Patient related outcomes and improvements in quality of life following orthognathic surgery

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Abstract

Aim: The purpose of this systematic review is to summarise the findings evaluating changes in patient quality of life (QOL) following orthognathic surgery.

Material and Methods: On-line searches were undertaken to identify suitable studies. Prospective cohort or case-control studies using questionnaires or similar assessment instruments to evaluate pre- and post-orthognathic surgery QOL were included in the analysis. QOL was assessed in the following five domains: physical functioning and limitations, physical pain, psychological well-being and self-esteem, self-perception with regards to aesthetics, and social functioning and relationships.

Results: Of the 13 studies included in the analysis most noted significant improvements in all QOL domains. The domains in which the greatest improvements were noted postoperatively were psychological well-being and self-esteem and self-perception with regards to aesthetics. The results of the Short Form Health Survey (SF-36) revealed that patients experienced no considerable changes in QOL after orthognathic surgery, while the other assessment instruments used demonstrated that patients experienced changes primarily in self-perception within the aesthetics domain.

Conclusions: The results indicate that orthognathic surgery significantly improved QOL in the five domains detailed. In particular, surgery elicited the greatest improvements in QOL in the psychological well-being and self-esteem and self-perception in the aesthetics domains.

Clinical Relevance – Orthognathic surgery to address facial disharmony is not without its risks, some being significant. Therefore, an evaluation of the benefits of such surgery would be helpful to both patients and clinicians in order to make an informed decision. This review demonstrated that orthognathic surgery generally yields significant improvements in QOL in physical functioning and limitations, physical pain, psychological well-being and self-esteem, self-perception with regards to facial aesthetics, and social functioning and relationships. Psychological well-being and self-esteem and self-perception with regards to aesthetics were the two domains in which the greatest surgery-related benefits have been observed.

Introduction

Orthognathic surgery encompasses a group of surgical procedures that are performed in conjunction with orthodontic treatment to improve functional and aesthetic defects caused by facial and dental disproportion. Orthognathic surgery was introduced more than 100 years ago, and the first mandibular osteotomy was described by Hullihen in 1849.¹ Orthognathic surgery comprise procedures involving the maxilla, mandible, or both and may be used to treat a wide variety of abnormalities, including class II and class III skeletal or dental abnormalities, abnormal occlusions, cleft palate, and several types of facial asymmetry or facial disproportions.

The human face is a critical aesthetic area; thus, its appearance can have a major impact on a patient's physiological well-being, social interactions and overall quality of life (QOL). In some patients, even slight abnormalities can negatively influence QOL.² By improving aesthetics, orthognathic surgery can play a crucial role in improving patients' self-esteem, as well as other QOL-related factors. Additionally, functionality of the face and jaws or oral cavity is also important. Orthognathic surgery can correct a poor maxilla-mandible relationship, leading to improvements in chewing, biting and speech, which can substantially improve patient satisfaction and overall well-being. The relationships between aesthetic and functional deficiencies are complex and are often affected by multiple factors. Therefore, identifying the factors that contribute to general well-being is often difficult when attempting to determine the best means of improving patient QOL. Furthermore, it is important to have evidence of patient reported outcomes following elective surgical procedures, as this is essential when justifying healthcare funding, and also to inform patients of benefit.

Validated health related quality of life questionnaires have been used for many health related studies and have provided important information relating to patient outcomes, additionally they provide an opportunity to collate the findings.

Thus, several studies have assessed the impact of orthognathic surgery on patient QOL. The purpose of this systematic review is to summarise the findings of the most recent studies regarding changes in QOL after orthognathic surgery in the following five QOL domains: physical functioning and limitations, physical pain, psychological well-being and self-esteem, self-perception with regards to facial aesthetics, and social functioning and relationships.

Material and Methods

This systematic review was performed in accordance with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.³ The search protocol is shown in Figure 1.

[Insert Figure 1 near here]

Search Strategy

Studies eligible for inclusion in the analysis were identified through searches of MEDLINE (PubMed), Web of Science ('Surgery' and 'Dentistry Oral Surgery Medicine' categories), and Scopus. The aim of this review was to summarise the most recent studies regarding changes in QOL post-orthognathic surgery; thus, the searches were limited to studies published within the last 13 years, i.e., studies published from 2005-2018. The search was also restricted to English-language studies. The final PubMed search was conducted on Feb 1st, 2018, and the other searches were completed on Feb 2nd, 2018.

Information regarding the search strategies utilised within the above databases include the following terms used to search PubMed and Web of Science:

((Orthognathic surgery) OR (treat*) OR (Correction) OR (Le Fort I osteotomy) OR (BSSO) OR (bilateral sagittal split osteotomy) OR (maxillary advancement) OR (maxillary elongation) OR (maxillary impaction) OR (mandibular advancement) OR (mandibular set back) OR (bimaxillary osteotomy) OR (osteotomy) OR (surgical) OR (orthodontic-surgical)) AND ((dentofacial deformities) OR (class II) OR (class III) OR (malocclusion) OR (facial asymmetry) OR (facial deformities) OR (skeletal discrepancy) OR (skeletal discrepancies) OR (intermaxillary relationship) OR (inter-maxillary relationship)) AND ((quality of life) OR (satisfaction) OR (questionnaire) OR (outcome) OR (perception) OR (well-being) OR (aesthetics) OR (esthetics) OR (appearance) OR (self-consciousness) OR (function*) OR (awareness) OR (limitation) OR (psychological)).

A limited number of terms may be used in Scopus searches; thus, the following three separate groups of terms were used to search this database: ((orthognathic surgery) OR (treat*) OR (correction)) AND ((dentofacial deformities) OR (class II) OR (class III)) AND ((quality of life) OR

(satisfaction)); ((Orthognathic surgery) OR (bilateral sagittal split osteotomy) OR (BSSO) OR (Le fort I osteotomy)) AND ((facial asymmetry) OR (facial deformities) OR (skeletal discrepancy) OR (malocclusion) OR (occlusion)) AND ((quality of life) OR (perception)); and ((Orthognathic surgery) OR (advancement) OR (set back) OR (bimaxillary osteotomy) OR (osteotomy) OR (surgical)) AND ((deformities) OR (malocclusion) OR (occlusion)) AND ((quality of life) OR (questionnaire) OR (appearance) OR (psychological)).

Inclusion and Exclusion Criteria

Studies were included in this review if they were prospective cohort or case-control studies, involved patients who underwent maxillary and/or mandibular orthognathic surgery (with or without other surgical procedures) to correct facial disproportion causing functional and/or aesthetic problems, and used questionnaires or similar assessment instruments to assess patients' perceptions of their QOL before and after surgery. To be included in the analysis, each study must have evaluated healthy subjects without syndromic dentofacial deformities or systemic diseases who may or may not have undergone preoperative or postoperative orthodontic treatments. Eligible studies must also have assessed patient QOL in at least one of the following domains: physical functioning and limitations, physical pain, psychological well-being and self-esteem, self-perception with regards to facial aesthetics, and social functioning and relationships.

Studies including subjects who underwent distraction osteogenesis, as well as studies that failed to exclude patients who had psychological illnesses, cleft lip and/or palate, craniofacial syndromes, traumatic facial deformities, congenital malformations, or sleep apnoea, were excluded from the analysis.

Study Selection

Titles and abstracts of the studies were then screened and identified through the abovementioned online searches to eliminate studies that clearly did not meet the inclusion criteria. Subsequently the full-text versions of the remaining studies were evaluated to determine whether they met the inclusion/exclusion criteria. Duplicate studies were also excluded from the analysis. Study selection was performed independently by the authors, and discrepancies were resolved via discussion.

