexithymia, and personality traits were shown not to affect the pain in the first 48 hours postoperatively. Only psychoticism subscale scores were, however, detected to be statistically significant in the change in VAS-Static scores according to the Single-Factor ANOVA Analysis for Repeated Measures, and the level of this effect was around 5.5%. Besides, when the psychometric properties evaluated in the study were controlled, the significant change in VAS-Dynamic scores was found to continue, but the effect size of the change decreased from 61.8% to 6.7%.

In the current study, although psychoticism was an effective factor in the change in postoperative VAS-Dynamic scores, this effect size was small. People with high psychoticism scores were thought to might interpret somatosensorial stimuli differently. The psychoticism dimension has been shown to have a pain-increasing effect on dynamic pain scores. Individuals with psychoticism might be, therefore, inferred to could perceive pain more after the intervention for the patient.

There is not much information about the biological basis of the psychoticism dimension. Higher psychoticism scores were obtained among psychopaths and criminals in the literature. There has been reported to be a strong relationship between the psychoticism dimension and antisocial behaviors [26, 27].

Basal cortisol levels were found to be low in individuals with antisocial personality disorders. Cortisol has a pain-reducing effect due to its anti-inflammatory effect. In the literature, there has been reported to be a negative correlation between psychopathy and this level [28]. Individuals displaying antisocial and aggressive behaviors were observed to have high testosterone levels [29]. Testosterone and cortisol have a reciprocal antagonistic effect. These people may have low cortisol when testosterone levels rise.

Surgery is one of the strongest stimuli of adrenocorticotropic hormone (ACTH) and cortisol. Cortisol and ACTH release after surgical trauma are sensitive indicators of the stress response. Basal cortisol and ACTH levels increase in the acute period [30]. Arthroplasty operations have been reported to lead to significant surgical stress response [31]. The cortisol secretion from the beginning of these operations may contribute to the reduction of acute pain. In our study, the basal cortisol levels of patients with psychoticism after surgical trauma were thought to may be lower than those without psychoticism.

Abnormalities in the serotonergic system have been detected in individuals with antisocial personality behavior (ASPD) [32]. The serum-free tryptophan level was determined to be higher in individuals with antisocial behaviors, impulsivity, and violent behaviors compared to healthy controls [33]. As a result of the stimulation of serotonergic neurons in the central nervous system, serotonin exerts an analgesic effect in the posterior horn of the medulla spinalis [34].

In a study conducted by Davis et al. [35] on uni-

versity students, psychological pain was stated to be significantly associated with self-harm and psychoticism. However, the relationship between physical pain and psychoticism has not been reported in the literature.

In many studies, the pain has been associated with the dimension of neuroticism [36]. However, these studies have been evaluated in relation to chronic pain or in the late postoperative period. In our study, acute pain severity in the early postoperative period was evaluated and the neuroticism dimension was not associated with pain in this period.

Neuroticism is a personality trait with a reported effect on somatization and can be defined as the tendency to react negatively to social and psychological stressors [37]. Somatization, considered a subset of neuroticism, has been reported to be associated with the number of somatic symptoms and coping with these symptoms [38, 39]. In a study by Atay *et al*. [40], a positive correlation was found between high pain scores in the late-postoperative period and somatosensory amplification in patients undergoing total knee arthroplasty and those were consistent with the results of previous studies. There is a significant relationship between psychometric symptoms and pain in patients with chronic pain. However, early-postoperative period was evaluated in our study and this relationship was not detected.

## CONCLUSION

No significant relationship was determined between preoperative psychometric factors and postoperative acute pain scores in our study. Considering the Single Factor ANOVA Analysis, only psychoticism subscale scores were, however, deduced to have a statistically significant effect on the change in VAS-Static scores. The significant change in VAS-Dynamic scores was shown to continue at a low effect with the control of all psychometric features. The psychoticism dimension was concluded to be more related to ASPD or aggressive patients, and the high level of pain might be related to the neurobiologically low serotonin and cortisol levels. Thus, we think that conducting new studies investigating the effects of psychoticism on ongoing post-surgical pain symptoms may contribute to the literature.

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