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Effect of surgery-first approach on quality of life and mental health of orthognathic patients: A systematic review and meta-analysis

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ABSTRACT

Objectives: This study intends to explore the effects of the surgery-first approach (SFA) on quality of life and mental health of patients who undergo orthognathic surgery compared to the conventional three-stage approach (CTA).

Data: The analysis included eight studies with a total of 307 patients, of which one was randomized controlled trial (RCT), one was clinical controlled trial (CCT), and six were non-randomized studies of interventions (NRSIs).

Sources: Electronic databases such as Medline, Embase, Scopus, and Web of Science were searched for eligible trials up to April 2023.

Study selection: RCTs, CCTs, and NRSIs, which compared the quality of life or mental health of orthognathic patients treated with SFA and CTA, were included in this study. The meta-analysis showed that the standardized mean differences (SMD) of Oral Health Impact Profiles-14 (OHIP-14) scores and the Orthognathic Quality of Life Questionnaire (OQLQ) between SFA and CTA were -1.58 ($P = 0.05$) and -2.99 ($P < 0.00001$) at the termination of the first-stage treatment, which altered to -0.94 ($P = 0.54$) and 0.09 ($P = 0.65$) after total treatment. Two studies applied the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) and the Beck Depression Inventory (BDI-II) to examine mental health, resulting in a trend similar to the former scales.

Conclusion: In contrast to the conventional procedure, orthognathic treatment with SFA can instantly enhance the quality of life at the end of the first-stage treatment but has similar effects after the overall treatment. Moreover, SFA has a positive impact on psychological conditions.

Clinical significance: This study first systematically reviewed the effect of SFA on patients' mental well-being. According to our findings, it is better to select SFA if possible. Otherwise, the patient's psychological condition should be monitored appropriately throughout decompensation for better well-being both physically and mentally.

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1. Introduction

Dentofacial deformity, characterized by abnormal volume and morphology of the jaw due to deviant development, entails not only the disrupted relationships between the jaw and other craniofacial bones but also the concomitant irregularities in the dental-jaw relationship and the functional aberrations in the stomatognathic system, as well as the facial morphological abnormalities. Mild skeletal malocclusions can be effectively managed through orthodontic camouflage treatment, while severe skeletal malocclusions require a combination of orthodontic and orthognathic treatment for proper correction [1].

The established and widely used approach for correcting skeletal deformities in most cases involves presurgical orthodontics, orthognathic surgery, and postsurgical orthodontics, the so-called conventional three-stage approach (CTA) for combined orthodontic-orthognathic treatment. Nonetheless, preoperative orthodontic treatment, with a prolonged duration lasting from 1 to 2 years [2], results in a decompensation effect, causing deterioration in the patient's dental-jaw relationship. This not only affects facial aesthetics but also hinders the proper exercise of functions such as mastication, swallowing, and speech. Consequently, the patient's physical and psychological well-being can be compromised, leading to a decrease in their overall quality of life.

To tackle the problems mentioned above, a novel protocol called the surgery-first approach (SFA) was developed by Nagasaka in 2009 [3], characterized by beginning with previous surgery and being followed by subsequent orthodontic treatment. In the SFA, the absence of preoperative orthodontic treatment not only spares patients from undergoing a period of deteriorated facial aesthetics but also enables them to achieve significant profile improvements early in the treatment process. Consequently, this approach may enhance patient satisfaction and motivation toward the treatment and may be conducive to mental health.

In accordance with the definition provided by the World Health Organization (WHO) [4], quality of life (QoL) encompasses an individual's subjective appraisal of their social standing within the cultural and value framework of their existence. It also includes their perceptions of personal aspirations, expectations, standards, and areas of focus. To assess the quality of life of patients with oral health problems, several scales were developed, including the Orthognathic Quality of Life Questionnaire (OQLQ) [5,6] and the Oral Health Impact Profiles-14 (OHIP-14) [7]. These questionnaires were widely utilized and proved to have excellent performance in evaluating the quality of life. Applying these scales, several studies have demonstrated that the SFA is beneficial for the quality of life and mental health due to the absence of a deterioration period of facial aesthetics and a shorter treatment course [8,9].

Previous systematic reviews [10,11] concluded that the SFA could improve QoL immediately at the beginning of the treatment. Nonetheless, there was not sufficient data that met the requirements of meta-analysis to conduct quantitative confirmation. Since the publication of the previous two systematic reviews, a span of four years has elapsed. In the intervening period, additional research has been published that could potentially impact the outcomes of the reviews. Furthermore, there was no high-quality evidence to verify the impact of SFA on the mental health of patients.

The current study aims to systematically assess the effect of SFA on the quality of life and mental well-being of patients who have undergone orthodontic-orthognathic therapy in comparison to the CTA group and provide evidence-based references for clinicians.

2. Methods

2.1. Study registration

The protocol of this systematic review has been registered on PROSPERO (PROSPERO 2023: CRD42023442436; www.crd.york.ac.uk/prospero/).

2.2. Research question

This study aims to examine the impact of the surgery-first orthognathic approach on patients' quality of life and psychological condition.

2.3. Eligibility criteria

2.3.1. Types of studies

Randomized controlled trials (RCTs) and clinical controlled trials (CCTs) were included. According to the results of the pre-search, there were few RCTs and CCTs. Therefore, non-randomized studies of interventions (NRSIs) were also included.

2.3.2. Types of participants

Studies involving adult participants diagnosed with severe skeletal class II or class III were included. Studies with mixed populations (adults and children) were eligible if separate data for adult participants were reported. Individuals were excluded for conditions including cleft lip/palate deformities, syndromes affecting craniofacial anatomy, post-traumatic dentofacial deformities, obstructive sleep apnea syndrome, and previous orthodontic treatment.

2.3.3. Types of interventions

Studies comparing the conventional three-stage orthognathic approach (orthodontic-first) with the surgery-first approach were included, without other additional treatments such as distraction osteogenesis. Single-arm trials were not considered.