Data Extraction

The authors independently extracted data pertaining to the following items from each study: the author(s), year of publication, types of participants/inclusion criteria, participants' ages, exclusion criteria, types of QOL questionnaires or instruments used therein, QOL assessment schedules, types of data analyses, and outcomes. Discrepancies were resolved by discussion. If necessary, the study authors were contacted to obtain missing information.

Critical Appraisal of the Included Studies

Each study included in the analysis was critically appraised, as recommended in the Critical Appraisal Skills Programme (CASP) Cohort Study Checklist and CASP Case Control Checklist.⁴ The appraisal entailed the performance of assessments for selection bias, as well as bias resulting from differences in sample size, interventions, outcome measurements (appropriate use of questionnaires and timing of assessments), confounding factors, follow-up periods and assessment schedules. Study appraisal was also performed independently by the two authors, and disagreements were resolved via discussion.

Results

Study Selection

A total of 30,635 articles were retrieved through the above database searches. After excluding duplicate articles and removing studies that did not fulfil the inclusion criteria, we ultimately included 13 studies in this systematic review. Information regarding the study selection process is depicted in Figure 1.

Study Characteristics

The characteristics of the 13 included studies (involving 918 participants) are shown in Table 1. Twelve studies were prospective cohort studies, and one study was a prospective case-control study. Questionnaires were used to assess various aspects of patient QOL before and after orthognathic surgery in all studies. Only one prospective case-control study also assessed control subject QOL. The mean sample size was 57 (range, 15 to 152), and participants' ages ranged from 11 to 61 years. The studies were conducted in various geographic regions. Specifically, five studies were conducted in

Europe, four studies were conducted in Asia, three studies were conducted in South America, and one study was conducted in Africa. The critical appraisal of the included studies, including an evaluation of study bias is shown in Table 2.

[Insert table 1 near here]

[Insert table 2 near here]

The majority of the studies included herein recruited participants who underwent various types of orthognathic surgery. Three studies included only patients who underwent bimaxillary osteotomies, and one study included only patients who underwent bilateral sagittal ramus osteotomy for class III skeletal deformities. The following QOL assessment tools were used: the Oral Health Impact Profile-14 (OHIP-14; see Supplementary Data S1),⁵ in 6 studies; the Orthognathic Quality of Life Questionnaire-22 (OQLQ-22; see Supplementary Data S2),⁶ in 5 studies; the Short Form Health Survey (SF-36; see Supplementary Data S3),^{7,8} in 4 studies; the Oral Health Impact Profile-49 (OHIP-49; not shown),⁹ in 1 study; the World Health Organization Quality of Life,¹⁰ in 1 study; and the Derriford Appearance Scale 59 (DAS59; not shown),¹¹ in 1 study. Four studies used their own investigator-created (and non-validated) questionnaires, and many studies used more than one assessment instrument. One study¹² using the OHIP-14 added 3 additional questions regarding discomfort during chewing, satisfaction with facial aesthetics, and loss of sensation, respectively. No study was free of bias.

Domain Outcomes

Physical Functioning and Limitations

Twelve studies assessed whether patients experienced changes in physical functioning and limitations after orthognathic surgery. Some used one type of questionnaire, whereas others used more than one type of questionnaire to assess this domain. As shown in Table 3, most of the studies¹³⁻¹⁷ using the OHIP-14 and OQLQ-22 reported that patients experienced significant improvements in physical functioning and functional limitations after orthognathic surgery, whereas the four studies using the

SF-36 reported that patients did not experience significant improvements in physical functioning post-surgery.^{13,14,18,19} Other studies using different types of assessment instruments also reported that patients experienced improvements in physical functioning and limitations. For example, Silva et al.²⁰ used the WHOQOL-Brief questionnaire and reported that 40% of participants had 'bite problems' preoperatively and that 86.7% of patients reported a high physical score postoperatively. Modig et al.²¹ used an investigator-created questionnaire, namely, the OHIP-49, and telephone interviews and reported that 18.6% of 32 participants initially sought treatment to improve their chewing ability, and 4.1% of participants sought treatment to improve their pronunciation ability. Postoperatively, 91% of patients reported improvements in their chewing ability, and 19% reported improvements in their speech.

[Insert table 3 near here]

Physical Pain

Seven studies assessed whether patients experienced changes in physical pain after surgery. Six studies used the OHIP-14, and three used the SF-36. As shown in Table 4, most of the studies using the OHIP-14^{13,14,16,17} reported that patients experienced significant improvements in physical pain postoperatively, whereas all the studies using the SF-36 questionnaire reported that patients experienced no changes in physical (bodily) pain after surgery.^{13,16,17}

[Insert table 4 near here]

Psychological Well-Being and Self-Esteem

Eleven studies assessed whether patients experienced changes psychological well-being and self-esteem. Six studies used the OHIP-14, four studies used the SF-36, five studies used the OQLQ-22, and one study used another assessment instrument. As depicted in Table 5, all of the studies using the OHIP-14 postoperatively,^{12-15,16,17,23} some of the studies^{13,18} using the SF-36, and most of the studies^{14,15,22} using the OQLQ-22 (awareness domain) noted that patients experienced improvements in psychological well-being and self-esteem postoperatively. In the lone study using other assessment instruments to assess whether patients experienced changes in this domain, Silva and colleagues²⁰

reported that participants experienced minimal changes in self-esteem; however, these authors also noted that most of their patients had exhibited high self-esteem before surgery. Moreover, two of the three subjects who exhibited fair self-esteem preoperatively exhibited good self-esteem postoperatively.

[Insert table 5 near here]

Self-perception with regards to facial aesthetics

Ten studies assessed whether patients experienced changes in self-perception with regards to facial aesthetics. Specifically, five studies used the OQLQ-22, and five studies used other assessment tools. All studies noted that patients experienced improvement in this domain after orthognathic surgery (Table 6).

[Insert table 6 near here]

Social Functioning and Relationships

Twelve studies assessed whether patients experienced improvements in social functioning and relationships. Six studies used the OHIP-14, four studies used the SF-36, five studies used the OQLQ-22, and two studies used other assessment tools. As shown in Table 7, studies^{13,14,16} using OHIP-14 reported that patients generally experienced moderate improvement in this domain after orthognathic surgery, and studies^{13,14,15,22} using the OQLQ-22 reported that patients experienced moderate or large improvement in this domain post-surgery. Studies using the SF-36 reported that patients experienced variable improvements in social functioning and relationships,^{13,14,18,19} and the two studies^{20,21} using other assessment tools reported mixed results with respect to the changes that patients experienced in the indicated domain. Silva et al.¹⁹ reported that 64.3% of participants experienced no changes in their professional relationships, 21.4% of participants experienced slight changes in their professional relationships, and 14.3% of participants experienced significant changes in their professional relationships postoperatively. These authors also reported that 60% of participants reported no changes in their social relationships, whereas 20% of participants noted slight improvement in their

social relationships, and 20% of participants reported significant improvement in their social relationships postoperatively. Modig et al.²¹ reported that 12% of participants tended to avoid public places and that 17% of participants had difficulty with respect to opposite-sex relationships preoperatively. However, these authors noted that 72% of participants felt more secure with respect to meeting people postoperatively.

[Insert table 7 near here]

Discussion

The aim of this systematic review was to assess changes in patient QOL in five domains following orthognathic surgery. We observed significant heterogeneity among the 13 included studies with respect to the populations evaluated and the orthognathic procedures, assessment tools, assessment schedules, and follow-up durations used therein. Thus, it was not appropriate to pool the data for meta-analysis.

Quality of Life Outcomes

Overall, the studies reported that patients experienced moderate or large changes in QOL after undergoing orthognathic surgery. Significant improvements were observed in all five QOL domains. Therefore, it is reasonable to conclude that orthognathic surgery has a substantial positive impact on QOL among patients who seek treatment for their conditions.

