

Systematic Review

Depression and anxiety changes in patients after orthognathic surgery: a systematic review and meta-analysis

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Abstract

This study was designed to evaluate the impact of orthognathic surgery on depression and anxiety in patients with dentofacial deformities. PubMed, Embase, Cochrane Library, Web of Science, CNKI and WANFANG databases were searched from 2000 to 2025. This systematic review included studies that evaluated the impact of orthognathic surgery on depression and anxiety as measured by the Symptom Checklist-90 (SCL-90), Minnesota Multiphasic Personality Inventory (MMPI), State-Trait Anxiety Inventory (STAI) and Social Appearance Anxiety Scale (SAAS). The review included 12 articles with 613 participants, of which 10 were included in the meta-analyses. It revealed that orthognathic surgery was associated with postoperative improvement in psychological status. Regarding depression, scores at more than 6 months postoperatively were significantly lower than preoperative levels for both SCL-90 (MD 0.20, 95% CI [0.07 to 0.32]) and MMPI (MD 1.77, 95% CI [−0.50 to 4.04]). However, a more pronounced reduction in depression was observed at 3 months postoperatively (MD 0.33, 95% CI [−0.15 to 0.80]) compared to 6 months, suggesting a potential partial relapse during this interim period. For anxiety, significant improvement was noted at more than 6 months using the SAAS (MD 9.41, 95% CI [2.21 to 16.61]), while just a positive trend was observed with the SCL-90 (MD 0.10, 95% CI [−0.07 to 0.27]). Similarly, a more pronounced reduction in anxiety was observed at 3 months postoperatively (MD 0.33, 95% CI [−0.14 to 0.80]). Orthognathic surgery improves psychological status including anxiety and depression in patients with dentofacial deformities, with peak effects observed at 3 months that may relapse by 6 months.

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Keywords: Malocclusion; Orthognathic surgery; Psychology; Anxiety; Depression

Introduction

Orthognathic surgery has been widely applied in clinical practice as a critical intervention for correcting dentofacial deformities, improving oral function, and enhancing facial aesthetics.^{1,2} However, dentofacial deformities can not only lead to physiological dysfunction but also contribute to abnormal psychological states in patients.^{3,4} Studies indicate that patients with skeletal Class II and III deformities often experience severe social avoidance, masticatory dysfunction, and psychological distress due to significant craniofacial structural abnormalities, with preoperative anxiety and depression levels markedly higher than those with mild deformities.^{5,6} Although surgery effectively improves anatomical structures, its long-term psychological impact remains controversial: some studies report significant

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postoperative mental health improvements,⁷ while others suggest that pain during recovery, delayed adaptation to aesthetic changes, or functional recovery uncertainties may exacerbate psychological distress, particularly when conclusions vary across assessment tools.^{8,9}

This study focuses on integrating multi-phase data at the preoperative, 3 months, and 6 months postoperative stages to systematically analyse the longitudinal impact of orthognathic surgery on anxiety and depression. By examining temporal trends in psychological outcomes and the confounding influence of assessment tool heterogeneity, this research aims to provide evidence-based guidance for targeted psychological intervention strategies in patients after orthognathic surgery treatment, thereby addressing deficiencies in patient stratification, dynamic tracking, and methodological standardisation in the existing literature.

Material and methods

Protocol and registration

This systematic review was developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Checklist under the ID CRD420251044273 (PRISMA).

Eligibility criteria

The following inclusion criteria were established based on the PICO framework: Population (P): Patients diagnosed with dentofacial deformities; studies involving were excluded; Intervention (I): Undergoing orthognathic surgery treatment; Comparison (C): Comparison of psychological status before surgery versus after surgery; Outcome (O): Anxiety and depression assessed using validated psychometric instruments; Study design (S): Cohort studies.

The following exclusion criteria were applied: (1) Patients younger than 18 years; (2) Studies with missing or incomplete data; (3) Patients with orofacial neoplasms, or cleft lip/palate; (4) Reviews, letters, conference abstracts, expert opinions, case reports, and case control studies.

