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Psychological status affects postoperative quality of life, function, and pain after periacetabular osteotomy

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Aims

Psychological status may be an important predictor of outcome after periacetabular osteotomy (PAO). The aim of this study was to investigate the influence of psychological distress on postoperative health-related quality of life, joint function, self-assessed pain, and sports ability in patients undergoing PAO.

Methods

In all, 202 consecutive patients who underwent PAO for developmental dysplasia of the hip (DDH) at our institution from 2015 to 2017 were included and followed up at 63 months (SD 10) postoperatively. Of these, 101 with complete data sets entered final analysis. Patients were assessed by questionnaire. Psychological status was measured by Brief Symptom Inventory (BSI-18), health-related quality of life was raised with 36-Item Short Form Survey (SF-36), hip functionality was measured by the short version 0f the International Hip Outcome Tool (iHOT-12), Subjective Hip Value (SHV), and Hip Disability and Outcome Score (HOS). Surgery satisfaction and pain were assessed. Dependent variables (endpoints) were postoperative quality of life (SF-36, HOS quality of life (QoL)), joint function (iHOT-12, SHV, HOS), patient satisfaction, and pain. Psychological distress was assessed by the Global Severity Index (GSI), somatization (BSI Soma), depression (BSI Depr), and anxiety (BSI Anx). Influence of psychological status was assessed by means of univariate and multiple multivariate regression analysis.

Results

In multiple multivariate regression, postoperative GSI, BSI Soma, and BSI Depr had a negative effect on postoperative SF-36 (e -2.07, -3.05, and -2.67, respectively; $p < 0.001$), iHOT-12 (e -1.35 and -4.65, respectively; $p < 0.001$), SHV (e -1.20 and -2.71, respectively; $p < 0.001$), HOS QoL (e -2.09 and -4.79, respectively; $p < 0.001$), HOS Function (e -1.00 and -3.94, respectively; $p < 0.001$), and HOS Sport (e -1.44 and -5.29, respectively; $p < 0.001$), and had an effect on postoperative pain (e 0.13 and 0.37, respectively; $p < 0.001$).

Conclusion

Psychological distress, depression, and somatization disorders affect health-related quality of life, perceived joint function, and sports ability. Pain perception is significantly increased by somatization. However, patient satisfaction with surgery is not affected.

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Keywords: developmental dysplasia of the hip, psychological distress, depression, anxiety, quality of life, periacetabular osteotomy, bone defects

Introduction

Developmental dysplasia of the hip (DDH) is a common cause of hip complaints in adolescents and young adults.[1] As a complex 3D pathology, it is characterized by a deficient coverage of the femoral head, causing pathological stress on the acetabular rim and adherent chondro-labral complex ultimately leading to joint degeneration.[2] If diagnosed in time, PAO is the surgical therapy of choice with the goal of preserving the native hip joint, relief of pain and maintenance of

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activity.[3] It was previously shown that both joint-specific function and quality of life improve after PAO.[4]

Age at the time of surgery, preoperative degree of osteoarthritis (OA), and preoperative joint-specific function are critical criteria to consider in the indication as they affect outcome.[5] Other factors include instability, subluxation of the femoral head, and joint congruency.[6] Although most patients are otherwise healthy, depression has been described as a common comorbid condition in patients undergoing PAO for DDH.[7]

Current biopsychosocial models of health and disease take an integrative medical approach that views disease, not purely mechanistically, but as a disorder of the interaction of physical, psychological, and social factors.[8]

Depression, anxiety, panic disorders, and somatoform disorders are conditions with high prevalence worldwide. Recent studies demonstrate that psychosocial determinants, such as somatization, anxiety, and depression, influence postoperative outcomes in terms of quality of life, functional disability, and pain intensity in the setting of musculoskeletal surgery and need to be taken into account.[9,10] Because of this, clarification of the impact of psychological distress on impaired functional health and quality of life must not be discounted.