The greatest improvements in QOL were observed in the ‘psychological well-being and self-esteem’ and ‘self-perception with regards to facial aesthetics’ domains. Most of the studies using the OHIP-14 noted that patients experienced more significant changes in psychological distress/discomfort and disability than in any other aspects of their lives. The effect sizes for changes in these two categories were considered large (0.84 and 0.83), whereas the effect sizes for changes in the other domains were considered moderate (0.65 to 0.77) in the study by Göelzer et al.¹⁶ The effect sizes for changes in the two domains were also larger than those in all the other domains in the two other studies^{13,14} reporting effect sizes for changes in OHIP-14 psychological categories. In studies

using the OHIP-14 that did not calculate effect sizes, the mean differences for these two psychological categories were greater than those for all the other OHIP-14 domains.

Of the five domains, self-perception with regards to facial aesthetics demonstrated the greatest change in every study using the OQLQ-22. Choi et al.¹⁴ and Lee et al.¹³ reported effect sizes of 1.52 and 1.01, respectively, for postoperative changes in QOL in the aesthetic domain. Similarly, Murphy et al.¹⁵ and Soh and Narayan²² reported effect sizes for changes in QOL in the aesthetic domain that were greater than the corresponding effect sizes for changes in QOL in the other domains. In the study by Rustemeyer and Gregersen,¹² an additional question regarding patient satisfaction with respect to aesthetic changes (known as AD-2) demonstrated a larger improvement after surgery than the other OHIP-14 items.

Our finding that psychological well-being and self-esteem and self-perception with regards to facial aesthetics were the domains influenced most positively by orthognathic surgery is consistent with the findings of two previous systematic reviews.^{25,26} Furthermore, our observation that patients experienced substantial benefits in both domains suggests that they may be interrelated. Thus, it may be useful for future studies to investigate the potential correlation between the two domains.

Our finding that surgery had a significant impact on aesthetic outcomes indicates that aesthetics is one of the most important issues to consider when planning orthognathic surgery. The finding is also consistent with the findings of previous studies,^{24,26-28} in which appearance improvement was one of the most popular reasons why patients sought orthognathic surgery. Interestingly, although oral functional improvement was the most common factor that motivated patients to undergo surgery in several studies^{21,29-31} the findings of the current review, which are based on patient responses to relevant questionnaire items, demonstrate that function does not appear to improve as much as aesthetics and psychological being. Despite the fact that post-surgery aesthetic changes are an important factor in patient decisions regarding surgery, many previous studies used questionnaires such as the SF-36 or OHIP-14, which do not include an aesthetic domain, to assess changes in QOL after orthognathic surgery. Future studies should use questionnaires with specific dentofacial aesthetic domains or incorporate additional assessment methods to review the changes in aesthetics experienced by patients who have undergone orthognathic surgery.

Outcomes and Assessment Tools

The current review showed that the SF-36, in contrast to most other evaluation instruments, often reported that patients experienced minimal or no changes in all the indicated domains. This finding may be attributable to the fact that almost every SF-36 question refers to general health- as opposed to dento-facial-related issues. For instance, the questions regarding changes in physical function pertain to activities such as running or walking. Additionally, the SF-36 questionnaire includes no questions regarding the aesthetic domain, whose importance is discussed above. Therefore, the SF-36 is a less appropriate tool for assessing QOL in patients with dento-facial abnormalities than other more condition-specific assessment tools.

The OHIP-14 was useful for assessing changes in the following four domains: physical functioning and limitations, physical pain, psychological well-being and self-esteem, and social functioning and relationships, and therefore focused on key outcomes that would be assessed following surgery that would be important to patients. The changes in QOL detected by the OHIP-14 were similar to those detected by the OQLQ-22 and other assessment instruments. Thus, although the OHIP-14 was designed to assess general oral health-related QOL, it is also capable of evaluating QOL before and after orthognathic surgery. However, as is the case with the SF-36, the OHIP-14 does not include an aesthetic domain section. Therefore, one should consider modifying the OHIP-14 or asking additional aesthetics-related questions when using the questionnaire for studies involving patients who have undergone orthognathic surgery. However, any questionnaire modifications or additional questions employed in such studies should be validated and standardised so that the outcome data obtained therein can be reliably pooled in future meta-analyses.

The OQLQ-22 also noted significant changes in the functional, psychological, and social domains after orthognathic surgery, changes that were generally greater than those noted by the OHIP-14 in the same domains, with the exception of the psychological domain. As noted above, of all the domains assessed by the indicated questionnaire, the aesthetic domain displayed the greatest changes. These results are similar to those obtained using the global transitional scale (GTS), which was used to confirm the results of the OQLQ-22 in the study by Murphy et al.¹⁵ wherein 46% of participants who completed the GTS reported large improvements in appearance surpassing those in other domains (including appearance, chewing, comfort, and speech). However, the OQLQ-22 lacks a

domain for assessing pain, an important QOL determinant in patients undergoing orthognathic surgery. Assessing pain related to temporomandibular disorders (TMDs) is particularly important, as such disorders are very common in patients with dento-facial abnormalities.³²⁻³⁴ Some studies^{35,36} have demonstrated that TMDs worsened significantly after orthognathic surgery, whereas other studies^{37,38} have reported that TMDs improved significantly. Using the OQLQ-22 and OHIP-14 together is an option for overcoming the deficiencies of each assessment tool, and such a strategy was used by some of the studies^{13,14} included in this review.

Regarding the other assessment tools used by studies included in this review, the non-validated (investigator-created) questionnaires, VAS, WHOQOL-Brief, and DAS59 demonstrated no significant changes in the psychological domains. Social functioning outcomes remained unchanged in the study by Silva et al.²⁰ but reportedly improved in the study by Modig et al.²¹ However, the results of the latter study were not conclusive, as the preoperative and postoperative data reported therein did not pertain to equivalent outcomes. The preoperative data pertained to questions regarding avoidance of public places and relationships with the opposite sex, whereas the postoperative data pertained to questions regarding feelings of security when meeting people. In contrast, other assessment tools noted dramatic changes in aesthetic outcomes. Silvola et al.¹⁷ and Rustemeyer and Gregersen¹² both reported changes in aesthetic-related scores that were greater than those in other domains. Similarly, Sadek and Salem²⁴ noted significant improvements in all three domains of the DAS59 (a questionnaire that specialises in assessing subjective perceptions of aesthetics) following surgery. These results highlight the importance of evaluating changes in self-perceptions with respect to facial aesthetics when assessing orthognathic surgery outcomes.

Limitations

Only one study, namely, the study by Göezler et al.¹⁶ assessed the relationship between postoperative hypoesthesia and the above QOL domains. In that study, 72% of participants reported loss of sensation; however, OHIP domain scores did not differ between patients with or without hypoesthesia. Further studies are required to explore this relationship, as neurosensory disturbances after orthognathic surgery are relatively common and may affect patient QOL.^{39,40}

Additionally, bias likely affected the results of the included studies. The objective of this review was to summarise the results of studies regarding orthognathic surgery; however, many studies^{12-14,18,22} recruited only participants who had specific type(s) of dento-facial deformities or required only a specific orthognathic procedure. Therefore, it may be inappropriate to extrapolate the results of these studies to the entire orthognathic surgery population. Preoperative assessments and pre-surgical orthodontic procedures, which were performed in some studies,^{13,15,16,18-22,24} may have been another source of bias, as the orthodontic treatments themselves may have affected the accuracy of the assessment tools utilised in the studies included in this review.

Furthermore, many studies did not calculate effect sizes for changes in specific QOL domains between the pre- and postoperative periods, which reduced the ability of the studies in question to quantify any changes in QOL.