Information sources and search strategy

A total of seven electronic databases were systematically searched to identify potentially relevant articles, including PubMed (n = 592), Embase (n = 565), Cochrane Central Register of Controlled Trials (CENTRAL) (n = 266), Web of Science (n = 2011), China National Knowledge Infrastructure (CNKI) (n = 176), WANFANG Database (n = 324). The search covered the period from January 1, 2000, to September 1, 2025. The search strategies were summarised in Table S1 (online only).

Selection process

The screening process was divided into two phases. After removing duplicates in Phase 1, two independent reviewers

(J. W. and W. H.) screened the relevance of articles based on the inclusion criteria through their titles and abstracts. In Phase 2, the same reviewers applied the eligibility criteria to the full text of the articles. In case of any disagreements, a third reviewer (C. L.) was recruited to reach a consensus. A detailed explanation for the exclusion of studies was provided in Table S2 (online only).

Data collection process and data items

Two reviewers (J.W. and W.H.) independently extracted data using a standardised form. The extracted information included: first author; publication year; country; sample size; continuous outcome data for anxiety and depression from the psychological instruments; and main findings. Corresponding authors were contacted for missing data. Studies without comparable data across the predefined time points were excluded from quantitative synthesis.

Assessment of risk of bias

The risk of bias for the included cohort studies was independently assessed by three reviewers using the Newcastle-Ottawa Scale. This tool evaluates study quality across three key domains: the selection of the study groups, the comparability of the groups, and the ascertainment of the exposure or outcome of interest. A star system is used to rate each domain, with a maximum possible score of nine stars. For this review, we classified the studies based on their total score. Studies scoring between seven and nine stars were considered to have a low risk of bias, reflecting high methodological quality.

A score of four to six stars indicated a moderate risk of bias, while a score of zero to three stars indicated a high risk of bias. Any disagreements between the reviewers were resolved through discussion until a consensus was achieved.

Statistical analysis

All analyses were performed using Review Manager version 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration). Considering the large variability commonly seen among relevant studies, we decided a priori to use the random-effects model in all meta-analyses. Mean difference (MD) estimates were used to quantify effect sizes. A two-tailed significance level of 5% was applied to all analyses. Subgroups were classified based on assessment timing: before surgery, 3 months after surgery, and 6 months after surgery. Statistical heterogeneity among studies was assessed using Cochran's Q test and the I² statistic, with I² values above 50% indicating substantial heterogeneity.

Results

Study selection

Fig. 1 illustrates the study selection process for this meta-analysis. The systematic search across databases yielded

3578 records. After removing 903 duplicates, the titles and abstracts of 2675 records were screened. Of these, 1346 records were excluded. The full texts of the remaining 89 articles were assessed for eligibility by three independent reviewers. At this stage, 77 studies were excluded for not meeting the inclusion criteria. Ultimately, 12 studies were included in the quantitative synthesis and meta-analysis.

Study characteristics

The key characteristics of the 12 included studies are summarised in Table 1. All selected studies employed a cohort design, encompassing a total of 613 participants. The sample sizes of individual studies ranged from 22 to 119. The follow-up assessments were categorised based on the num-

ber of distinct time points reported: two time points in eight studies,^{4,7,10–15} three time points in three studies,^{16–18} and four time points in one study.¹⁹ The primary outcome measures, as documented in all included publications, comprised scores from SCL-90, MMPI, SAAS, and STAI.

Risk of bias in included studies

The risk of bias was assessed using the Newcastle-Ottawa Scale (NOS) in Table S3 (online only). The NOS scores for the 12 included studies ranged from 5 to 7. The majority of studies (n = 6) scored 7, indicating a low risk of bias, some studies (n = 5) scored 6, indicating a moderate risk of bias, while a minority (n = 1) scored 5, suggesting a high risk of bias.