According to the World Health Organization (WHO), mental disorders affect one in five people, or 1.54 billion people, worldwide.[11] It has been previously reported that psychological symptoms, such as pain catastrophizing, anxiety, and depression, co-exist in a variety of hip pathologies and especially in patients with DDH, thus affecting pain and function.[12] However, there is no evidence to what extent the psychological patient status affects outcomes after PAO.

Therefore, the aim of the present study was to investigate the influence of psychological status on postoperative quality of life, joint function, pain perception, patient satisfaction, and sports ability after PAO. We hypothesized that postoperative quality of life, joint-specific function, pain, patient satisfaction, and sports ability are negatively affected by psychological impairment in PAO patients.

Methods

Study design. We conducted a retrospective analysis of prospectively collected data from 173 patients who had received PAO for DDH at a single university centre (Center for Musculoskeletal Surgery, Charité-University Medicine, Berlin, Germany) between January 2015 and June 2017. Prior approval of the local ethics committee was obtained (EA1/052/21).

Psychopathological states were assessed using the Brief Symptom Inventory (BSI). As a patient-reported measure, the questionnaire includes subjective impairment due to physical and psychological symptoms.[13]

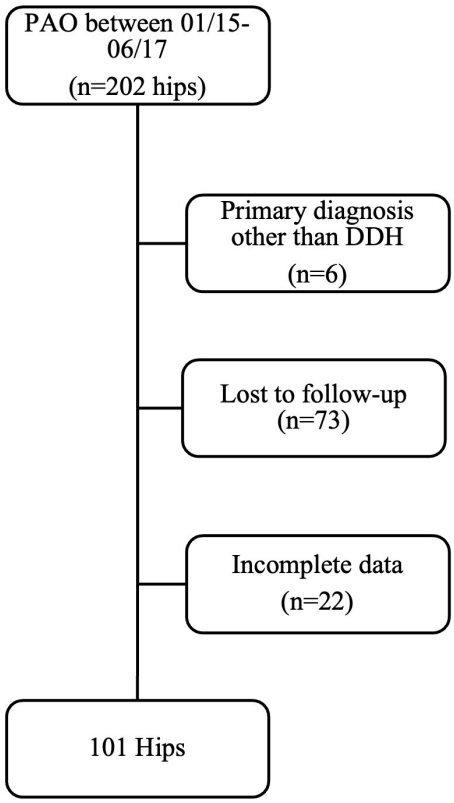

Fig. 1
Flowchart of patient selection.

A total of 202 consecutive hips in 173 patients underwent PAO during this period. Inclusion criteria were patients with a primary diagnosis of DDH treated with PAO with completed questionnaires, including clinical data and signed informed consent. Exclusion criteria were a primary diagnosis other than DDH (i.e. acetabular retroversion), prior operation on the ipsilateral hip joint, or incomplete data at follow-up.

Out of the initial 202 cases, six (3.0%) were operated for indications other than DDH. In 73 cases (36.1%), the patient could not be invited for follow-up assessment due to change of address or telephone number and were therefore lost to follow-up. A total of 22 patients (10.9%) did not provide complete data, thus 101 cases (50%) with complete data sets were included in the final analysis (Figure 1).

Procedure. In the study cohort, acetabular reorientation and fixation was achieved under fluoroscopic guidance using an ilioinguinal approach. Target of intraoperative acetabular reorientation was defined as lateral central edge angle (LCEA) between 30° and 35°, acetabular inclination (AI) between 0° and 5°, and femoral head extrusion index (FHEI) between 17% and 26% with an anteverted acetabulum without crossover sign.

All patients were mobilized according to a standardized postoperative mobilization regimen with tip-touch

partial weightbearing for six weeks postoperatively. After the sixth week, the load was increased to half the patient's body weight from the seventh to the tenth postoperative week. After the tenth week, the load was gradually increased to full weightbearing.