2.3.4. Types of outcome measures

Primary outcomes of interest are scales evaluating the quality of life (QoL) of patients, such as the OHIP-14 and OQLQ. Secondary outcomes are scales for mental health.

2.4. Search strategy

A comprehensive search of relevant literature was conducted using electronic databases, including Medline (via PubMed), Embase, Scopus, and the Web of Science. The search was performed using a combination of keywords turned from the PICO model, which is given in Table 1. The search was limited to studies up to April 2023 without language limitations. Additionally, reference lists of relevant articles and systematic reviews were manually screened to identify additional studies that might have been missed in the initial search.

2.5. Study selection

Two independent reviewers screened the titles and abstracts of the identified studies to assess eligibility. Full-text articles were retrieved for potentially eligible studies, and final inclusion decisions were made based on the predetermined eligibility criteria. Disagreements were resolved through discussion and consultation with a third reviewer, if necessary.

2.6. Data extraction and management

A standardized data extraction form was developed via Excel (2019, Microsoft) and pilot-tested, which would be exhibited after data extraction. Two independent reviewers extracted data from the included studies, including study characteristics (author, year, study design), participant characteristics (sample size, age, sex, malocclusion type), intervention details (surgery approach), and outcome measures (scales, assessing time, subitems and overall scores).

Additionally, when detailed data were unavailable in the original articles, data were extracted from diagrams via Engauge Digitizer software (http://digitizer.sourceforge.net/). If the standard deviation cannot be extracted from the text or diagram in a certain article, the mean of the standard deviations in other studies in this review will be calculated and used.

Table 1
Search strategy.

Database	Search terms
Medline (via Pubmed)	**#1** "perception" OR "subjective*" OR (quality of life) OR (QoL) OR (oral health-related quality of life) OR (OHQoL) OR scale OR questionnaire* OR satisfaction OR awareness OR psycho* OR "quality of life"[Mesh] **#2** malocclusion OR (class II) OR (class III) OR (Dentofacial Deformit*) OR (Dentofacial Abnormalit*) OR (Dentofacial Dyplasia*) OR (Maxillofacial Abnormalit*) OR (Jaw Abnormalit*) OR Prognathism OR Retrognathia OR orthodontic* OR "Orthodontics"[Mesh] OR "Maxillofacial Abnormalities"[Mesh] OR "Jaw Abnormalities"[Mesh] OR "Prognathism"[Mesh] OR "Retrognathia"[Mesh] OR "Malocclusion"[Mesh] **#3** surgery-first OR "SFA" OR (orthognathic surgery) OR (orthognathic surgeries) OR (Orthognathic Surgical Procedure*) OR (Jaw Surgery) OR (Jaw Surgeries) OR (Maxillo-Mandibular Surgery) OR (Maxillo-Mandibular Surgeries) OR (Maxillofacial Orthognathic Surgery) OR (Maxillofacial Orthognathic Surgeries) OR "Orthognathic Surgery"[Mesh] OR "Orthognathic Surgical Procedures"[Mesh] **#4** #1 AND #2 AND #3
Embase	**#1** 'perception' OR 'subjective*' OR 'quality of life' OR 'QoL' OR 'oral health-related quality of life' OR 'OHQoL' OR scale OR questionnaire* OR satisfaction OR awareness OR psycho* OR 'quality of life'/exp **#2** malocclusion OR 'class ii' OR 'class iii' OR 'dentofacial deformit*' OR 'dentofacial abnormalit*' OR 'dentofacial dyplasia*' OR 'maxillofacial abnormalit*' OR 'jaw abnormalit*' OR prognathism OR retrognathia OR orthodontic* OR 'malocclusion'/exp OR 'jaw malformation'/exp **#3** ′surgery-first' OR 'sfa' OR 'orthognathic surgery' OR 'orthognathic surgeries' OR 'orthognathic surgical procedure*' OR 'jaw surgery' OR 'jaw surgeries' OR 'maxillo-mandibular surgery' OR 'maxillo-mandibular surgeries' OR 'maxillofacial orthognathic surgery' OR 'maxillofacial orthognathic surgeries' OR 'orthognathic surgery'/exp **#4** #1 AND #2 AND #3
Web of Science	**#1** "perception" OR "subjective*" OR (quality of life) OR (qol) OR (oral health-related quality of life) OR (ohrqol) OR scale OR questionnaire* OR satisfaction OR awareness OR psycho* **#2** malocclusion OR (class II) OR (class III) OR (Dentofacial Deformit*) OR (Dentofacial Abnormalit*) OR (Dentofacial Dyplasia*) OR (Maxillofacial Abnormalit*) OR (Jaw Abnormalit*) OR Prognathism OR Retrognathia OR orthodontic* **#3** surgery-first OR "SFA" OR (orthognathic surgery) OR (orthognathic surgeries) OR (Orthognathic Surgical Procedure*) OR (Jaw Surgery) OR (Jaw Surgeries) OR (Maxillo-Mandibular Surgery) OR (Maxillo-Mandibular Surgeries) OR (Maxillofacial Orthognathic Surgery) OR (Maxillofacial Orthognathic Surgeries) **#4** #1 AND #2 AND #3
Scopus	(TITLE-ABS-KEY ("perception" OR "subjective*" OR "quality of life" OR "qol" OR "oral health-related quality of life" OR "ohrqol" OR scale OR questionnaire* OR satisfaction OR awareness OR psycho*) AND TITLE-ABS-KEY (malocclusion OR "class II" OR "class III" OR "Dentofacial Deformit*" OR "Dentofacial Abnormalit*" OR "Dentofacial Dyplasia*" OR "Maxillofacial Abnormalit*" OR "Jaw Abnormalit*" OR prognathism OR retrognathia OR orthodontic*) AND TITLE-ABS-KEY (surgery-first OR "SFA" OR "orthognathic surgery" OR "orthognathic surgeries" OR "Orthognathic Surgical Procedure*" OR "Jaw Surgery" OR "Jaw Surgeries" OR "Maxillo-Mandibular Surgery" OR "Maxillo-Mandibular Surgeries" OR "Maxillofacial Orthognathic Surgery" OR "Maxillofacial Orthognathic Surgery")) AND (LIMIT-TO (DOCTYPE, "ar"))

2.7. Risk of bias assessment

The risk of bias for each included study was independently assessed by two reviewers using the Cochrane Collaboration's Risk of Bias 2.0 tool (RoB 2.0) and the Risk of Bias in Non-randomized Studies of Interventions tool (ROBINS-I) for RCT/CCT and NRSIs, respectively.