Conclusions

This review demonstrated that orthognathic surgery generally yields significant improvements in QOL in the following five main domains: physical functioning and limitations, physical pain, psychological well-being and self-esteem, self-perception with regards to facial aesthetics, and social functioning and relationships. Psychological well-being and self-esteem and self-perception with regards to aesthetics were the two domains in which the greatest surgery-related benefits were observed. Thus, aesthetic domains should be assessed in any future studies examining outcomes after orthognathic surgery. The SF-36 is not suitable for evaluating QOL in patients undergoing orthognathic surgery. The OHIP-14 and OQLQ-22 are more useful assessments tools than the SF-36; however, they should be modified and/or used in combination to optimally assess changes in QOL in patients undergoing orthognathic surgery.

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Conflict of Interest

The authors confirm there are no conflicts of interest regarding the publication of this manuscript.

Ethical Approval - No ethical approval was required for this review.

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Figure Legends

Figure 1. Flow diagram of the study selection process

Table 1. Characteristics of the Included Studies

Table 2. Critical Appraisal of the Included Studies

Table 3. Physical Function and Limitation Before and After Orthognathic Surgery

Table 4. Physical Pain Before and After Orthognathic Surgery

Table 5. Psychological Well-being and Self-esteem Before and After Orthognathic Surgery

Table 6. Self-perception with Regards to Facial Aesthetics Before and After Orthognathic Surgery

Table 7. Social Functioning and Relationships Before and After Orthognathic Surgery

Table 1. Characteristics of the Included Studies

Study authors	Study design	Participants	Sample size	Age (y)	Exclusion criteria	Instruments	Assessment schedule	Outcomes	Data analysis
Göelzer et al. ¹⁵	Prospective cohort	Patients with dento-facial deformities (including Angle class I, II, and III deformities) who presented for treatment from 2010 to 2013	74	15-53 (28.0±9.0)	Patients with cleft lip and palate, syndromes, facial deformities caused by trauma or congenital malformations, pre-existing systemic disease, pregnancy, <15 years old	OHIP-14; questions on degree of lip hypoesthesia (ratings ranged from 'none' [score, 1] to 'extreme' [score, 5])	Preop: OHIP-14 before surgery (T ₀) Postop: OHIP-14 and hypoesthesia questions at 4-6 months after surgery (T ₁)	Pre- and postop OHIP-14 scores	Kolmogorov–Smirnov test to assess data normality; Fisher's exact test to assess the associations among gender, age, type of surgery, and type of deformity; Wilcoxon matched-pairs test to assess the changes in OHIP-14 scores between T ₀ and T ₁ ; calculation of test power and effect sizes; Spearman's correlation coefficient to assess the correlations between the above changes in OHIP-14 scores and OHIP-14 domains; level of significance set at 5%
Choi et al. ¹³	Prospective	All ASA class I	32	23.94±	Patients with	SF-36, OHIP-	Preop: all	Pre- and	Overall scores and

	cohort	and II patients		6.65	physical	14, OQLQ-22	questionnaires	postop SF-36,	separate domain scores
		scheduled to			disabilities;		at recruitment	OHIP-14, and	were obtained;
		undergo			pain or		(T ₀)	OQLQ-22	Friedman 2-way
		bimaxillary			discomfort in		Postop: all	scores	ANOVA to assess QOL
		surgery and			any part of		questionnaires		scores; Wilcoxon
		receive			the body;		at 6 weeks		signed-rank test to
		orthodontic			syndromes or		post-surgery		assess the differences in
		therapy			congenital		(T ₁), 6 months		QOL scores between T ₀
					deformities,		post-surgery		and T ₁ , T ₀ and T ₂ , and
					such as cleft		(T ₂), and after		T ₀ and T ₃ ; calculation of
					lip and palate;		orthodontic		effect sizes
					and any		treatment (T ₃ ; at		
					previous jaw		least 12 months		
					surgery		after surgery		
							and 6 months		
							after		
							orthodontic		
							treatment)		
Khadka et al. ¹⁸	Prospective case-control	Group A: participants who underwent pre-op orthodontic treatment and required orthognathic surgery	152 (Group A: 110 Group B: 42)	Group A: 18-34 (22.86) Group B: 20-37 (27.21)	Both groups: Patients with physical disabilities, acquired or congenital deformities, or any	SF-36, OQLQ-22	Preop: all questionnaires at 30 days before surgery Postop: all questionnaires at 6-8 months post-surgery	Pre- and postop SF-36 and OQLQ-22 scores	Calculation of mean, SD, median, and 25th- and 75th-percentile scores; Wilcoxon signed-rank test to assess the differences in QOL scores between the two times; Mann-Whitney U

		(primarily class II or class III malocclusion or jaw asymmetries requiring several types of orthognathic surgery)			previous jaw surgeries		(after completing postop orthodontic treatment)	test to assess the differences between groups both pre-op and postop; level of significance set at 5%
		Group B: participants with square faces or prominent zygoma requiring mandibular outer cortex ostectomy, mandibular angle ostectomy, “V” line ostectomy, or zygomatic “L”-shaped osteotomy			Group A: Patients requiring surgical correction for high zygoma, square face, or retrogenia; or patients requiring osteodistraction			
					Group B: Patients undergoing orthodontic treatment			
Rustemeyer et al. ²¹	Prospective cohort	Patients with skeletal	30	24.3±4.5	Patients with cleft lip and	OHIP-14, lateral	Preop: 6.2±1.2 months before	Pre- and postop Kolmogorov-Smirnov OHIP-14 scores test to assess data

		malformations displaying mandibular prognathia with class III malocclusion			palate, craniofacial syndromes, or post-traumatic deformities; patients scheduled to undergo orthognathic surgery without orthodontic treatments or additional procedures, such as genioplasty or distractor device placement	cephalometry	presurgical orthodontics	Post-op: 8.3±1.2 months after orthodontic appliance removal	and cephalometric hard and soft tissue landmarks and angles	normality; paired t test to assess the differences between groups; level of significance set at 5% and 0.1%; Pearson correlation analysis to assess the correlation between the changes in OHIP-14 item scores and those in soft and hard tissues
Silvola et al. ¹⁶	Prospective cohort	Patients requiring either orthodontic or surgical-orthodontic treatment who	52 (orthognathic surgery group: 38,	18-61 (21.0±4.1)	NR	OHIP-14 (Finnish version); VAS; Aesthetic Component	Preop: OHIP-14, VAS, and AC scores before starting treatment.	Postop: OHIP-	Pre- and postop OHIP-14, VAS, and AC scores	Calculation of mean values and changes in instrument scores; paired t test to assess the differences before and after treatment; study

		had severe skeletal malocclusion (diagnosed by cephalometry) and functional disorders, such as pain, traumatic occlusion, or difficulty masticating.	orthodontic group: 14)			(AC) of the Index of Orthodontic Treatment Need score (assessed by laypersons, dental students, and orthodontists using standardized dental photographs)	14 and VAS scores at 3.1±1.22 y after treatment and AC scores at 3.0±1.07 y after treatment		group was divided into subgroups according to aesthetic satisfaction quartiles to determine the relationship between aesthetic satisfaction and OHIP-14 scores using univariate general linear modelling; Pearson correlation analysis to evaluate the correlations between changes in OHIP-14 scores and patient aesthetic satisfaction and AC scores
Nicodemo et al. ¹⁷	Prospective cohort	Patients with Angle's class III malocclusion (negative overjet ≥4 mm) and indications for surgical treatment who	29	17-46	NR	SF-36	Preop: 30 days before surgery Postop: 6 months after surgery	Preop and postop SF-36 scores	Descriptive statistics and inferential analysis used to characterize and compare variables; repeated measures ANOVA to compare types of surgery, gender, and time periods (pre- and postop); multiple comparisons using

