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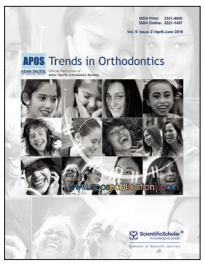

Systematic Review

Surgery-first orthognathic approach: A "scoping review" for mapping outcomes and plausible recommendations to develop core outcome sets

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ABSTRACT

Aims and Objectives: The aim of this scoping review was to identify the type of outcomes measured in surgery-first orthognathic approach (SFOA). The objectives were to classify the outcomes into predetermined domains and explore the degree of representation of each domain. Furthermore, to identify which domains are over- or under-represented and determine whether the findings of this scoping review could be employed to provide a template for core outcome sets (COS). Five outcomes were identified, and all the research pertinent to SFOA were assigned to these outcomes.

Materials and Methods: Electronic databases and additional records were searched from January 2009 to March 2019 to source the data, and 525 records were identified.

Results: The initial database and additional search resulted in 525 records, of which 54 potentially relevant articles were retrieved in full. 35 studies met the selection criteria following screening and were included in the scoping review with the results of the search depicted in the preferred reporting items for systematic reviews and meta-analyses. Domains such as morphological features or changes in maxillofacial skeleton and occlusion (n = 25, 71.42%) and psychosocial well-being including quality of life outcome (n = 8, 22.85%) were well represented while functional status (n = 1, 2.85%), health resource utilization (n = 0), and adverse effects (n = 1, 2.85 %) were under-represented.

Conclusions: Limited research on SFOA precludes development of COS. However, future SFOA clinical trials should consider underrepresented outcome domains to address the SFOA treatment modality comprehensively.

Keywords: Surgery-first orthognathic approach, Core outcome sets, Scoping review

INTRODUCTION

A "scoping review" is a relatively new but increasingly becoming a popular research synthesizing approach. A scoping review plays an important role in mapping an existing literature on a subject or a topic or a field of interest that is not extensively reviewed or is of a complex in nature.[1-3] The basic premise of scoping review is to establish a groundwork on which an extensive research, such as full systematic review, could be carried out.[4] Furthermore, scoping review provides a robust and transparent method to identify research gaps in the existing literature pertaining to the specific topic and act as a preliminary step to a more comprehensive systematic review.[5,6] Surgery-first

orthognathic approach (SFOA) is an emerging sub-discipline of orthodontics-orthognathic jaw surgery domain whose roots can be traced back to 1960s, when Skaggs JE promulgated that, to achieve adequate interarch relationship, orthognathic jaw surgery should commence before orthodontic treatment.[7] Since then, a surfeit of SFOA treatment protocols is aimed at (1) reduction of total treatment time, (2) accelerating post-operative orthodontic tooth movement, (3) improving patient satisfaction rate, and (4) enhancing health-related quality of life (HRQoL).[8-14,15] Recent review on SFOA outcome shows that the researchers have placed emphasis on assessing morphological features of maxillofacial skeleton and occlusion, reduction in total treatment time, and patient or practitioners satisfaction level. However, there is no uniform consensus on which outcomes of SFOA needs to be analyzed to identify the potential benefits and pitfalls of SFOA or whether there is an impetus to develop an overall core outcome sets (COS) for clinical trials of SFOA to overcome or significantly reduce heterogeneity amongst SFOA studies and minimize outcome reporting bias. Development of COS is one such robust tool that can aid to standardize outcomes for clinical trials and systematic reviews to overcome the aforementioned limitations.[16] Outcome measures in rheumatology and harmonizing outcome measures for eczema are some of the initiatives that are undertaken, in medicine, to improve endpoint outcome measurement through a data-driven, iterative alignment process.[17-19]

MATERIALS AND METHODS

A scoping review of the literature was carried out with the analytic framework using the methodology described by Arksey and O'Malley.[5] The literature search, scope, and reporting of findings were focused with the following stages:

- Framework Stage 1: Identifying the research question.
- Framework Stage 2: Identifying relevant studies.
- Framework Stage 3: Study selection.
- Framework Stage 4: Charting the data.
- Framework Stage 5: Collating, summarizing, and reporting the results.

Framework Stage 1: identifying the research question

We formulated our primary research question: What are the types of outcomes measured in SFOA? This scoping review was undertaken with the following aims; (1) to identify the type of outcomes measured in SFOA; (2) to categorize the outcomes into predetermined domains; (3) to explore the extent of representation of each domain to identify which domains have been over- or under-represented; and (4) to determine whether the findings of this scoping review could be employed in providing a template for COS that should be measured in all future clinical trials involving SFOA.