RoB 2.0 evaluates the potential for bias across several domains, including random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. According to the guideline, every domain should be judged as "low risk of bias," "some concerns," or "high risk of bias" after answering signal questions. The overall risk of bias is judged as the worst judgment across all domains. If several domains are evaluated as "some concerns" and no domain is "high risk of bias," the overall risk of bias should be labeled as "high" too.

Similarly, ROBINS-I assesses bias due to confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurements, and selected reporting. Each domain will be labeled as "low risk," "moderate risk," "serious risk," "critical risk," and "no information." The overall risk of bias is judged as the worst judgment across all domains. If at least one domain is evaluated as "no information" while there is no serious or critical risk in others, the overall risk should be "no information."

Discrepancies in risk of bias assessments were resolved through discussion and consensus.

2.8. Data synthesis and analysis

Meta-analysis will be conducted while the clinical and methodological heterogeneity is acceptable. The statistic heterogeneity is defined as the I^2 being no less than 50 or the P value of the Q-test being no more than 0.05. For all studies, unadjusted estimated effects are utilized, which are calculated by Review Manager 5.0 (Cochrane). Continuous outcomes were analyzed using standard mean differences (SMD) with a 95 % confidence interval (CI). The fixed effect or random effect model will be applied for data synthesis according to statistical heterogeneity.

To explore whether SFA favors patients' quality of life and mental health or not, we will compare the two groups at the end of the

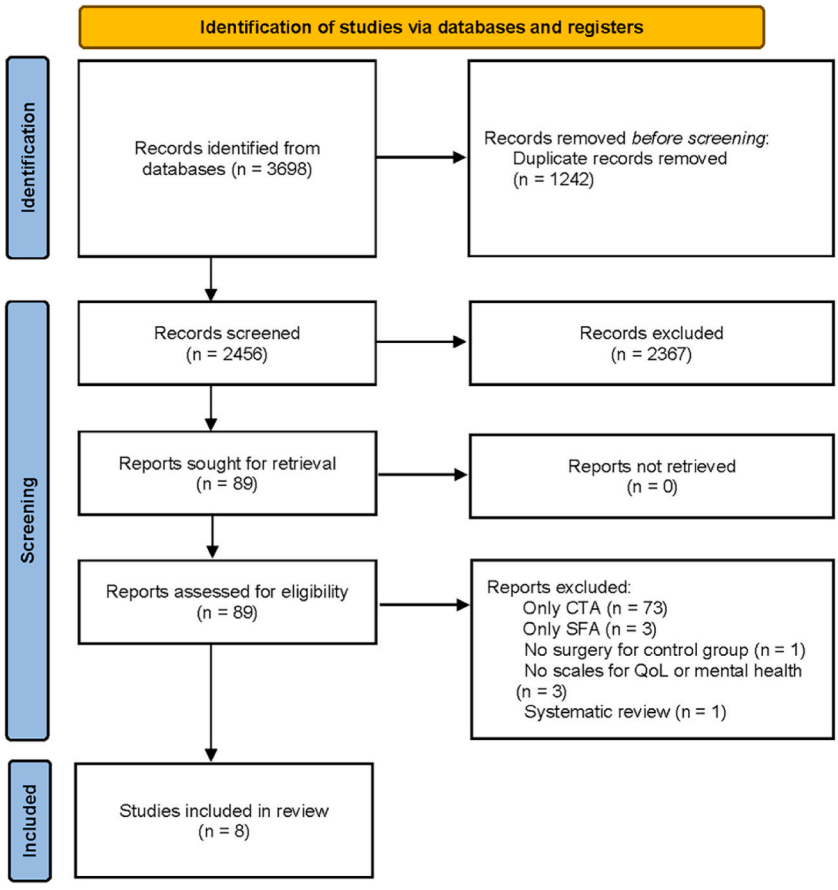

Fig. 1. Study flow diagram shows the selection process of literature. Pubmed, Embase, Web of Science, and Scopus were searched up to April 2023 without language limitations. CTA, the conventional three-stage approach; SFA, the surgery-first approach.

first-stage treatment and total treatment.

If sufficient data are available, subgroup analyses are planned based on participant characteristics (age, sex, and malocclusion type), study design, and surgical approach. Sensitivity analysis will be performed using the one-study-removed approach to explore the robustness of the findings.

3. Result

3.1. Description of studies

After the screening, a total of 89 studies were selected for further evaluation of eligibility. 73 of 89 studies were excluded for single-arm designs. Finally, eight studies fulfilled the criteria and were included in this systematic review (see Fig. 1).

The features and details of the studies included in this review are shown in Table 2. In these studies, one is an RCT [12], one is a CCT [13], and the others are NRSIs. The average age of participants in two of them was unavailable [13,14], which was within the range of 20–30 in other studies. For the malocclusion type of patients, 6 of 8 studies solely investigated skeletal class III malocclusion, and the other 2 also enrolled skeletal class II patients [13,15]. Regarding the surgery approach, 2 of them didn't report enough information [15,16]. As for the outcome measurement, all of them applied the OHIP-14 or OQLQ, whereas 3 of them further evaluated psychological conditions through other scales [14–16].

3.2. Risk of bias in included studies

The RCT [12] and CCT [13] were judged to have a high overall risk of bias, which was caused by no information about "missing outcome data" or other several domains, respectively (see Figs. 2 and 3).