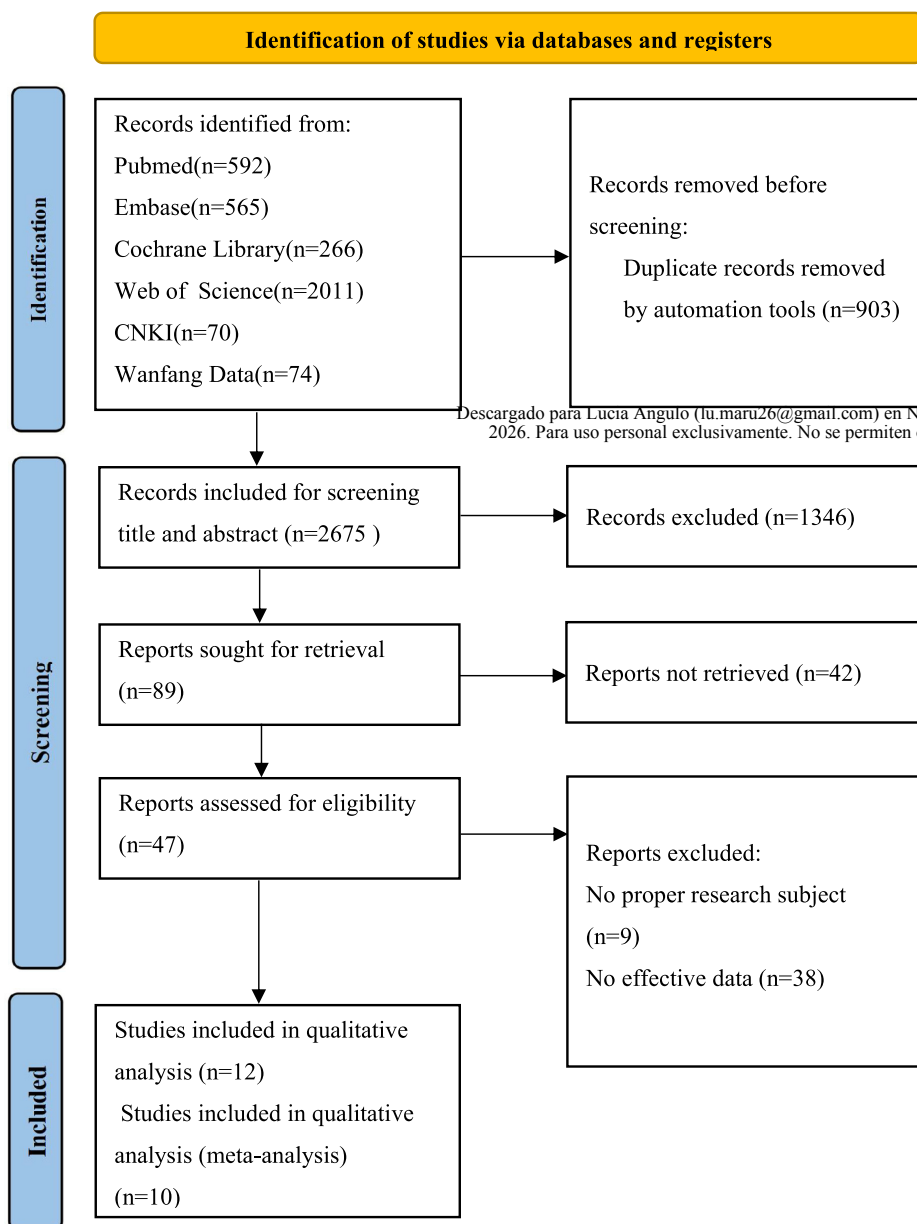


Fig. 1. PRISMA flowchart of search criteria and literature selection.

Table 1
Study and patient characteristics.