		had undergone orthodontic preparation for 1-1.5 y							Bonferroni's test to identify the specific items responsible for the differences in the ANOVA results; level of significance set at 5%; Pearson correlation coefficients to examine the correlation between antero-posterior discrepancies and QOL
Silva et al. ¹⁹	Prospective cohort	Patients with dento-facial deformities who underwent corrective orthognathic surgery	15	17-35 (25±5.7)	Patients with cleft lip or palate or other uncontrolled pathology	Preop self-administered, investigator-created questionnaire; postop self-administered, investigator-created questionnaire; WHOQOL-BREF	Preop: Preop questionnaire on day of hospitalization Postop: postop questionnaire and WHOQOL-BREF	Participants' preop and postop questionnaire responses, postop WHOQOL-BREF score	Collection of absolute and percentile distributions; McNemar's test; Fisher's exact test; Student's t test with equal and unequal variables; Levene's F test to verify the hypothesis
Lee et al. ¹²	Prospective cohort	Patients with ASA class I or II	36	23.25±6.60	Patients with physical disability,	SF-36, OHIP-14, OQLQ-22	Preop: all questionnaires completed at	Preop and postop SF-36, OHIP-14,	Obtaining overall and domain scores; Wilcoxon signed-rank

		malocclusion who completed pre-surgical orthodontic treatment and were about to undergo bimaxillary orthognathic surgery			pain or discomfort in any body part; patients with syndromes or congenital deformities, such as cleft lip and palate; or patients with any previous jaw surgery		recruitment (T ₀) Post-op: all questionnaires completed at 6 weeks (T ₁) and 6 months post-surgery (T ₂)	OQLQ-22 scores	test to assess the differences in QOL scores between T ₀ and T ₁ and T ₀ and T ₂ ; Mann-Whitney U test to perform between-group comparisons; calculation of effect sizes
Rustemeyer and Gregersen ¹¹	Prospective cohort	Patients with skeletal class II or III malocclusion	50	18-52 (26.9±9.9)	Patients with cleft lip or palate or craniofacial syndromes; patients scheduled to undergo orthognathic surgery without orthodontic	OHIP-14 with 3 additional questions (AD-1, AD-2, and AD-3)	Preop: OHIP-14, AD-1, and AD-2 at 9.1±2.4 months pre-surgery Postop: OHIP-14, AD-1, AD-2, and AD-3 at 12.1±1.4 months after surgery	Preop and postop OHIP-14 scores and additional questions	Kolmogorov–Smirnov test to assess data normality; 2-tailed t-test to assess the differences between the subgroups; Pearson correlation to assess the correlations between variables; level of significance set at 5% and 0.1%

					treatments or additional procedures, such as genioplasty or distractor device placement				
Murphy et al. ¹⁴	Prospective cohort	Patients with congenital deformities of the maxilla and/or mandible or both (without symptoms suggestive of a syndrome)	52	18-38 (21.6)	NR	OQLQ-22, VAS, GTS	Preop: OQLQ-22 and VAS during the orthodontic treatment phase Postop: OQLQ-22, VAS, and GTS at 6 months after surgery	Preop and postop OQLQ-22, VAS, and GTS scores	Determination of descriptive statistics; paired t tests to assess the differences between pre- and post-treatment scores; significance level set at 5%; calculation of effect sizes for each domain
Soh and Narayanan ²²	Prospective cohort	Patients with dentofacial deformities and indications for orthognathic surgery	66	18-30 (23.4)	Patients with congenital craniofacial deformities, cleft lip and palate, a history of	OQLQ-22 with 3 additional postop questions	Preop: OQLQ-22 during pre-surgical orthodontic phase Postop: OQLQ-22 with	Pre-op and postop OQLQ-22 and postoperative questions scores	Paired t tests to assess the differences between pre- and post-treatment scores; 1-way ANOVA to assess the differences in pre-op and postop scores between

					previous orthognathic surgery, and an inability to complete the questionnaire		3 additional questions at least 6 months after surgery		different types of dento-facial deformities; significance level set at 5%; calculation of effect sizes for each domain
Modig et al. ²⁰	Prospective cohort	Consecutive healthy patients who underwent combined surgical-orthodontic treatment from 1999–2001 and had completed a preop questionnaire (Questionnaire 1)	32	20-59 (32)	NR	Questionnaire 1 (assessment of previous experience with and knowledge of malocclusion and treatment options, medical and psychological function and appearance); Questionnaire 2 (assessment of treatment impact; VAS used for some outcomes); OHIP-49; telephone	Preop: Questionnaire 1 Postop: Questionnaire 2, OHIP-49, and telephone interview	Participants' responses to questionnaire s and telephone interview; postop OHIP-49 score	NR

Sadek and Salem ²³	Prospective cohort	Patients with dento-facial deformities and indications for orthognathic surgery	120	11-33 (21.0±4.1)	NR	interview Investigator-created questionnaire, DAS59, VAS for patient satisfaction	Preop: first part of an investigator-created questionnaire and DAS59 Postop: second part of the questionnaire, VAS, DAS59	Participants' responses to questionnaires; pre-op and postop DAS59 scores	t-test to assess the differences between pre-op and postop DAS59 scores; Pearson correlation analysis to determine the correlation between surgical outcomes and patient postop satisfaction
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Age data are presented as means, means $\pm$ standard deviations, and/or ranges.

Abbreviations: ANOVA, analysis of variance; ASA, American Society of Anesthesiologists; DAS59, Derriford Appearance Scale 59; GTS, global transition scale; NR, not reported; OHIP-14, Oral Health Impact Profile-14; OHIP-49, Oral Health Impact Profile-49; OQLQ-22, Orthognathic Quality of Life Questionnaire-22; preop, preoperative; postop, postoperative; QOL, quality of life; SF-36, Short Form Health Survey; VAS, visual analogue scale; WHOQOL-BREF, World Health Organization Quality of Life-BREF

Table 2. Critical Appraisal of the Included Studies

Study authors	Type of bias assessment						
		Sample selection	Sample size	Type of intervention	Bias in outcomes measurement	Confounding factors	Follow-up
Göelzer et al. ¹⁵	Risk rating	Low	Low	High	Medium	High	Low
	Rationale for rating	Patients with dentofacial deformities were recruited.	74 participants	No clear mention of the types of orthognathic procedures	Questionnaires were completed by each participant before and after surgery; preop orthodontics may have affected the preop assessment.	Participants were wearing orthodontic appliances, so the outcomes may not have been accurate.	The second questionnaire was completed 4-6 months post- surgery.
Choi et al. ¹³	Risk rating	High	Medium	High	Low	Low	Low
	Rationale for rating	Patients undergoing bimaxillary osteotomy were recruited, so the results may not be applicable to patients undergoing monomaxillary	32 participants	Only bimaxillary osteotomy.	Participants completed 3 questionnaires (SF- 36, OHIP-14, and OQLQ-22) preoperatively upon recruitment and at 6 weeks, 6 months, and at least 12 mo after surgery (after	Assessments were conducted at recruitment and after completion of post-surgical orthodontic treatment, so the accuracy of assessments was not affected.	The last questionnaire was completed at least 12 months after surgery (6 months after completion of orthodontic treatment).