For the overall RoB of NRSIs, two were identified as critical, two as serious, and the remaining two had no available information. The risk of bias was primarily derived from domain D1, namely bias due to confounding. We have previously recognized certain significant confounders, such as age, sex, malocclusion type, and severity of malocclusion. In two studies [16,17], which had moderate RoB in D1, these confounders were well controlled so that the baseline characteristics of patients had no significant difference between CTA and SFA, while the rest of the six studies didn't report the malocclusion severity measured by cephalometry, which may induce various QoL at baseline. In domain D5, all these studies lacked information to evaluate whether there was bias due to missing data,

Table 2
Study characteristics.

Author (Year)	Study Design	Approach (Sample size)	Age	Malocclusion	Surgery	Outcome measurement	Assessment timing
Y. Fındık (2022) [16]	NRSI	CTA (9 M, 9F) SFA (9 M, 5F)	29.27 ± 3.78 y 23.04 ± 3.36 y	Skeletal class III	Double jaw surgery	OQLQ OHIP-14 PIDAQ BDI-II	2w before surgery; 1 m after surgery; After debonding
J. Hu (2021) [18]	NRSI	CTA (12 M, 14F) SFA (12 M, 16F)	21.9 y 23.8 y	Skeletal class III	Le Fort I osteotomy and BSSO	OQLQ	Before treatment; 1 y after treatment
H. Saghafi (2020) [14]	NRSI	CTA (14) SFA (18)	17-47 y	Skeletal class III	Le Fort I osteotomy and/or BSSO	OQLQ GAD-7 PHQ-9	1w before surgery; 6w after surgery; 6 m after surgery
M. Brucoli (2019) [15]	NRSI	CTA (6 M, 19F) SFA (4 M, 4F)	27.61 y	Skeletal class II, Skeletal class III	–	OHIP-14 SF-36 RSA PIDAQ BDI-II	10-20 d before surgery; 4w after surgery; 6 m after surgery
J. Wang (2017) [12]	RCT	CTA (12 M, 13F) SFA (13 M,12F)	25.1 ± 6.8 y 25.4 ± 6.4 y	Mandibular prognathism	BSSO	OHIP-14	before treatment; 1/6/12 m after first stage treatment; the end of treatment
S. Pelo (2017) [13]	CCT	CTA (15) SFA (15)	–	Skeletal class II, Skeletal class III	Le Fort I osteotomy and BSSO	OQLQ OHIP-14	before treatment; 1 m before surgery; 1 m after surgery
S. Huang (2016) [19]	NRSI	CTA (12 M. 13F) SFA (13 M, 12F)	25.2 ± 4.2 y; 24.2 ± 5.8 y	Skeletal class III	BSSO	OHIP-14	before treatment; 1/6/12/18 m after treatment beginning; the end of treatment
J. K. Park (2015) [17]	NRSI	CTA (3 M, 12F) SFA (2 M, 9F)	25.0 ± 3.25 y; 26.27 ± 4.45 y	Skeletal class III	Le Fort I osteotomy and BSSO	OQLQ	before treatment; before surgery; 3 m after surgery; after debonding

which were caused by no author reporting the sample size included in the final analysis (see Figs. 4 and 5). Additionally, owing to results that did not include all parts of which they described in the methods, one study [18] was judged to have a critical risk of bias in D7.

3.3. Effects of interventions

The main results of the studies are listed in Table 3.

3.3.1. Measured by OHIP-14

At the end of the first-stage treatment, we compared the OHIP-14 scores of the two groups. (see Fig. 6). Subgroup analyses, performed according to the study design, demonstrated that the study design was the main source of statistical heterogeneity. After data synthesis using the random effect model, the upper 95 % CI of the overall estimated effect exactly terminated at 0, indicating the OHIP-14 scores of the two groups were not significantly different. Sensitivity analysis showed that when Pelo [13] was omitted, the 95 % CI of the overall effect did not contain 0 anymore, which means this study had a substantial impact on it (see Fig. 7).

After the completion of total treatment, the quality of life was assessed via OHIP-14 in three studies [12,16,19]. Fig. 8 reveals considerable statistical heterogeneity ($I^2 = 98$ %) among these studies, which could not be explained by subgroup analysis according to our former plan. Therefore, data synthesis for this time point was not appropriate.

3.3.2. Measured by OQLQ

Four studies investigated the QoL through OQLQ at the end of the first-stage treatment. Subgroup analysis revealed that the study design largely accounts for heterogeneity. The 95 % CI of the overall estimated effect indicated significant differences between SFA and CTA. After the first-stage treatment, the OQLQ scores of the SFA group decreased significantly compared with the CTA group, implying a more pronounced improvement in quality of life (see Fig. 9). As shown in Fig. 10, no matter which study was omitted, the 95 % CI would be less than 0 throughout, demonstrating the result was robust.

At the termination of overall treatment, three studies evaluated the QoL by OQLQ. The forest plot shows no statistical heterogeneity exists among the three studies. The 95 % CI crosses the zero axis, indicating the effect of SFA and CTA on QoL had no significant difference (see Fig. 11). This result was robust, as confirmed by the sensitivity analysis (Fig. 12).

3.3.3. Measured by other questionnaires

Fındık [16] applied the Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ) and Beck Depression Inventory (BDI-II) to examine QoL and mental health. The overall scores of PIDAQ at the end of the first-stage treatment were 48.79 ± 6.77 vs. 37.28 ± 4.79 (CTA vs. SFA), and after total treatment were 27.29 ± 5.37 vs. 27.06 ± 5.66 (CTA vs. SFA) after the completion of total treatment, respectively. Specifically, discrepancies in the item "psychological impact" between the SFA and CTA groups contributed the most to the differences in the total score. What's more, in BDI-II, the total scores were 12.45 ± 1.36 vs. 11.27 ± 3.06 (CTA vs. SFA) at the end of the first-stage treatment and 11.27 ± 0.78 vs. 10.66 ± 1.74 (CTA vs. SFA) at the termination of the overall treatment. Brucoli [15] also found a similar trend, using PIDAQ and BDI-II, without any detailed data being reported.