Framework Stage 2: identifying relevant studies, and framework Stage 3: study selection

Reviews suitable for the central research question of this scoping review was carried out by adopting a comprehensive search strategy that involved searching different sources[5] such as, electronic databases, reference lists, manual searching of key journals, existing networks, relevant organizations, and conferences. The scoping reviews study selection criteria are enumerated in Table 1.

Electronic databases: The following electronic databases were searched from January 2009 to March 2019 without restrictions to language. The start date of 2009 was chosen because the case report by Nagasaka *et al.*[13] published in 2009 is often cited as the first clinical application of SFOA,[7] and subsequently, numerous research papers have been published with reference to surgery-first protocol.[8-11,20]

PubMed (www.ncbi.nlm.nih.gov/pubmed/), Cochrane Library Databases, MEDLINE via OVID, EMBASE via OVID, Literatura Latino Americana em Ciências da Saúde, ClinicalTrials.gov., Australian New Zealand clinical trials registry (http://www.anzctr.org.au/), Australian clinical trials (www.australianclinicaltrials.gov.au/search/node/), and Google Scholar were searched with following term sequence: ("surgery first OR surgery early") AND ("orthognathic surgery") OR ("surgery first") AND ("orthodontics" [MeSH]). The term "modified surgery" was excluded from the search strategy and further during the full texts article assessment for eligibility, as it did not satisfy the true meaning of performing surgery-first without orthodontics or minimal orthodontics (i.e. placing only brackets and wires immediately or 1 month before orthognathic surgery).

Framework Stage 4: charting the data

The data extracted from the eligible studies were recorded with information of the first author, year of publication, and study characteristics. The specific information of the eligible studies was charted according to the PICO guidelines with enumeration of study design, participants, intervention, comparison, outcome (primary and secondary), method of measurement, and also outcome domain [Table 2]. Studies that were excluded from the review are shown in Table 3 with reasons for exclusion.

The outcomes were further categorized into the following domains using the method described by Sinha *et al.*[67] and Tsichlaki *et al.*[19]

1. Morphological features or changes in maxillofacial skeleton and occlusion.
2. Psychosocial well-being including quality of life outcome.
3. Functional status.

4. Health resource utilization.
5. Adverse effects of SFOA.

RESULTS

Framework Stage 5: collating, summarizing and reporting the results

The initial database and additional search resulted in 525 records, of which 54 potentially relevant articles were retrieved in full. 35 studies met the selection criteria following screening and were included in the scoping review with the results of the search depicted in the preferred reporting items for systematic reviews and meta-analyses flow chart [Figure 1]. The studies included in the review are shown in Table 2, and excluded studies with reasons are enumerated in Table 3. Morphological features and oral HRQoL were evaluated in the majority of studies. Morphological features or changes in maxillofacial skeleton and occlusion (n = 25, 71.42%) and psychosocial well-being including quality of life outcome (n = 8, 22.85%) were well represented with under-representation of functional status (n = 1, 2.85%), health resource utilization (n = 0), and adverse effects (n = 1, 2.85 %) [Figure 2]. No randomized control trials (RCTs) were identified with majority of the studies being retrospective in nature.

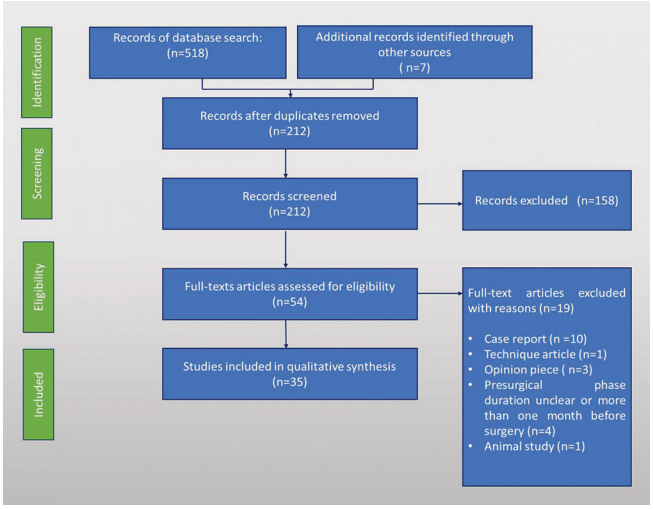

Figure 1: Preferred reporting items for systematic reviews and meta-analyses flow chart.

DISCUSSION

This is the first of its kind scoping review of studies that address selection of outcomes for use in SFOA clinical trials. Five outcome domains were identified, and the domains were examined for their degree of representation in the available literature. Also, to determine whether any recommendations could be made for the development of COS. Overall, the scoping review shows that SFOA evidence is in its formative stage with much emphasis placed on the assessment of morphological features and in determining the quality of life.