Radiological assessment. Measurements of radiological parameters characterizing DDH were performed preoperatively, postoperatively after initial mobilization, and at three-month follow-up using standing anteroposterior (AP) pelvic radiographs. All patients had at least one radiological abnormality, including a Wiberg[14] LCEA angle of less than 25°, AI of more than 10°, Heyman and Herndeon[15] FHEI of more than 26%, and osteoarthritis (OA) grade of ≤ 1 according to Tönnis.[16]

Functional radiographs in 30° abduction were also obtained and showed good joint congruency in all hips. No significant loss of correction was observed on radiological follow-up.

Clinical assessment. Clinical outcome assessment included quality of life (36-Item Short Form Survey (SF-36),[17] and Hip Disability and Outcome Score (HOS)[18] quality of life (HOS QoL)), joint function (International Hip Outcome Tool (iHOT-12)), Subjective Hip Value (SHV), pain (Numerical Rating Scale (NRS)),[19] patient satisfaction, and sports activity (HOS Sport).[20]

The SF-36 includes health-related quality of life with 36 questions. The iHOT-12 consists of 12 questions and is divided into four subscales.[21] The SHV assesses hip function as perceived by the patient. It is expressed as the percentage between 0 to 100%.[22] Pain intensity was measured using the NRS.

The HOS has five subcategories: Pain (HOS Pain), symptoms (HOS Sym) and stiffness, activities of daily living (HOS Func), function in sports and recreational activities (HOS Sport), and quality of life (HOS QoL).[23] Originally developed for patients with OA of the hip, it was validated and found suitable for assessment of patients undergoing PAO for DDH. Satisfaction with surgical outcome was also measured by the NRS (0 to 10).[24]

The psychological status of PAO patients was assessed postoperatively using the Brief Symptom Inventory (BSI-18).[25] With six items each, the syndromes somatization (BSI Soma), depressiveness (BSI Depr), and anxiety (BSI Anx) are mapped, whereby the total score of the BSI correlates with the extent/severity of psychological distress (Global Severity Index (GSI)). The 18 items are answered on a five-point Likert scale. The BSI-18 is evaluated by adding the items to sum scores of the three syndrome scales. The GSI reflects the extent of psychological distress and is calculated by dividing the sum of the item scores by the number of items answered.[12]

Statistical analysis. Pearson correlation for continuous variables and Spearman correlation for ordinal-scaled variables were used to evaluate relationships between demographic, clinical and radiological, as well as postoperative level and pre-postoperative differences of hip-related measurements with GSI, BSI Soma, BSI Depr, and BSI Anx. After that, variables with significant relationships were entered in a multiple multivariate regression model. Inspection of variance inflation factors indicated relatively high collinearity, which is why they were removed from the respective models. Pillai's trace type II multivariate analysis of variance tests were used to evaluate redundancy of predictors in the multivariate models. All p-values < 0.5 were considered to be statistically significant.

Table I. Demographics of periacetabular osteotomy patients.

Variable	Data
Mean operative age, yrs (SD)	27.86 (7.52)
Mean BMI, kg/m² (SD)	24.11 (4.61)
Mean operation duration, mins (SD)	104.46 (45.65)
Mean inpatient stay, days (SD)	8.36 (1.53)
Mean GSI (SD)	4.99 (5.43)
Mean BSI Soma (SD)	2.02 (2.1)
Mean BSI Depr (SD)	1.66 (3.01)
Mean BSI Anx (SD)	1.31 (1.70)
Sex (F:M), n	87:14
Operative side (left:right), n	47:54
Osteoarthritis Tönnis grade (0:1), n	41:60

BSI, Brief Symptom Inventory; BSI Anx, Brief Symptom Inventory anxiety; BSI Depr, Brief Symptom Inventory depression; BSI Soma, Brief Symptom Inventory somatization; GSI, Global Severity Index; SD, standard deviation.

Results

PAO patients were followed up at 63 months (standard deviati0n (SD) 10) postoperatively. Of 101 patients, 73 (72.3%) showed symptoms of somatization, 48 (47.5%) showed symptoms of depression, and 54 (53.5%) showed symptoms of anxiety. Mean scores for GSI and BSI subscores are displayed in Table I.