		surgery.			postop orthodontic treatment was complete).		
Khadka et al. ¹⁸	Risk rating	Medium	Low risk	Low risk	Medium risk	High risk	Low risk
	Rationale for rating	Patients in the orthognathic group (Group A) mainly had class II or III malocclusion or asymmetric jaw-related abnormalities .	110 participants	Sagittal split osteotomy, intraoral vertical ramus osteotomy, Le Fort I osteotomy, and anterior sub-apical segmental osteotomy.	Participants were assessed 30 days preoperatively (the accuracy of these measurements may have been affected by preop orthodontics) and 6-8 months after surgery after completing postop orthodontics.	Participants were assessed preoperatively while undergoing orthodontic treatment.	The last questionnaires were completed 6-8 months after surgery.
Rustemeyer et al. ²¹	Risk rating	High	Medium	High	Low	Low	Low
	Rationale for rating	Only participants with mandibular prognathia and class III malocclusion were recruited.	30 participants	Only bilateral sagittal split ramus osteotomy.	Each patient completed 1 questionnaire before the orthodontic appliances were applied (6.2±1.2 months before surgery) and another	Assessments were performed before the preop orthodontics were applied and after the postop orthodontic treatments were finished.	The last questionnaire was completed 8.3 ± 1.2 months after surgery (after orthodontic appliance removal).

					after the appliances were removed (8.3±1.2 months after surgery).		
Silvola et al. ¹⁶	Risk rating	High	Medium	Low	Medium	Low	Low
	Rationale for rating	Patients requiring surgical- orthodontic (or orthodontic treatment alone) treatment for severe skeletal malocclusion were recruited. Specific types of malocclusion were not mentioned.	38 participants (surgical group)	Sagittal ramus osteotomy and/or Le Fort I osteotomy	Assessments were performed by questionnaire before treatment and 3.1±1.22 y after treatment. Confounding orthodontic treatments were excluded.	The recruited participants were assessed before preop orthodontic treatment and after postop orthodontic treatment.	The last questionnaire was completed 3.1±1.22 y after active treatment.
Nicodemo et al. ¹⁷	Risk rating	High	Medium	Low	Medium	High	Low
	Rationale for rating	Only patients with Angle's class III malocclusion who required surgical treatment and had undergone preop	29 participants	Bimaxillary osteotomy and monomaxillary osteotomy techniques.	The validated Brazilian SF-36 questionnaire was used for the preop assessment when the participants	The participants were wearing orthodontic appliances, so the outcomes may not have been accurate.	The last questionnaire was completed 6 months after treatment.

		orthodontic treatment were recruited.			were undergoing orthodontic treatment (which may have affected the accuracy of the assessments) and was administered 6 months after surgery.		
Silva et al. ¹⁹	Risk rating	Low	High	Low	High	High	Low
	Rationale for rating	Patients with dentofacial deformities who required orthognathic surgery were recruited.	15 participants	Maxillary advancement or mandibular setback or both (bimaxillary surgery).	The validity of the preop and postop investigator-created questionnaires was not clear.	Whether the participants underwent orthodontic treatment was not mentioned.	The last questionnaire was completed 6 months after treatment.
Lee et al. ¹²	Risk rating	High	Medium	High	Medium	High	Low
	Rationale for rating	Only patients undergoing bimaxillary orthognathic surgery were recruited.	36 participants	Only bimaxillary osteotomy, so the results may not have been applicable to patients undergoing monomaxillary surgery.	Data were collected by the SF-36, OHIP-14, and OQLQ-22 during recruitment (which was after the completion of preop	The participants were wearing orthodontic appliances, so the outcomes may not have been accurate.	The last questionnaire was completed 6 months after treatment.

					orthodontic treatment, so the accuracy of the assessments may have been affected), 6 weeks after surgery, and 6 months after surgery.		
Rustemeyer and Gregersen ¹¹	Risk rating Rationale for rating	Medium Only patients with skeletal class II or III malocclusion were recruited	Medium 50 participants	High Only bimaxillary osteotomy, so the results may not have been applicable to patients undergoing monomaxillary surgery.	Low OHIP-14 questionnaires were completed before the initiation of preop orthodontic care (9.1±2.4 months before surgery) and after the completion of postop orthodontics and the removal of osteosynthesis plates and screws (12.1±1.4 months after surgery). Thus, these confounding	Low There were minimal confounding factors.	Low The last questionnaire was completed 12.1±1.4 months postoperatively.

					factors were excluded, which minimized the risk of this bias.		
Murphy et al. ¹⁴	Risk rating	Low	Medium	Low	Medium	High	Low
	Rationale for rating	Patients with maxilla and/or mandibular congenital deformities were recruited. The dentofacial deformities were not syndromic.	52 participants	Bimaxillary or monomaxillary surgery.	Data were collected with the OQLQ-22, VAS, and GTS during the preop orthodontic phase of treatment (which may have affected accuracy of the assessments) and 6 months after surgical treatment.	Participants were wearing orthodontic appliances, so the outcomes may not have been accurate.	The last questionnaire was completed 6 months after treatment.
Soh and Narayanan ²²	Risk rating	Low	Medium	Low	Medium	High	Low
	Rationale for rating	Patients with dentofacial deformities who were undergoing orthognathic surgery were recruited.	66 participants	Bimaxillary or monomaxillary surgery	Questionnaires were completed by participants during the preop orthodontic treatment phase (which may have affected the	Participants were wearing orthodontic appliances during the preop assessment, so the outcomes may not have been accurate.	The last questionnaire was completed at least 6 months after treatment.

					accuracy of the assessments) and at least 6 months post-surgery.		
Modig et al. ²⁰	Risk rating	Low	Medium	Low	High	High	Low
	Rationale for rating	Healthy patients with maxillary and mandibular dentofacial deformities who required surgical-orthodontic treatment were recruited.	32 participants	Bimaxillary or monomaxillary surgery	The investigator-created questionnaires 1 and 2 (used before and after treatment, respectively) have not been validated. The exact timing of the preop questionnaire was not mentioned.	It is unclear whether the participants were assessed while undergoing orthodontic treatment.	The last questionnaires were completed at least 3 y after treatment.
Sadek and Salem ²³	Risk rating	Low	Low	High	High	High	Low
	Rationale for rating	Patients with dentofacial deformities who required orthognathic surgery were recruited.	120 participants	Types of surgery not mentioned	The questionnaire assessing motivation for surgery and satisfaction with treatment has not been validated. The exact timing of the preop questionnaire	It is unclear whether the participants were assessed while undergoing orthodontic treatment.	The last questionnaires were completed 6-12 months after surgery.

was not mentioned.

Timing data are presented as means $\pm$ standard deviations or ranges.

Abbreviations: GTS, global transition scale; NR, not reported; OHIP-14, Oral Health Impact Profile-14; OQLQ-22, Orthognathic Quality of Life Questionnaire-22; preop, preoperative; postop, postoperative; SF-36, Short Form Health Survey; VAS, visual analogue scale

Table 3. Physical function and limitation before and after orthognathic surgery

Study	Domain/ question	Pre-op outcome (SD or 95% CI)	Post-op final outcome (SD or 95% CI)	Mean difference (SD or 95% CI)	Effect size	P value
Assessed by the OHIP-14 questionnaire						
Göelzer et al. ¹⁵		1.51 (1.13)	0.58 (0.63)	0.93 (1.02)	0.65	<0.001
Choi et al. ¹³		2.41(10.08)	1.03 (1.49)	-1.38 (1.76)	-0.75	<0.001
Silvola et al. ¹⁶		1.7	0.8	-0.9		<0.05
Lee et al. ¹²		2.47 (1.98)	1.56 (1.48)	0.92 (1.89)	0.46	0.008
Rustemeyer and Gregersen ¹¹	Question 1	0.8 (0.46 – 1.14)	0.64 (0.39 – 0.89)	-0.16 (-0.51 – 0.18)		
	Question 2	0.32 (0.09 – 0.55)	0.60 (0.29 – 0.91)	0.29 (-0.01 – 0.57)		
Assessed by the SF-36 questionnaire						
Choi et al. ¹³		96.88 (4.88)	96.25 (8.98)	-0.63 (10.38)	-0.13	0.620
Khadka et al. ¹⁸		95.63 (5.07)	95.72 (5.10)	0.09 (0.67)		
Lee et al. ¹²		97.22 (4.54)	96.67 (5.73)	0.56 (5.32)	0.12	0.681
Assessed by the OQLQ-22 questionnaire						
Choi et al. ¹³		9.31 (4.93)	2.81 (4.38)	-6.50 (4.72)	-1.32	<0.001
Khadka et al. ¹⁸		9.12 (3.72)	3.29 (2.45)	5.83 (4.41)		
Lee et al. ¹²		9.25 (5.06)	4.94 (3.41)	4.31 (5.05)	0.85	<0.001
Murphy et al. ¹⁴		7.46 (5.99)	5.69 (5.77)	1.77 (6.00)	0.4	0.0384
Soh and Narayanan ²¹		8.67 (3.83)	7.89 (3.52)		-0.18	0.071