First author, year, reference	Origin	Participants (age in years)	Malocclusion	Measures	Type of orthognathic surgery	Assessment timing	Conclusion
Agırmashgil, 2019 ¹⁰	Turkey	45: M 18, F 27; Age: 21.40 ± 2.02	Class III	SAAS	Le Fort I; BSSRO	T0: before surgery; T1: 6 months after treatment	Social appearance anxiety levels decreased significantly
Alanko, 2017 ⁴	Finland	22: M 6, F 16; Age: 18–54	Not stated	SCL-90	BSSO; Bimaxillary surgery; Maxillary surgery	T0: before surgery; T1: 1 year after treatment	The SCL-90 scores were lower at 1 year after surgery, indicating a decrease in psychiatric symptoms
Alanko, 2022 ¹¹	Finland	22	Not stated	SCL-90	Not stated	T0: before surgery; T1: 1 year after treatment	All aspects of SCL improved
An, 2019 ¹²	China	30: M 14, F 16; Age: 27.5 ± 6	Not stated	SCL-90	Not stated	T0: before surgery; T1: 3 months after treatment	The postoperative F2-F9 scores in the treatment group were all lower than the preoperative scores.
Chen, 2003 ¹⁹	China	73	Not stated	SCL-90	Not stated	T0: immediately after surgery; T1: 3 months after treatment; T2: 6 months after treatment; T3: 1 year after treatment	By three months scores had declined to near-preoperative levels, while at six months and one year, they showed a significant reduction compared to baseline
Dong, 2008 ¹⁶	China	42	Not stated	SCL-90	Not stated	T0: Immediately after surgery; T1: 3 months after treatment; T2: 6 months after treatment	The SCL-90 scores were significantly lower than before treatment
Kim, 2009 ¹³	Korea	34: M 10, F 24; Age: 22.5 ± 5.65	Not stated	SCL-90, MMPI	Single oral and maxillofacial surgeon	T0: before surgery; T1: 6 months after treatment	Significant differences in personality characteristics were noticed after orthognathic surgery
Li, 2015 ¹⁴	China	36: M 16, F 20; Age: 21.7	Not stated	SCL-90	Not stated	T0: before surgery; T1: 2 years s after treatment	Depression, anxiety, phobic anxiety and psychosis were significantly higher than normal preoperatively
Scariot, 2019 ¹⁸	Brazil	44	Not stated	STAI	Not stated	T0: before surgery; T1: 1 month after treatment T2: 6 months after treatment	Preoperative trait anxiety levels can serve as an effective reference indicator for screening patients with high postoperative state anxiety
Takatsuji, 2015 ¹⁵	Japan	119: M 38, F 81; Age: 25.5 ± 9.4	Class I; Class II; Class III	MMPI	Le Fort I; BSSO	T0: before surgery; T1: 6 months after treatment	The MMPI scores for depression, hysteria, psychasthenia, and social introversion scales were significantly higher than standard values before surgery
Wang, 2024 ⁷	China	50: M 23, F 27; Age: 22.14 ± 2.31	Class III	SAAS	Le Fort I; BSSRO	T0: before surgery; T1: 6 months after treatment	Social appearance anxiety decreased
Yang, 2024 ¹⁷	China	96	Not stated	STAI	Not stated	T0: before surgery; T1: 3 months after treatment T2: 6 months after treatment	Gender and the ESR1 gene polymorphism rs9340799 were associated with anxiety levels in orthognathic surgery patients

BSSO: Bilateral sagittal split ramus osteotomy; BSSRO: Bilateral sagittal split ramus osteotomy; F: Female; M: Male; MMPI: Minnesota Multiphasic Personality Inventory; SAAS: Social Appearance Anxiety Scale; SCL-90: Symptom Checklist-90; STAI: State-Trait Anxiety Inventory.

Results of individual studies

Based on the timings for SCL-90, MMPI and SAAS assessment among the studies included in quantitative synthesis, we classified the data into three categories: before surgery, 3 months after surgery, and 6 months after surgery. We compared the depression and anxiety assessed at different times to investigate the changes in the patients' depression and anxiety after orthognathic surgery and the changes during the two distinct stages of treatment.

Of the studies included in meta-analyses, three questionnaires including SCL-90, MMPI and SAAS were involved for the assessment of depression and anxiety. Two questionnaires MMPI and SAAS focus on depression and anxiety, respectively. While the questionnaires SCL-90 focus on both depression and anxiety. We statistically synthesised the total scores for depression and anxiety for questionnaires SCL-90, MMPI and SAAS.