Radiological parameters were improved significantly pre- to postoperatively ($p < 0.001$, Pearson/Spearman correlation). Pearson/Spearman correlation were used to evaluate significant relationships between demographic, clinical and radiological hip-related measurements. Joint specific function as measured by the above mentioned patient-reported outcome measures (PROMs) ($p < 0.001$, Pearson/Spearman correlation), and pain ($p < 0.001$, Pearson/Spearman correlation) also improved significantly. For a summary of pre- and postoperative radiological measures and PROMs, see Table II.

Overall, psychopathological symptoms as measured by the GSI correlated with poorer hip joint function and quality of life, as well as increased pain after PAO.

On univariate analysis for correlation between psychological status and outcome measurements, the GSI showed most significant negative correlations to the scales SF36, iHOT, SHV, and HOS by Pearson correlation

Table II. Pre- and postoperative radiological parameters and PROMs of periacetabular osteotomy patients.

Parameter	Preoperative, mean (SD)	Postoperative, mean (SD)	Delta-p	p-value*
LCEA, °	15.93 (6.2)	29.21 (5.97)	13.18 (6.11)	< 0.001
TA, °	13.12 (6.83)	1.05 (7.5)	-11.98 (6.57)	< 0.001
FHEI, %	24 (8.0)	10 (9.0)	-0.14 (0.07)	< 0.001
iHOT-12	40.39 (21.87)	73.21 (22.28)	32.83 (27.27)	< 0.001
SHV	41.32 (23.88)	80.5 (17.32)	39.23 (27.82)	< 0.001
Pain, NRS	7.32 (1.82)	2.18 (2.0)	-5.14 (2.36)	< 0.001
HOS Sym	50.5 (26.62)	71.78 (18.86)	21.29 (27.15)	< 0.001
HOS Pain	43.02 (23.5)	79.36 (18.68)	36.34 (23.02)	< 0.001
HOS Func	54.22 (29.02)	84.28 (17.47)	30.07 (25.39)	< 0.001
HOS Sport	73.95 (24.27)	73.95 (24.27)	35.46 (26.49)	< 0.001
HOS QoL	28.03 (28.03)	62.07 (25.39)	34.03 (29.76)	< 0.001

All p-values are significant.
*Spearman correlation.
FHEI, femoral head extrusion index; HOS Func, Hip Disability and Outcome Score activities of daily living; HOS Pain, Hip Disability and Outcome Score pain; HOS QoL, Hip Disability and Outcome Score quality of life; HOS Sport, Hip Disability and Outcome Score sport; HOS Sym, Hip Disability and Outcome Score symptoms; LCEA, lateral central edge angle; NRS, Numerical Rating Scale; PROMs, patient-reported outcome measures; SD, standard deviation; SHV, Subjective Hip Value; TA, Tönnis angle.

Table III Postoperative Pearson correlations of PROMs for periacetabular osteotomy patients.

Variable	GSI	BSI Soma	BSI Depr	BSI Anx	SF-36	iHOT	OP satisfaction	SHV	NRS	HOS QoL	HOS Func	HOS Pain	HOS Sym	HOS Sport
GSI	1	-	-	-	-	-	-	-	-	-	-	-	-	-
BSI Soma	0.79	1	-	-	-	-	-	-	-	-	-	-	-	-
BSI Depr	0.87	0.49	1	-	-	-	-	-	-	-	-	-	-	-
BSI Anx	0.69	0.41	0.40	1	.	-	-	-	-	-	-	-	-	-
SF-36	-0.61	-0.56	-0.57	-0.23	1	-	-	-	-	-	-	-	-	-
iHOT	-0.34	-0.43	-0.23	-0.15	0.60	1	-	-	-	-	-	-	-	-
OP satisfaction	-0.17	-0.15	-0.16	-0.08	0.21	0.53	1	-	-	-	-	-	-	-
SHV	-0.38	-0.41	-0.30	-0.16	0.57	0.78	0.51	1	-	-	-	-	-	-
NRS	0.34*	0.41**	0.26	0.13	-0.58	-0.70	-0.49	-0.69	1	-	-	-	-	-
HOS QoL	-0.45	-0.50	-0.32	-0.28	0.62	0.81	0.53	0.79	-0.63	1	-	-	-	-
HOS Func	-0.32	-0.47	-0.20	-0.09	0.66	0.81	0.39	0.76	-0.71	0.76	1	-	-	-
HOS Pain	-0.42	-0.50	-0.30	-0.21	0.66	0.84	0.44	0.77	-0.76	0.78	0.91	1	-	-
HOS Sym	-0.39	-0.54	-0.22	-0.17	0.58	0.72	0.29	0.66	-0.63	0.68	0.78	0.79	1	-
HOS Sport	-0.33	-0.46	-0.17	-0.18	0.62	0.80	0.47	0.77	-0.65	0.80	0.89	0.85	0.70	1