4. Discussion

4.1. Main results

Our study revealed that there was no significant difference between SFA and CTA after the whole treatment, supported by the data synthesis of OHIP-14 or OQLQ, whose robustness had been demonstrated via sensitivity analysis. The orthognathic treatment could enhance patients' quality of life with either a conventional or surgery-first approach. Patients with skeletal class II or III malocclusion who undergo orthognathic surgery can improve their psychosocial acceptance, oral function, aesthetics, and self-esteem, no matter if orthodontic or orthognathic surgery goes first, consistent with previous studies.

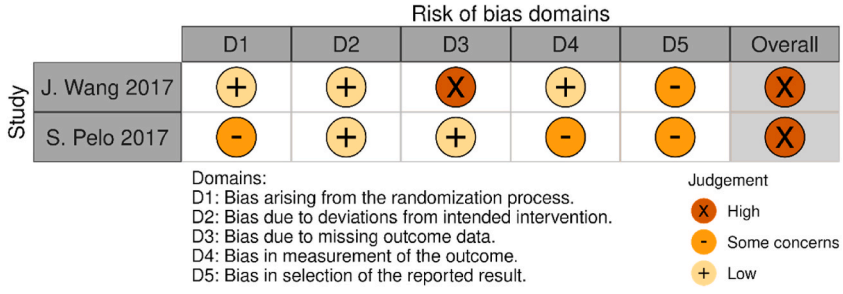

Fig. 2. Traffic light plot for risk of bias (RoB) of RCTs/CCTs, assessed by the RoB 2.0 tool.

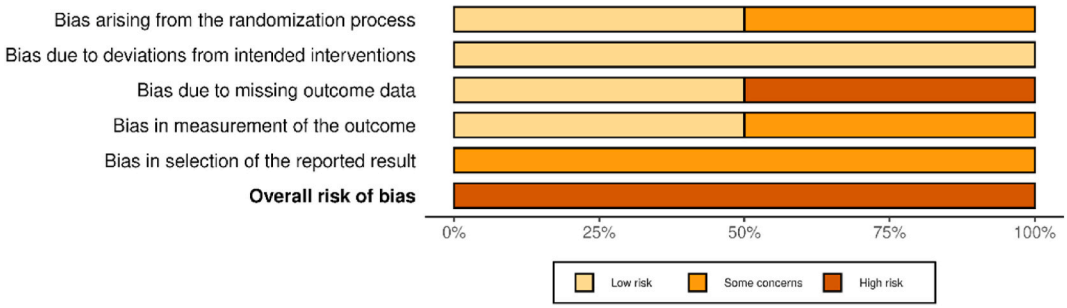

Fig. 3. Summary for RoB of RCTs/CCTs.

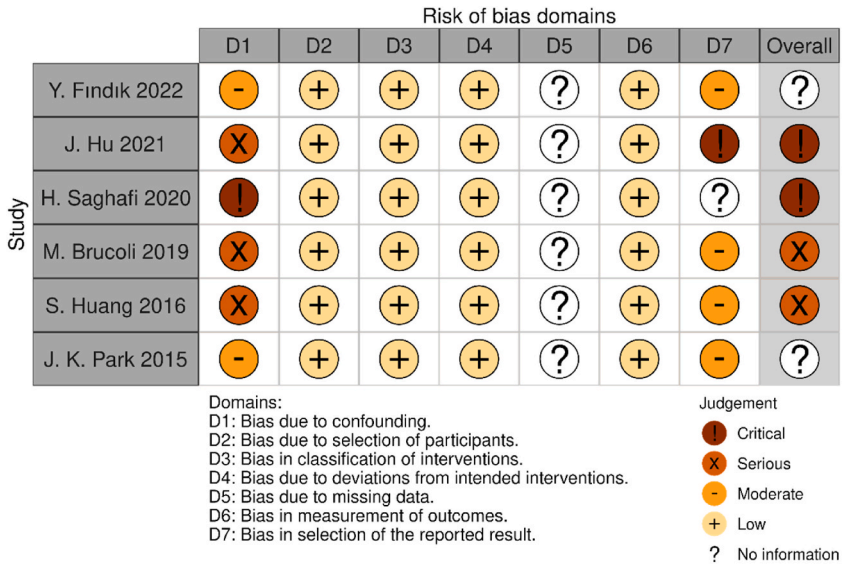

Fig. 4. Traffic light plot for RoB of NRSIs, assessed by the ROBINS-I tool.

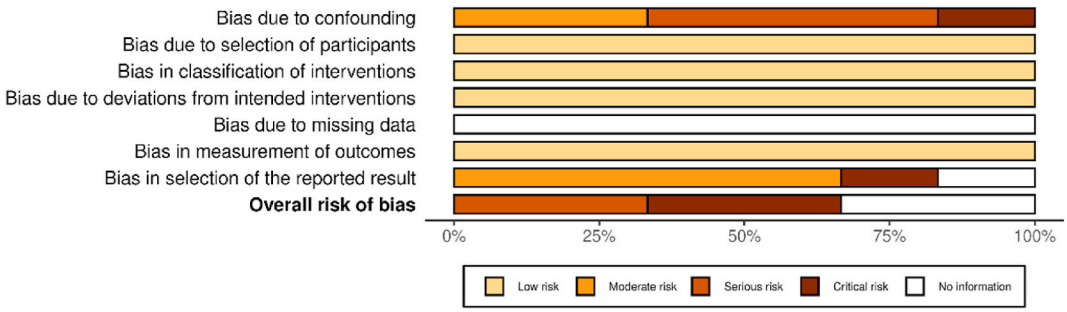

Fig. 5. Summary for RoB of NRSIs.