Assessed by other instruments/questionnaires

Study	Instruments	Pre-op outcome	Post-op final outcome
Silva et al. ¹⁹	Questionnaires used by authors WHOOQL-Brief	40% of participants reported “bite problems”	86.67% of participants reported high physical aspect
Modig et al. ²⁰	Questionnaires used by authors Visual Analogue Scale OHIP-49 Telephone interview	28.55% of participants wanted better chewing ability 4.13% of participants wanted better pronunciation of word	91% of participants reported better chewing ability 19% of participants reported better pronunciation of word

Table 4. Physical Pain Before and After Orthognathic Surgery

Study	Score	Preop outcome (SD or 95% CI)	Postop final outcome (SD or 95% CI)	Mean difference (SD or 95% CI)	Effect size	P value
OHIP-14						
Göelzer et al. (2014)	Physical pain	2.10 (2.19)	0.72 (0.83)	NR	-0.74	≤0.001
Choi et al. (2010)	Physical pain	3.06 (1.87)	0.84 (1.35)	-2.22 (1.60)	-1.19	<0.001
Silvola et al. (2014)	Physical pain	4.6	1.8	-2.9	NR	<0.05
Lee et al. (2008)	Physical pain	3.11 (1.79)	2.00 (1.74)	-1.11 (1.79)	-0.62	0.001
Rustemeyer and Gregersen (2012)	Question 3 ^a	0.98 (0.63 to 1.32)	0.97 (0.71 to 1.24)	-0.08 (-0.41 to 0.25)	NR	0.904
Rustemeyer et al. (21)	Question 4 ^b	0.92 (0.59 to 1.24)	0.90 (0.55 to 1.24)	-0.02 (-0.46 to 0.42)	NR	0.928
	Physical pain	NR	NR	NR	NR	NS
SF-36						
Choi et al. (2010)	Bodily pain	79.34 (18.68)	86.97 (15.72)	7.63 (23.42)	0.41	0.054
Khadka et al. (2011)	Bodily pain	93.97 (9.33)	94.11 (9.65)	0.13 (3.46)	NR	NR
Lee et al. (2008)	Bodily pain	83.14 (18.92)	85.78 (17.41)	2.64 (3.79)	0.14	0.681

^a question 3 refers to mouth pain

^b question 4 refers to having discomfort while eating food

For the OHIP-14, lower scores represent more favourable responses (better QOL). In contrast, for the SF-36, lower scores represent less favourable responses (worse QOL).

Abbreviations: CI, confidence interval; NR, not reported; NS, not significant; OHIP-14, Oral Health Impact Profile-14; preop, preoperative; postop, postoperative; SD, standard deviation; SF-36, Short Form Health Survey

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Table 5. Psychological Well-being and Self-esteem Before and After Orthognathic Surgery

Study	Psychological domain or question	Preop outcome (SD or 95% CI)	Postop final outcome (SD or 95% CI)	Mean difference (SD or 95% CI)	Effect size	P value
OHIP-14						
Göelzer et al. (2014)	Psychological discomfort	2.68 (1.11)	0.44 (0.73)	NR	-0.84	≤0.001
	Psychological disability	2.13 (1.02)	0.41 (0.72)	NR	-0.83	≤0.001
Choi et al. (2010)	Psychological discomfort	4.44 (2.00)	1.44 (2.09)	-3.00 (2.17)	-1.50	<0.001
	Psychological disability	3.94 (2.17)	1.13 (1.76)	-2.81 (1.67)	-1.29	<0.001
Rustemeyer et al. (21)	Question 5 ^a	1.42 (1.01 to 1.83)	0.68 (0.41 to 0.96)	-0.73 (-0.29 to -1.18)	NR	0.022
	Question 6 ^b	1.47 (0.99 to 1.95)	0.84 (0.51 to 1.17)	-0.63 (-0.14 to -1.11)	NR	0.045
	Question 10 ^c	1.26 (0.66 to 1.86)	0.47 (0.18 to 0.75)	-0.78 (-0.27 to -1.31)	NR	0.027
Silvola et al. (2014)	Psychological discomfort	3.7	0.9	-2.8	NR	<0.05
	Psychological disability	2.8	0.5	-2.3	NR	<0.05
Lee et al. (2008)	Psychological discomfort	4.42 (1.98)	2.78 (2.31)	-1.64 (2.18)	-0.83	<0.001
	Psychological disability	3.94 (2.29)	2.39 (2.03)	-1.56 (1.81)	-0.68	<0.001
Rustemeyer and Gregersen (2012)	Question 5 ^a	1.30 (0.91 to 1.68)	0.75 (0.46 to 1.04)	-0.65 (-1.10 to -0.20)	NR	0.017
	Question 6 ^b	1.18 (0.81 to 1.55)	0.67 (0.39 to 0.95)	-0.52 (-0.81 to -0.22)	NR	<0.001

	Question 9 ^d	1.02 (0.66 to 1.38)	0.58 (0.31 to 0.84)	-0.44 (-0.73 to -0.15)	NR	0.003
	Question 10 ^c	1.44 (1.03 to 1.84)	0.50 (0.25 to 0.74)	-1.02 (-1.38 to -0.65)	NR	<0.001
SF-36						
Choi et al. (2010)	Role – emotional	77.07 (34.34)	88.54 (26.25)	11.47 (42.86)	0.33	0.131
	Mental health	68.13 (15.82)	73.88 (14.51)	5.75 (18.98)	0.36	0.089
Khadka et al. (2011)	Role – emotional	78.18 (32.38)	83.63 (23.35)	5.45 (14.65)	NR	NR
	Mental health	66.94 (16.15)	67.89 (14.94)	0.94 (2.65)	NR	NR
Nicodemo et al. (2008)	Emotional well-being (males)	79.5 (8.9) ^e	71.7 (10.6) ^e	NR	NR	0.019 ^f
	Emotional well-being (females)	58.4 (8.4) ^e	87.5 (7.4) ^e	NR	NR	
	Mental health	NR	NR	NR	NR	NS
Lee et al. (2008)	Role – emotional	79.63 (32.15)	91.67 (16.67)	12.04 (31.02)	0.37	0.029
	Mental health	70.11 (15.64)	70.78 (15.05)	0.67 (15.40)	0.04	0.925
OQLQ-22						
Choi et al. (2010)	Awareness of dentofacial aesthetics	7.91 (4.26)	5.44 (4.31)	-2.47 (5.14)	-0.58	0.012
Khadka et al. (2011)	Awareness of dentofacial aesthetics	7.15 (4.47)	3.64 (2.63)	3.5 (5.6)	NR	NR
Lee et al. (2008)	Awareness of dentofacial	7.58 (4.12)	6.72 (4.53)	-0.86 (3.16)	-0.21	0.101

	aesthetics						
Murphy et al. (2011)	Awareness of dentofacial aesthetics	6.90 (4.80)	5.73 (4.19)	-1.17 (3.93)	-0.2	0.0363	
Soh and Narayanan (22)	Awareness of dentofacial aesthetics	10.52 (2.85)	6.20 (2.40)	NR	-1.52	0.0001	

^a question 5 refers to feelings of self-consciousness

^b question 6 refers to feeling tense

^c question 10 refers to feelings of embarrassment

^d question 9 refers to difficulty relaxing

^e standard error

^f p value for the effects of the interaction between gender and time period (preoperative and postoperative) on emotional well-being. The Bonferroni tests showed that emotional well-being improved significantly only in females after surgery.