All data have have statistically significant p-values. Pearson correlations; adjustment method: Holm (1979).
BSI Anx, Brief Symptom Inventory anxiety; BSI Depr, Brief Symptom Inventory depression; BSI Soma, Brief Symptom Inventory somatization; GSI, Global Severity Index; HOS Func, Hip Disability and Outcome Score activities of daily living; HOS Pain, Hip Disability and Outcome Score pain; HOS QoL, Hip Disability and Outcome Score quality of life; HOS Sport, Hip Disability and Outcome Score sport; HOS Sym, Hip Disability and Outcome Score symptoms; iHOT-12, short version of the International Hip Outcome Tool; NRS, Numerical Rating Scale; OP, operation satisfaction; PROMs, patient-reported outcome measures; SF-36, 36-Item Short Form Survey; SHV, Subjective Hip Value.

($p < 0.001$). Furthermore, there was significant correlation between GSI and postoperative pain and NRS by Pearson correlation ($p < 0.050$).

Somatization disorders also correlated with poorer hip joint function and quality of life, as well as increased pain after PAO as the scale BSI Soma showed significant negative correlations for SF-36, iHOT, SHV, and HOS by Pearson correlation ($p < 0.001$) and positive significant correlation between BSI Soma and NRS by Pearson correlation ($p < 0.010$).

Patients with depression after PAO showed a highly significant negative correlation with SF-36 by Pearson correlation ($p < 0.001$). GSI, BSI Soma, and BSI Depr negatively correlated with satisfaction with surgery; however, this correlation was not significant. A detailed summary of univariate analysis is outlined in Table III.

Somatization disorders had the strongest negative influence on quality of life, hip function, pain perception, and sports ability after PAO. Patients with somatization disorders achieved the significantly highest negative correlations with SF-36, post-HOS QoL, post-iHOT-12, post-HOS Func, post-HOS Pain, post-HOS Symp, and post-HOS Sport in multiple multivariate regression analysis ($p < 0.001$). Depression disorders after PAO showed a highly significant negative correlation with postoperative quality of life as measured by the SF-36 in multiple multivariate regression analysis ($p < 0.001$).

Patients with anxiety disorders after PAO showed no significant correlation with postoperative health-related quality of life, joint-function, self-assessed pain, and sports ability.

Our study showed that psychological distress (GSI) after PAO had highly significant negative correlations in the categories SF-36, post-HOS QoL, post-iHOT-12, post-HOS Func, post-HOS Pain, post-SHV, post-HOS Symp, post-SHV, post-NRS, and post-HOS Sport in multiple multivariate regression analysis ($p < 0.001$) (Table IV).

The significant correlations in Pillai's trace type II multivariate analysis of variance (MANOVA) test ($p < 0.001$) could again be confirmed in patients with psychological stress, somatization disorders, and depression, but not anxiety disorders after PAO (see Supplementary table i).

Discussion

To the best of our knowledge, the present study is the first to investigate the influence of psychological distress and dimensions, such as somatization, depression, and anxiety on patient outcomes after PAO.