We also found that the differences between the two groups were statistically significant in terms of first-stage treatment outcomes. The 95 % CI of the overall effect synthesized from the OQLQ scores was below 0. Since the subgroup analysis showed the study design explained over half of the heterogeneity, we considered the SFA could facilitate the quality of life and decrease the OQLQ scores at this time point. As for the OHIP-14, although the synthesis result showed no significant difference between groups, this finding was not robust and would alter if the study of Pelo [13] was omitted. Moreover, the overall effects within both subgroups statistically favored the SFA. Briefly, the SFA avoided a deterioration period, leading to a positive impact on the quality of life of patients, which was consistent with our conjecture and previous systematic reviews [10,11].

Table 3
Primary results of studies (original data).

Author (Year)	Assessment timing	OHIP-14 scores in CTA	OHIP-14 scores in SFA	OQLQ scores in CTA	OQLQ scores in SFA
Y. Fındık (2022)	2w before surgery	9.74 ± 1.64	16.08 ± 2.96	61.44 ± 12.75	66.24 ± 14.23
	1 m after surgery	12.88 ± 3.91	10.5 ± 2.56	32.56 ± 6.53	37.72 ± 6.02
	After debonding	4.89 ± 0.38	6.68 ± 1.06	16.63 ± 6.12	15.49 ± 7.23
J. Hu (2021)	Before treatment	–			
	1 y after treatment			15.60 ± 6.05	17.36 ± 6.13
H. Saghafi (2020)	1w before surgery	–		63.00 ± 11.0	47.33 ± 18.9
	6w after surgery			28.50 ± 18.8	21.61 ± 14.3
	6 m after surgery			16.64 ± 14.1	15.29 ± 10.60
M. Brucoli (2019)	10-20 d before surgery;	7.9803	16.9435	–	
	4w after surgery;	11.9509	8.9631		
	6 m after surgery	3.9312	6.8403		
J. Wang (2017)	before treatment;	39.526 ± 4.189	38.656 ± 4.348	–	
	1 m after first stage treatment beginning	41.581 ± 4.19	27.668 ± 3.162		
	6 m after first stage treatment beginning	48.458 ± 3.874	13.913 ± 2.055		
	12 m after first stage treatment beginning	11.937 ± 2.688	6.798 ± 1.343		
	the end of treatment	5.692 ± 1.027	3.953 ± 1.028		
S. Pelo (2017)	before treatment	13 ± 5	16 ± 6	52 ± 10	57 ± 10
	1 m before surgery	18 ± 6	–	60 ± 9	57 ± 10
	1 m after surgery	3 ± 2	2 ± 1	29 ± 9	22 ± 3
S. Huang (2016)	before treatment	39.55 ± 4.15	38.68 ± 4.35	–	
	1 m after treatment beginning	41.67 ± 4.14	27.72 ± 3.26		
	6 m after treatment beginning	48.48 ± 3.91	13.94 ± 2.13		
	12 m after treatment beginning	28.86 ± 3.83	6.9 ± 1.39		
	18 m after treatment beginning	15.61 ± 2.49	4.11 ± 0.49		
	the end of treatment	8.68 ± 1.65	3.89 ± 1.02		
J. K. Park (2015)	before treatment	–		53.87 ± 17.81	51.64 ± 19.27
	before surgery			58.07 ± 18.18	51.64 ± 19.27
	3 m after surgery			23.53 ± 9.28	23.09 ± 22.41
	after treatment			11.60 ± 8.20	11.36 ± 14.15

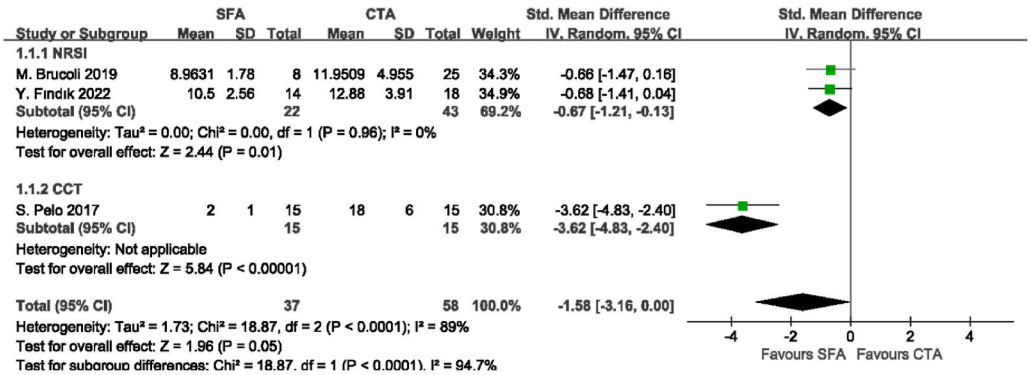

Fig. 6. Scores of OHIP-14 after the first-stage treatment. For the SFA, this time point refers to 4 weeks after orthognathic surgery. Regarding the CTA, however, it is the end of the pre-surgical orthodontic phase, which is 2–4 weeks before orthognathic surgery.

Besides, the current study systematically reviewed the influence of SFA on mental health compared with CTA. As the paradigm in medical practice transitions towards the biopsychosocial model [20], the treatment of diseases encompasses not only the eradication of pathology and improvement of function but also aesthetic rehabilitation and recognition of psychological status [21]. Psychological and physiological factors are interconnected, with physiological issues influencing psychological states [22], while psychological factors can also impact various aspects of patient care, such as treatment plans, treatment duration, postoperative complications, and postoperative satisfaction.