Effects of orthognathic surgery in questionnaire SCL-90 and MMPI for depression

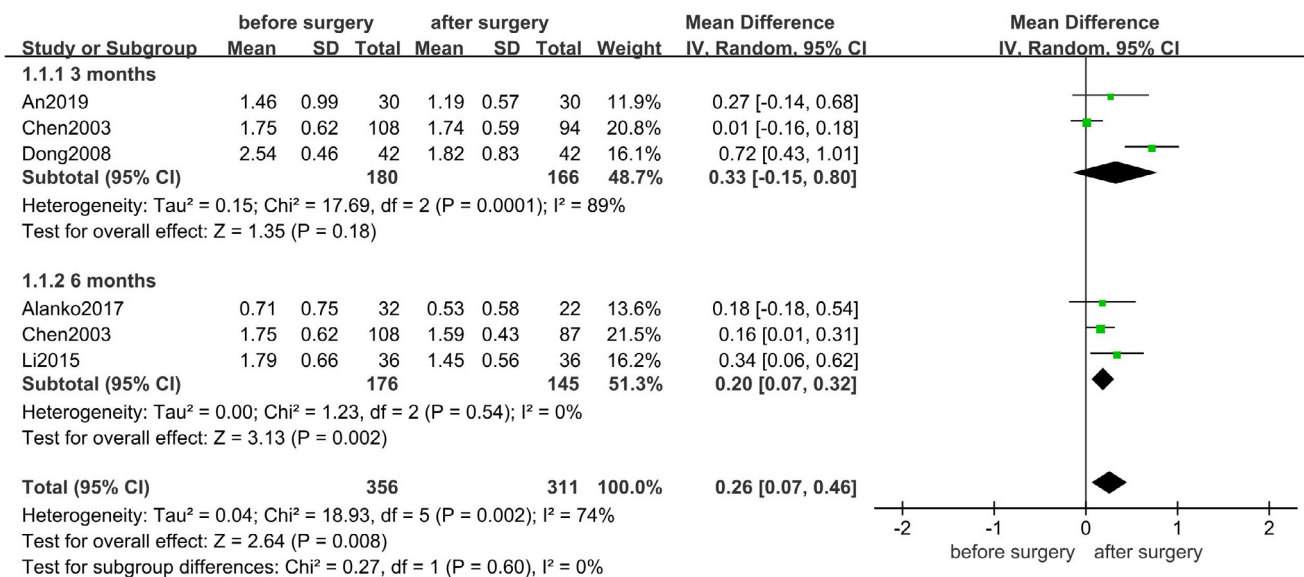
The meta-analysis showed that the scores of patients' depression at more than 6 months after orthognathic surgery were all lower than the scores before surgery in both questionnaire SCL-90 (MD 0.20, 95% CI [0.07 to 0.32]) and MMPI (MD 1.77, 95% CI [−0.50 to 4.04]) (Fig. 2). The score of depres-

sion measured by SCL-90 at 3 months after surgery was also lower than the results before surgery (MD 0.33, 95% CI [−0.15 to 0.80]). However, compared to pre-orthognathic surgery, patients at 3 months after orthognathic surgery had lower depression scores than patients more than 6 months after surgery. This seems to indicate that patients at 3 months after orthognathic surgery show a better improvement in depression than those at more than 6 months after surgery. Over time, there may be some degree of relapse in the patients' depressive state, but it is still an improvement over the preoperative period.

Effects of orthognathic surgery in SCL-90 and SAAS questionnaire for anxiety

When comparing the results of the improvements of patients' anxiety states which evaluated at more than 6 months after surgery with before surgery in both questionnaire SCL-90 (MD 0.10, 95% CI [−0.07 to 0.27]) and SAAS (MD 9.41, 95% CI [2.21 to 16.61]) (Fig. 3). The conclusions show that the patients' anxiety improved better at 3 months (MD 0.33, 95% CI [−0.14 to 0.80]) after orthognathic surgery than at more than 6 months after surgery, which is similar to the previous patients' depression. Overall, orthognathic surgery has improved patients' anxiety, except for the study Chen et al,¹⁹ which showed a slight increase in patients' postoperative anxiety status instead.