Our study showed that quality of life, perceived joint function, and pain in PAO patients are significantly affected by psychopathological syndromes, such as somatization and depression. In contrast, satisfaction with PAO surgery was not affected by psyche. Postoperative anxiety acted as a significant predictor of reduced quality of life after PAO.

The lower the postoperative psychological complaints, such as somatization, depression, and anxiety, the greater scores were observed for postoperative quality of life and joint function after PAO.

Previous studies were able to identify predictors of poor outcomes after PAO. These predictors included age at surgery, poor preoperative joint function, and preoperative OA.[26] These studies are in line with our findings as in our study, cohort, age, and preoperative reduced functional status were negative predictors of quality of life and function after PAO (Table IV).

Major surgery is experienced as stressful by most patients.[27] Often, psychological distress symptoms are not transient concerns regarding upcoming surgery, but frequently represent evidence of clinically significant chronic psychological disorders requiring treatment.

In surgery, physical discomfort is the main focus, and the psyche can be easily forgotten. PAO is a surgical intervention of a significant magnitude followed by extensive postoperative rehabilitation with weeks of hindered mobilization and return to normal daily and physical activity often months later.

It has been shown that untreated somatization, depression, and anxiety can contribute to surgical complications, as well as poorer recovery after surgery.[28] They may promote a less favourable disease course overall, leading to reduced quality of life and postoperative outcomes of joint function as perceived by the patient.[29] At the same time, it was previously shown that depression is a comorbidity with relevant prevalence in DDH patients.[1]

Previous studies have reported that psychological symptoms, such as depression and anxiety, may influence severity of symptoms in patients with musculoskeletal disorders and thus might affect quality of life.[30]

Hampton et al[12] used a prospective study of 328 patients diagnosed with hip dysplasia, femoracetabular impingement, lateral trochanteric pain syndrome, hip OA, and avascular hip necrosis to investigate whether the extent of preoperatively existing psychopathogic symptoms, such as pain catastrophizing, anxiety, and depression, correlate with current functional outcome.[13] The authors concluded that preoperative psychopathological symptoms of orthopaedic patients could influence functional outcome.

While in the cited study only preoperative status was assessed, we were able to demonstrate that psychological symptoms, such as somatization, depression, and anxiety, negatively influence postoperative quality of life and joint function as perceived by the patient postoperatively after PAO.

It is critical to note that the cited study did not assess the influence of somatization by using the Hospital Anxiety and Depression Scale for anxiety (HADS-A) and depression (HADS-D), whereas the BSI that was used in our study also captured somatization, which is important in musculoskeletal disease.[31]

Psychosomatic disorders are a common differential diagnosis in orthopaedic symptoms. They have a major influence on orthopaedic complaints, outcome, patient satisfaction with orthopaedic surgery, and on the chronification of orthopaedic complaints. Psychological comorbidity, particularly somatization, also has a significant impact on surgical outcome as shown for example by Bierke et al,[30] who evaluated the effect of depression and somatization in patients after knee arthroplasty. This is consistent with our findings as somatization had a significant impact on postoperative health-related quality of life and PROMs after PAO.

A crucial factor after every surgical procedure is pain. Postoperative pain is a multidimensional individual symptom to which several factors may contribute. Various studies proved that preoperative depression correlates with increased pain after surgical intervention.[32] Bierke et al[30] demonstrated that patients with depressive symptoms, and especially patients with somatization disorders 12 months after uncomplicated total knee arthroplasty (TKA), generally showed a significantly higher pain scores at rest and during activities, and lower knee function before and 12 months after uncomplicated TKA.

This suggests that patients with concomitant depression and somatization are at significantly higher risk of

Table IV. Multiple multivariate regression analysis.