Although the entire orthodontic-orthognathic treatment will promote psychological wellness of patients, temporary deterioration

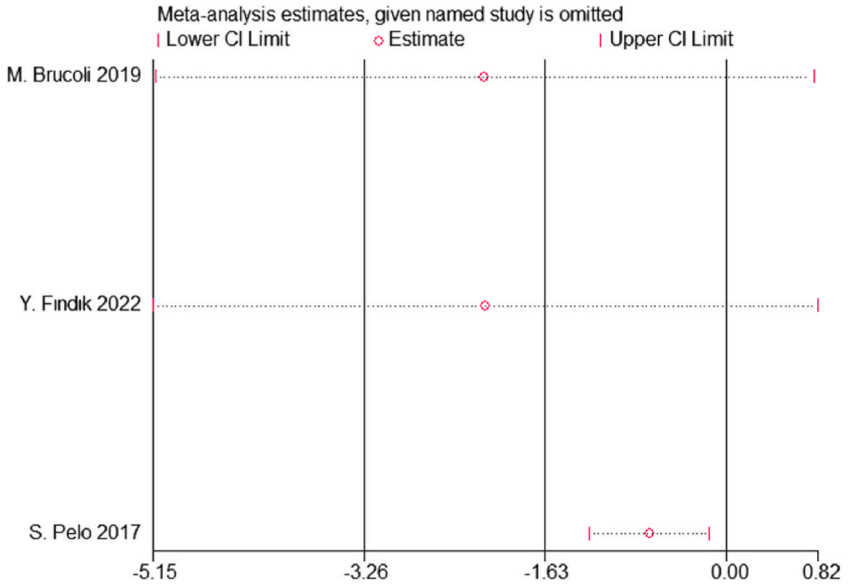

Fig. 7. Sensitivity analysis for the scores of OHIP-14 after the first-stage treatment. CI: confidence interval.

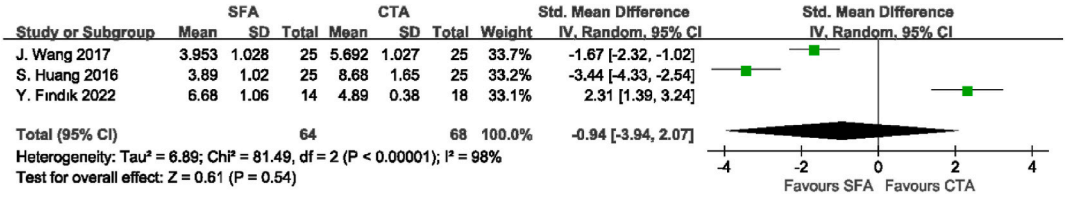

Fig. 8. Scores of OHIP-14 after the completion of total treatment.

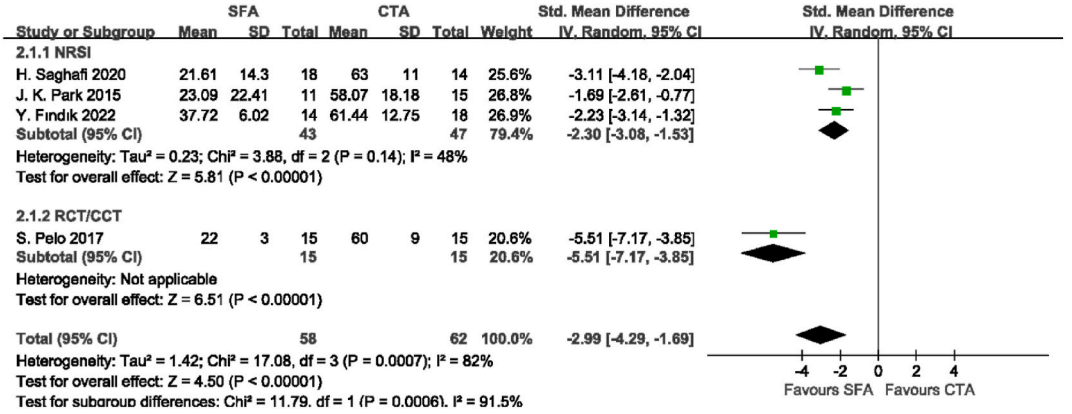

Fig. 9. Scores of OQLQ after the first-stage treatment. For the SFA, this time point refers to 1–3 months after orthognathic surgery. Regarding the CTA, however, it is the end of the pre-surgical orthodontic phase, which is 1–4 weeks before orthognathic surgery.

may occur during the process. As previously stated, the decompensation phase within the CTA may be detrimental to mental health. Despite the SFA can address this issue, it also has a risk of complications and drawbacks, like expanded surgery scope, and greater necessity of two-jaw surgery, which may trigger psychological disorders [23–25].

Taken together, comparing the psychological effects of the CTA and SFA is warranted. According to our findings, the time of the surgery did have a psychological impact and influenced the level of depression, indicating that the SFA was more favourable. Despite

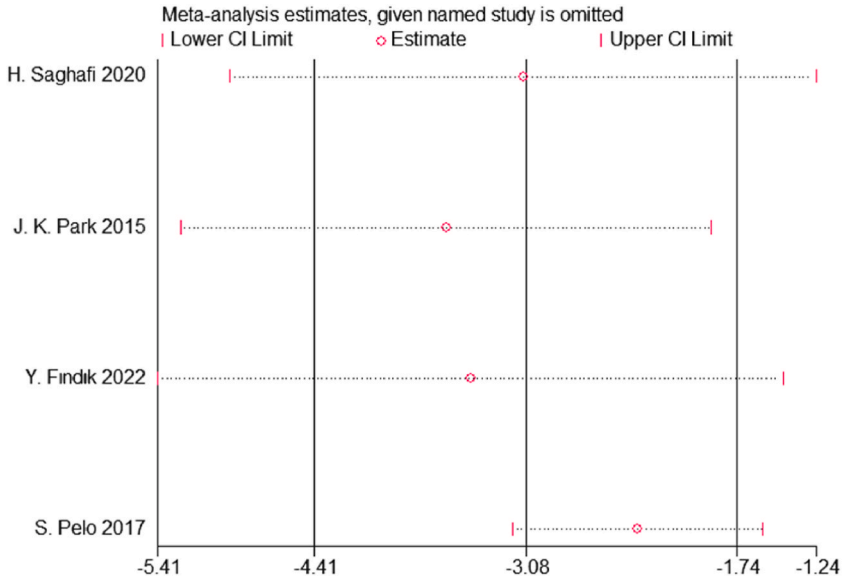

Fig. 10. Sensitivity analysis for the scores of OQLQ after the first-stage treatment.