A. In the study using the SCL-90 for depression after surgery



B. In the study using the MMPI for depression after surgery

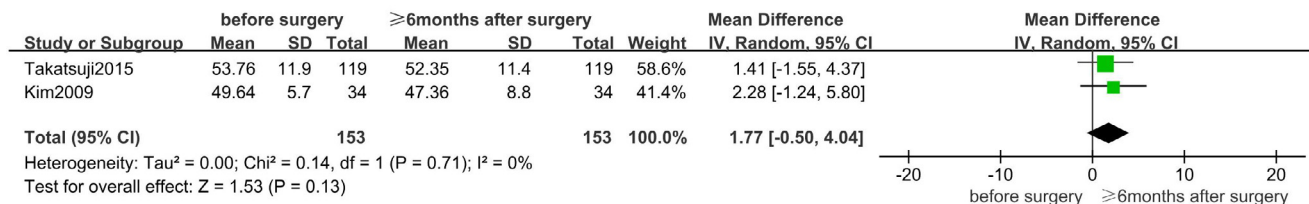


Fig. 2. Forest plot of the meta-analysis of SCL-90 and MMPI questionnaire for depression.

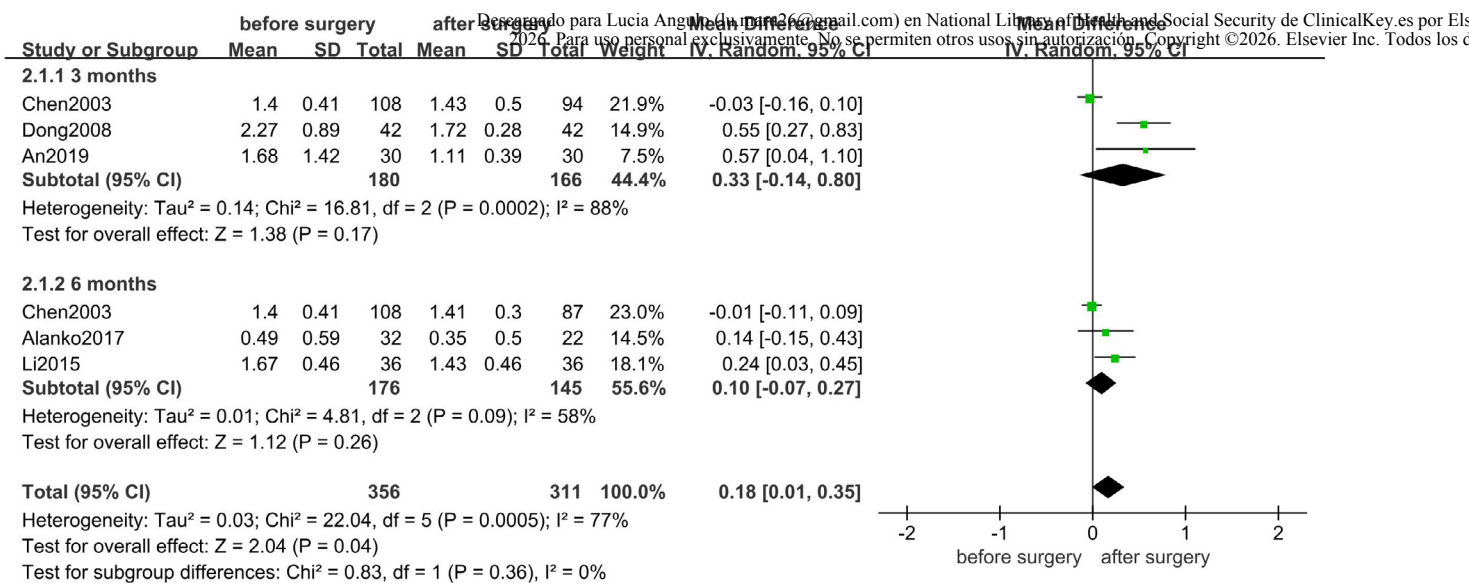
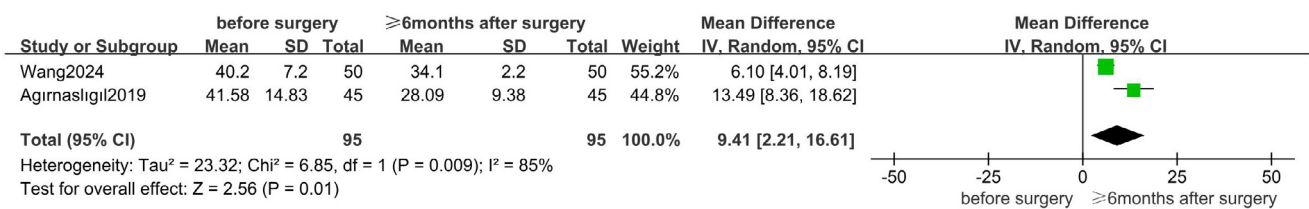
A. In the study using the SCL-90 for anxiety s after surgery**B. In the study using the SAAS for anxiety after surgery**

Fig. 3. Forest plot of the meta-analysis of SCL-90 and SAAS questionnaire for anxiety.