Variable	Estimate	SE		Estimate	SE
SF-36			**Post-HOS QoL**		
GSI	-2.07	0.25	GSI	-2.09	0.4
BSI Soma	-3.05	0.75	BSI Soma	-4.79	1.26
BSI Depr	-2.67	0.53	BSI Depr	-0.63	0.88
BSI Anx	0.59	0.86	BSI Anx	-1.47	1.44
Post-LCEA	0.13	0.32	Post-LCEA	0.3	0.52
Post-TA	0.33	0.26	Post-TA	-0.63	0.43
Post-FHEI	24.8	20.79	Post-FHEI	80.47	33.83
OP age	-0.39	0.19	OP age	-0.32	0.31
Pre-iHOT-12	0.25	0.06	Pre-iHOT-12	0.19	0.1
Post-iHOT-12			**Post-HOS function**		
GSI	-1.35	0.38	GSI	-1.00	0.28
BSI Soma	-4.65	1.18	BSI Soma	-3.94	0.84
BSI Depr	0.02	0.82	BSI Depr	0.04	0.59
BSI Anx	0.31	1.35	BSI Anx	0.87	0.97
Post-LCEA	0.46	0.49	Post-LCEA	0.03	0.36
Post-TA	-0.08	0.41	Post -TA	0.05	0.3
Post-FHEI	43.44	32.23	Post-FHEI	21.81	23.69
OP age	-0.05	0.29	OP age	-0.35	0.21
Pre iHOT-12	0.21*	0.1	Pre iHOT-12	0.28	0.07
OP satisfaction			**Post-HOS pain**		
GSI	-0.07	0.04	GSI	-1.40	0.3
BSI Soma	-0.1	0.14	BSI Soma	-4.08	0.92
BSI Depr	-0.08	0.1	BSI Depr	-0.24	0.64
BSI Anx	0.02	0.16	BSI Anx	-0.16	1.06
Post-LCEA	0.09	0.06	Post-LCEA	0.2	0.39
Post-TA	-0.03	0.05	Post-TA	0.12	0.32
Post-FHEI	0.18	3.62	Post-FHEI	19.71	25.3
OP age	-0.04	0.03	OP age	-0.14	0.23
Pre iHOT-12	0.01	0.01	Pre iHOT-12	0.25**	0.08
Post-SHV			**Post-HOS Sym**		
GSI	-1.20***	0.29	GSI	-1.30	0.31
BSI Soma	-2.71**	0.91	BSI Soma	-5.22	0.91
BSI Depr	-0.91	0.64	BSI Depr	0.56	0.64
BSI Anx	0.31	1.05	BSI Anx	0.14	1.05
Post-LCEA	-0.01	0.37	Post-LCEA	0.37	0.4
Post-TA	-0.51	24.33	Post-TA	0.19	0.34
Post-FHEI	47.4	0.31	Post-FHEI	45.8	26.43
OP age	-0.09	0.22	OP age	-0.13	0.24
Pre iHOT-12	0.15	0.07	Pre iHOT-12	0.15	0.08
Post-NRS			**Post-HOS Sport**		
GSI	0.13	0.04	GSI	-1.44	0.39
BSI Soma	0.37	0.11	BSI Soma	-5.29	1.18
BSI Depr	0.05	0.08	BSI Depr	0.56	0.82
BSI Anx	-0.06	0.13	BSI Anx	-0.39	1.35
Post-LCEA	-0.001	0.05	Post-LCEA	-0.23	0.5
Post-TA	0.03	0.04	Post-TA	-0.17	0.42
Post-FHEI	-4.52	2.95	Post-FHEI	11.95	32.81
OP age	-0.004	0.03	OP age	-0.45	0.3
Pre-iHOT-12	-0.01	0.01	Pre-iHOT-12	0.41	0.1

Postoperative multiple multivariate regression analysis on predictor variables affecting the dependent variables postoperative 36-Item Short Form Survey, International Hip Outcome Tool, operation satisfaction, Subjective Hip Value, Numerical Rating Scale, and Hip Disability and Outcome Score.
BSI Anx, Brief Symptom Inventory anxiety; BSI Depr, Brief Symptom Inventory depression; BSI Soma, Brief Symptom Inventory somatization; FHEI, femoral head extrusion index; GSI, Global Severity Index; HOS Func, Hip Disability and Outcome Score activities of daily living; HOS Pain, Hip Disability and Outcome Score pain; HOS Qol, Hip Disability and Outcome Score quality of life; HOS Sport, Hip Disability and Outcome Score sport; HOS Sym, Hip Disability and Outcome Score symptoms; iHOT-12, short version of the International Hip Outcome Tool; LCEA, lateral central edge angle; NRS, Numerical Rating Scale; OP, operation satisfaction; SE, standard error; SF-36, 36-Item Short Form Survey; SHV, Subjective Hip Value.