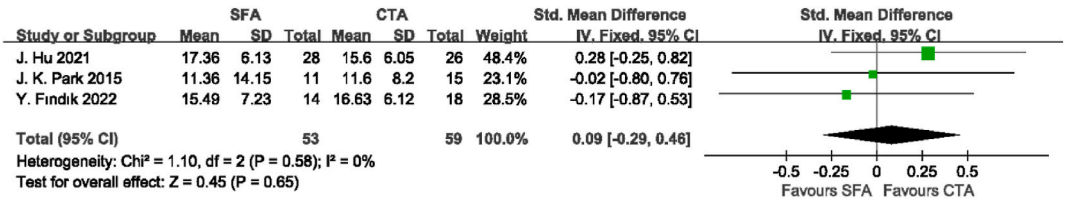

Fig. 11. Scores of OQLQ after the completion of total treatment.

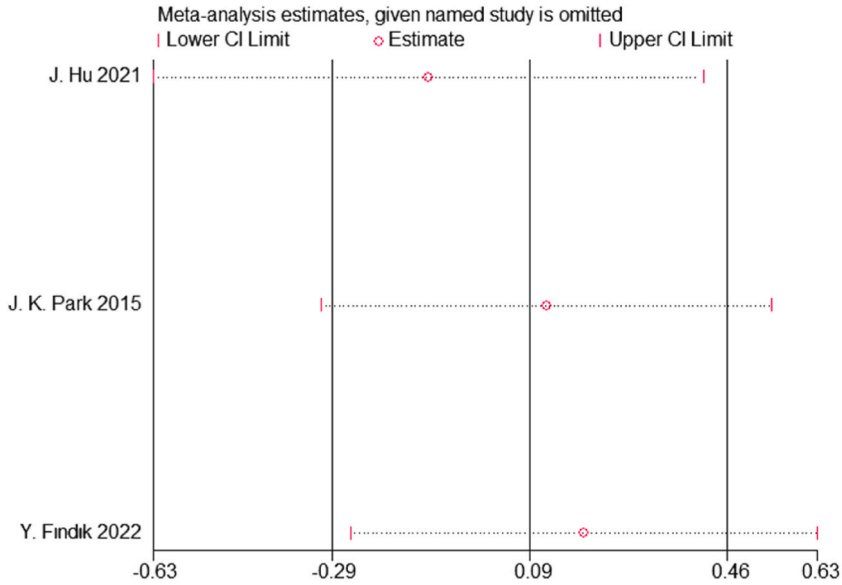

Fig. 12. Sensitivity analysis for the scores of OQLQ after the completion of total treatment.

the fact that this change in depressive symptoms caused by the orthognathic surgery approach was not clinically significant, we suggest to clinicians that the patients' psychological condition should be monitored appropriately throughout decompensation for better well-being both physically and mentally.

4.2. Risk of bias

Due to the indications of the SFA being those patients with relatively flat Spee curves, slight crowding in anterior teeth, and a normal interincisal angle [26], it is difficult to perform an RCT. Without the randomization process, potential confounders are not controlled in NRSI. Hence, it is crucial for researchers to take measures like stratifying to ensure the comparability of different groups.

In order to assess the RoB derived from confounding, which was identified as the primary source of bias in the studies of this systematic review, the ROBINS-I tool was employed [27]. At stage II-3 of the assessment, we examined and determined some confounders, including age, sex, malocclusion type, severity of malocclusion, and surgery approach.

Bortoluzzi [28] proved that the age of patients with dentofacial deformities had varying effects on quality of life, depending on the specific questionnaire used. Generally, older patients experienced a more pronounced negative impact on quality of life, particularly in the domains of facial aesthetics and oral function, as assessed by the OQLQ. With regard to sex, pronounced distinctions were detected when assessments of the quality of life were done by different sexes [29–31]. Specifically, women perceived a higher prevalence of perceived poor oral health compared to men, particularly in relation to physical pain and psychological disability. They were also more affected by oral problems, leading to higher scores in the domains of physical pain, psychological discomfort, and psychological disability. This finding aligned with expectations, as women tend to prioritize living more comfortably and place greater emphasis on their aesthetic appearance compared to men. Hence, these demographic characteristics should be balanced between groups.

Further evaluations showed that only two studies [16,17] had controlled the main confounders appropriately, while even the imbalance of malocclusion severity between the SFA and CTA in the other four studies had not been reported or properly measured, inducing the risk of bias that may potentially affect the results.

4.3. Limitation

In half of the included studies, the primary confounder, namely malocclusion severity, was not controlled which may induce at least a high risk of bias and have a potential effect on the quantitative analysis of this study. In addition, insufficient reporting impeded the evaluation of the risk of bias.

5. Conclusion

From this systematic review and meta-analysis, we concluded that:

I In contrast to the conventional procedure, orthognathic treatment with the surgery-first approach can instantly enhance the quality of life after the end of first-stage treatment.
II With regards to the overall treatment, the SFA and the CTA have similar effects on the quality of life.
III Compared with the CTA, the SFA has a positive impact on psychological conditions. However, the different effects between the two groups on mental health seem not to be clinically significant.

Further well-designed and homogeneous studies are required to confirm the results of our study. If possible, patients who conform to the indications of the SFA should be enrolled in the study and randomly divided into the two groups to conduct an RCT.

Data availability statement

Data has not been deposited into a public repository and will be made available on request.

CRediT authorship contribution statement

Yi Zheng: Data curation, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing, Formal analysis, Resources. **Ni Liao:** Methodology, Validation, Data curation, Formal analysis. **Shuixue Mo:** Conceptualization, Project administration, Supervision. **Xuanping Huang:** Conceptualization, Funding acquisition, Project administration, Supervision. **Nuo Zhou:** Conceptualization, Funding acquisition, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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