Discussion

This study conducted a systematic review and meta-analysis synthesising data from 10 studies to longitudinally assess the impact of orthognathic surgery on anxiety and depression in patients with dentofacial deformities. In contrast to previous research, which has often focused on single postoperative time points or short-term outcomes and been confounded by heterogeneity in statistical instruments, the study revealed the dynamic changes in psychological improvement by specifically examining three critical time points: preoperatively, 3 months postoperatively, and 6 months postoperatively. Data from standardised psychological assessment tools including the SCL-90, SAAS, and MMPI were incorporated for comprehensive cross-instrument analysis. Although conflicting findings regarding changes in patients' anxiety and depression, levels persist in the literature, the overall evidence indicates that, despite initial improvement observed from the preoperative period to 3 months postoperatively, a relapse in the severity of anxiety and depression symptoms is evident by the 6 month postoperative mark.

Although most studies failed to distinguish between skeletal Class II and Class III patients due to limited sample sizes, the aggregated data observed relapse at 6 months compared with 3 months postoperatively. Research by Mazzaferro et al²⁰ demonstrated that the psychological status of

skeletal Class II patients was generally poorer than that of Class III patients. Concurrently, studies by Duarte et al²¹ and Song et al²² revealed that Class III patients exhibited greater postoperative psychological improvement than Class II patients. Consequently, superior recovery might be anticipated in Class III patients, potentially resulting in better anxiety and depression outcomes. Also, multiple confounding factors present in the literature were neither distinguished nor excluded, thereby influencing outcomes. For instance, a significant gender imbalance was observed,^{22,23} with female participants constituting approximately two-thirds of the study cohorts, potentially affecting reported anxiety and depression levels.^{24,25} Anxiety and depression are also influenced by sociocultural factors, which vary across regions and the heterogeneous distribution of dentofacial deformities patients may limit the generalisability of the research findings.^{26,27} The prevalence of skeletal Class III malocclusion ranges from 1% to 5% in white populations, compared to as high as 14% in Asian populations.^{28,29} This explains, in part, the considerable volume of related research conducted in Asia, especially in China, which provides a large population base for such studies. Patients' socioeconomic status was also identified as influencing postoperative psychological outcomes, with the substantial financial burden of treatment compounding anxiety and depression.¹³ Additionally, pre-existing psychiatric conditions were shown

to correlate with postoperative dissatisfaction regarding aesthetics, occlusion, and functional results, adversely affecting psychological states.²² Heightened sensitivity and difficulty adapting to new facial appearance in a subset of patients may also contribute to this relapse.³⁰

Variations in assessment scales were found to generate divergent results. The SCL-90 was noted to be more sensitive to changes in psychological symptoms than other instruments, exhibiting more consistent postoperative improvements; the SAAS, which focuses exclusively on social anxiety, lacks the capacity to evaluate broader anxiety domains; and the MMPI, despite its comprehensiveness, often induced test fatigue and compromised the quality of responses owing to its length, with a typical completion time of 60 to 90 minutes.³¹ These methodological inconsistencies across studies may have introduced systematic error, potentially accounting for the apparent resurgence in anxiety and depression between 3 and 6 months. Consequently, the use of uniform standardised scales is deemed essential to determine whether this resurgence represents a genuine phenomenon or methodological artifact.³²