For the OHIP-14 and OQLQ-22, lower scores represent more favourable responses (better QOL). In contrast, for the SF-36, lower scores represent less favourable responses (worse QOL).

Abbreviations: CI, confidence interval; NR, not reported; NS, not significant; OHIP-14, Oral Health Impact Profile-14; OQLQ-22, Orthognathic Quality of Life Questionnaire-22; preop, preoperative; postop, postoperative; SD, standard deviation; SF-36, Short Form Health Survey

Table 6. Self-perception with Regards to Facial Aesthetics Before and After Orthognathic Surgery

Study	Domain or assessment method	Preop outcome (SD or 95% CI)	Postop final outcome (SD or 95% CI)	Mean difference (SD or 95% CI)	Effect size	P value
OQLQ-22						
Choi et al. (2010)	Facial aesthetics	13.63 (4.76)	6.41 (3.56)	-7.22 (5.12)	-1.52	<0.001
Khadka et al. (2011)	Facial aesthetics	11.97 (6.11)	4.46 (4.06)	7.5 (7.37)	NR	NR
Lee et al. (2008)	Facial aesthetics	13.31 (4.91)	8.36 (4.02)	-4.94 (4.63)	-1.01	<0.001
Murphy et al. (2011)	Facial aesthetics	12.21 (5.87)	7.00 (5.64)	-5.21 (6.19)	-0.9	0.0001
Soh and Narayanan (22)	Facial aesthetics	15.80 (2.98)	6.89 (2.19)	NR	-2.98	0.0001
Other Assessment Methods						
Silvola et al. (2014)	VAS of aesthetic satisfaction	61.4	18.5	-42.9	NR	<0.05
Alves e Silva et al. (19)	Questionnaires created by authors	53.3% of participants were “a little” satisfied with their appearance, and 40% were	Of the participants who were “a little” satisfied preoperatively, 33% became “satisfied”, and 20% became “very	NR	NR	NR

		“satisfied” with their appearance	satisfied”			
Rustemeyer and Gregersen (2012)	Additional question about dissatisfaction with facial aesthetics	3.12 (2.89 to 3.34)	1.74 (1.45 to 2.02)	-1.38 (- 1.03 to - 1.74)	NR	<0.001
Modig et al. (20)	Investigator- created questionnaires, the VAS, the OHIP-49, telephone interviews	In 30% of participants, the reason for surgery was an anticipated change in appearance; 43% of participants paid excessive attention to their appearance	28% of participants reported improvements in their appearance (by the VAS)	NR	NR	NR
Sadek and Salem (23)	DAS59: Assessments of general self- consciousness regarding appearance	48.2 (13.6)	14.2 (11.9)	NR	NR	<0.0001
	DAS59: Assessments of social self- consciousness	29.5 (15.6)	12.3 (10.9)	NR	NR	<0.0001

regarding appearance					
DAS59:	17.2 (4.1)	9.7 (3.5)	NR	NR	<0.0001
Assessments of negative self- conceptions					

For the OQLQ-22, OHIP-49, DAS59, and VAS, lower scores represent more favourable responses (better QOL).

Abbreviations: CI, confidence interval; DAS59, Derriford Appearance Scale 59; NR, not reported; NS, not significant; OHIP-49, Oral Health Impact Profile-49; OQLQ-22, Orthognathic Quality of Life Questionnaire-22; preop, preoperative; postop, postoperative; SD, standard deviation; SF-36, Short Form Health Survey; VAS, visual analogue scale

Table 7. Social Functioning and Relationships Before and After Orthognathic Surgery

Study	Domain or Question	Preop outcome (SD or 95% CI)	Postop final outcome (SD or 95% CI)	Mean difference (SD or 95% CI)	Effect size	P value
OHIP-14						
Göelzer et al. (2014)	Social disability	1.55 (1.10)	0.24 (0.60)	NR	-0.77	≤0.001
Choi et al. (2010)	Social disability	1.78 (1.52)	0.63 (1.26)	-1.16 (1.44)	-0.76	<0.001
Rustemeyer et al. (21)	Question 11 ^a	1.21 (0.67 to 1.75)	0.52 (0.24 to 0.81)	-0.68 (-0.18 to -1.17)	NR	0.043
	Question 12 ^b	NR	NR	NR	NR	NS
Silvola et al. (2014)	Social disability	1.9	0.2	-1.7	NR	<0.05
Lee et al. (2008)	Social disability	1.69 (1.67)	1.00 (1.76)	-0.69 (1.49)	-0.41	0.011
Rustemeyer and Gregersen (2012)	Question 11	0.70 (0.41 to 0.99)	0.38 (0.17 to 0.58)	-0.26 (-0.52 to -0.01)	NR	0.019
	Question 12	0.40 (0.14 to 0.66)	0.42 (0.17 to 0.66)	0.22 (-0.29 to 0.25)	NR	0.456
SF-36						
Choi et al. (2010)	Social functioning	82.44 (19.54)	91.02 (12.39)	8.58 (22.78)	0.44	0.063
Khadka et al. (2011)	Social functioning	82.27 (18.73)	82.61 (18.08)	0.34 (2.04)	NR	NR
Nicodemo et al. (2008)	Social functioning (males, bimaxillary surgery)	70.8 (11.9) ^c	77.2 (10.4) ^c	NR	NR	0.002 ^d

	Social functioning (females, bimaxillary surgery)	44.2 (10.7) ^c	80.2 (14.1) ^c	NR	NR	
	Social functioning (males, monomaxillary surgery)	69.9 (9.8) ^c	80.4 (8.6) ^c	NR	NR	
	Social functioning (females, monomaxillary surgery)	60.0 (6.3) ^c	89.9 (4.7) ^c	NR	NR	
Lee et al. (2008)	Social functioning	82.99 (19.17)	89.24 (16.68)	6.25 (19.48)	0.33	0.062
OQLQ-22						
Choi et al. (2010)	Social	13.88 (8.12)	6.03 (7.18)	-7.84 (7.54)	-0.97	<0.001
Khadka et al. (2011)	Social	12.57 (9.56)	4.05 (4.25)	-8.51 (10.4)	NR	NR
Lee et al. (2008)	Social	12.39 (8.08)	8.08 (6.47)	-4.31 (5.55)	-0.53	<0.001
Murphy et al. (2011)	Social	10.42 (8.33)	7.19 (8.32)	-3.23 (8.18)	-0.4	0.0063
Soh and Narayanan (22)	Social	22.26 (5.52)	14.98 (4.48)	NR	-1.49	0.0001

^a question 11 refers to irritability when interacting with others

^b question 12 refers to difficulty performing typical job-related tasks

^c standard error

^d p value for the effects of the interaction among gender, time period (preoperative and postoperative), and type of surgery on social functioning. The Bonferroni tests showed that

social functioning improved in both genders, as well as in patients undergoing either type of surgery, after surgery.

For the OHIP-14 and OQLQ-22, lower scores represent more favourable responses (better QOL). In contrast, for the SF-36, lower scores represent less favourable responses (worse QOL).

Abbreviations: CI, confidence interval; NR, not reported; NS, not significant; OHIP-14, Oral Health Impact Profile-14; OQLQ-22, Orthognathic Quality of Life Questionnaire-22; preop, preoperative; postop, postoperative; SD, standard deviation; SF-36, Short Form Health Survey

Figure 1. Flow diagram of the study selection process