suffering from increased pain even after surgery. The results of our study support this assumption as more severe psychological symptoms present after PAO resulted not only in reduced quality of life and function, but also in higher postoperative pain.

In a study by Podszewa et al,[33] the authors assessed the psychological state of adolescents before hip preservation surgery and found that up to one third of patients were at-risk or showed clinically significant symptoms of anxiety and/or depression. The authors concluded that preoperative psychological evaluation, with appropriate intervention and follow-up, if needed, should be considered before surgery selection as mental health conditions may be undiagnosed and will likely influence functional outcomes. While the authors did not assess influence on postoperative outcomes, the results of our study support this assumption, as postoperative outcomes were significantly affected by psychopathological symptoms.

In a study by Gambling et al,[34] the authors investigated the impact of hip symptoms triggered by DDH on quality of life and psychosocial wellbeing. The authors found that prolonged symptom duration due to delayed diagnosis and treatment was associated with a negative impact on quality of life and psychosocial wellbeing. This underlines the importance of timely diagnosis and treatment to prevent affection of the psyche by hip symptoms, and shows that hip symptoms and psychological symptoms are in a continuum and possibly influence each other both ways if untreated.

However, for the postoperative state, it was previously shown that postoperative pain reduction correlates with improved health-related quality of life and hip function.[35] These findings were confirmed by our study results as quality of life and joint function were negatively correlated with postoperative pain.

Given the results of our study and the cited literature, it seems logical to conclude that patients with psychopathologic syndromes should be identified preoperatively and offered psychological counseling in an effort to further optimize outcomes. This conclusion is supported by the results of a study by Richard et al,[36] in which it was demonstrated that preoperative psychological therapy prior to hip preservation surgery correlated with significantly improved surgical outcome in terms of postoperative pain, health-related quality of life, and mental health.

Interestingly, psychological status did not significantly influence patient satisfaction with surgery in the studied collective. However, correlation analysis showed a significant correlation of postoperative PROMs and pain with patient satisfaction. It was previously reported that patient satisfaction after orthopaedic surgery is influenced by factors that go beyond functional status, and pain leading to a progressive understanding that patient satisfaction is influenced by factors not captured by joint-specific outcome measures. Although not reflected in our results, previous studies reported that psychological factors might influence patient satisfaction after orthopaedic surgery.[20,37–39] However, there are more factors that seem to influence patient satisfaction, such as general health status and preoperative expectations.[35] Since such factors were not assessed in the cohort studied, their influence cannot be estimated with the results of the present work. According to our results, in the context of PAO, psychological status seems to have less of an impact on patient satisfaction than pain relief and functional improvements.

The presented study has inherent limitations. We did not assess psychological symptoms preoperatively. However, we were able to demonstrate a significant association of postoperative psychological distress and quality of life, as well as joint function.

In conclusion, postoperative somatization and depression are significant predictors of reduced quality of life, joint function, and increased pain, and therefore have a significant impact on outcome after PAO. Consequently, a psychopathological examination could be integrated into a multifactorial patient assessment to further improve the outcome in PAO patients with accompanying psychotherapeutic care, if necessary.

Take home message

- Postoperative somatization and depression are significant predictors of reduced quality of life, joint function, and increased pain, and therefore have a significant impact on outcome after periacetabular osteotomy (PAO).
- Consequently, a psychopathological examination could be integrated into a multifactorial patient assessment to further improve the outcome in PAO patients with accompanying psychotherapeutic care, if necessary.

Supplementary material

Table showing correlations for pre- and postoperative differences under the Pearson method.

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