The 6 month postoperative time frame itself was questioned as potentially suboptimal.²¹ Residual issues such as postoperative pain were documented at this stage,²⁴ with multiple studies reporting functional deterioration in 7% of patients, reduced overall comfort due to side effects in 15%, and impaired speech in 4%.^{32–35} Negative perception of body image may persist, with the results of treatment potentially falling short of patient expectations.³⁰ Socially, recreational and social activities were observed to decline immediately after surgery, only gradually returning to preoperative levels around 9 months. This transient reduction in social engagement, coupled with the 6 month proximity to surgery, may exacerbate anxiety and depression relative to the 3 month period.³⁶ Crucially, psychological adaptation was found to stabilise only after 2–5 years, suggesting that assessment of permanent psychological impact should be deferred to this later timeframe to allow for personality integration and functional adaptation.^{5,22,36–38}

These findings above align with the theoretical frameworks of ‘body image adaptation’ and ‘social function restoration’.¹⁰ Orthognathic surgery addresses the fundamental physiological aspects of dentofacial deformities, which are known triggers for social avoidance, functional limitations, and diminished self-esteem. As noted by Motegi et al,³⁷ the recovery of essential functions such as mastication and speech, coupled with the stabilisation of facial appearance, facilitates a positive reappraisal of body image. This process, in turn, encourages greater social engagement and bolsters self-confidence, ultimately leading to a reduction in anxiety and depression. The observed resurgence at 6 months, however, may reflect the transient stress response phase within the ‘adaptation process model’, wherein significant physical and functional changes necessitate time for psychological integration. This underscores the imperative for integrating psychological support throughout the rehabilitation continuum to facilitate successful adaptation.

Surgeons should proactively inform patients that psychological recovery after orthognathic surgery often follows a non-linear trajectory. Establishing realistic expectations regarding potential mood fluctuations, particularly the possibility of a temporary relapse between 3 to 6 months postoperatively, may prevent postoperative distress and improve satisfaction. We recommend implementing a standardised follow-up protocol that includes mandatory psychological assessment at 3 and 6 months postoperatively, using consistent, validated tools like the SCL-90, Orthognathic Quality of Life Questionnaire (OQLQ) and so on. The consultation at 6 months postoperatively is crucial for identifying patients experiencing a resurgence of anxiety or depression who may benefit from prompt psychological intervention.²⁴

Several included studies were limited by small sample sizes at specific intervals, most notably at 6 months postoperatively, and inconsistent availability of complete data across all three defined time points: preoperative, 3 months, and 6 months. This limitation may introduce selection bias and diminish the statistical power of longitudinal comparisons. Furthermore, the overrepresentation of Asian studies in the literature corresponds to the higher global disease burden of dentofacial deformities in these populations. Given that the expression and experience of anxiety and depression are profoundly influenced by sociocultural factors, this imbalance may limit the generalisability of our findings to other cultural contexts. Future research should also aim to incorporate direct cross-cultural comparisons and systematically measure relevant sociocultural variables to better elucidate the mechanisms.

Conclusion

This systematic review and meta-analysis demonstrate that orthognathic surgery is associated with significant postoperative improvement in psychological status, both in anxiety and depression. However, the magnitude of this improvement exhibits a distinct dynamic trajectory over time, being most pronounced at 3 months post-surgery and showing a degree of attenuation by the 6 month follow up. The synthesised evidence further indicates that the measured psychological outcomes are substantially influenced by the specific assessment instruments employed, underscoring the critical impact of methodological heterogeneity. These findings highlight the necessity for incorporating standardised psychological assessments in future research and for integrating longitudinal, targeted psychological support throughout the patient care continuum to consolidate and sustain the mental health benefits of orthognathic surgery treatment.

Ethics approval statement

Does not apply.

Patient consent statement

Does not apply.

Permission to reproduce material from other sources

Does not apply.

Declaration of competing interest

The authors declare that they have no competing interest.

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CRedit authorship contribution statement

Chenxinzi Lin: Conceptualization, Data curation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Chuyi Liu:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. **Weiwei Huang:** Formal analysis, Investigation. **Jiangyue Wu:** Formal analysis, Investigation. **Jingyuan Zhang:** Data curation, Formal analysis. **Yawen Chen:** Formal analysis. **Qilong Wan:** Conceptualization, Supervision, Resources, Writing – review & editing.

Appendix A. Supplementary material

Supplementary material to this article can be found online at <https://doi.org/10.1016/j.bjoms.2026.03.014>.

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