Clinical trials are only as credible as their outcomes.[17] Core outcome set is an agreed, standardized group of outcomes to be reported by all the trials within the research field.[68] COS provides a template for clinical trials such that the future clinical trials that follow the COS will have increased homogeneity, facilitate meta-analysis, reduce the risk of reporting bias, and involve a wide range of stakeholders (e.g., patients, caregivers, and health-care providers). Further, the tenets of COS state that, if no satisfactory core outcome set is found, and there is a need to develop one, then, a "scoping review" could be used as a conduit in establishing an informed base to conduct meaningful qualitative research (e.g., systematic research). Further, the scoping review assists in identifying the potential outcomes and ranks the outcomes to determine a "core" set.[69] Although this scoping review might be unable to recommend standard COS, this scoping review has identified five outcome domains that are measured in the existing literature pertaining to SFOA. Among the 5 identified outcome domains, 2 are over-represented and 3 are under-represented [Figure 2].

Table 1: Scoping reviews study selection criteria.

Inclusion criteria	Exclusion criteria
All types of studies pertaining to SFOA	Case reports and studies with less than five participants
All age groups, non-syndromic individuals with skeletal maxillofacial deformity	Personal opinions
Individuals treated with minimum or no pre-surgical orthodontic interventions	Non-human study
Any types of comparison with conventional orthognathic jaw surgery	Modified surgery with no surgery done immediately or within 1 month after orthodontic treatment
All types of reported outcomes	Technique article

SFOA: surgery-first orthognathic approach

Table 2: Studies selected for the scoping review.

Authors/Year	Study design	Participant	Intervention	Comparison	Outcome primary/ Secondary	Method of measurement	Outcome domain
Liao *et al.*/2010[21]	Retrospective study	33 pts, Conventional jaw surgery (*n*, 13; 21.0±4.0 years) and SFOA (*n*, 20; 23.0±4.0 years	SFOA in skeletal class III open bite	Conventional surgery in skeletal class III open bite	Facial aesthetics, occlusion, stability, and efficiency	Lateral cephalograph, peer assessment rating	Morphological features
Baek *et al.*/2010[8]	Prospective study	11 pts, SFOA (*n*, 20; 22.95±2.54 years	SFOA in skeletal class III		Surgical movement and postoperative orthodontic treatment	Lateral cephalographs	Morphological features
Wang *et al.*/2010[22]	Case-control retrospective	36 pts: 18 conventional jaw (23.3±4.2 years) and 18 surgery-first (22.3±3.8 years)	Patients with skeletal Class III undergoing SFOA	Conventional surgery, bimaxillary surgery	Changes of transverse dimension in both dental arches	Cephalometric measurements	Morphological features
Ko *et al.*/2011[23]	Retrospective cohort study	53 pts, Conventional jaw surgery (*n*, 35; 22.0±4.1 years) and SFOA (*n*, 18; 24.6±4.9 years)	SFOA in skeletal class III dentofacial deformities	MC approach	Dental and skeletal changes, postsurgical dental and skeletal stability, and treatment efficacy	Lateral cephalographs	Morphological features and treatment efficacy
Liou *et al.*/2011[20]	Prospective	22 adult pts	SFOA in skeletal dentofacial deformities		Postoperative changes in bone metabolism, tooth mobility	Periotest method, immunoassay	Morphological features, biomarkers
Ko *et al.*/2013[24]	Retrospective cohort study	45 pts, Conventional jaw surgery (*n*, 25; 25.1±6.8 years) and SFOA (*n*, 25; 25.4±6.4 years)	SFOA in skeletal class III dentofacial deformities	Groups based on the amount of horizontal relapse	Parameters identification related to skeletal stability after SFOA	Lateral cephalograph cephalometric measurements	Morphological features
Kim *et al.*/2014[25]	Retrospective cohort study	61 pts, Conventional jaw surgery (*n*, 38; 21.6±3.5 years) and SFOA (*n*, 23; 23.0±6.3 years)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	Stability of mandibular setback surgery	Lateral cephalograph cephalometric measurements	Morphological features
Hernández-Alfaro *et al.*/2014[10]	Prospective	45 pts: SFOA	SFOA in class II, III and asymmetry		Specific orthodontic and surgical protocol	VAS on patient satisfaction and orthodontists on selected treatment approach	SFOA protocol development. Adverse effects of Tx physical consequence
Lee *et al.*/2014[26]	Retrospective	40 pts (22.6±4.0 years)	SFOA in skeletal class III dentofacial deformities		Postsurgical skeletal changes	Cephalograms generated from cone-beam computed tomography	Morphological features

(Contd...)

Table 2: *Continued*

Authors/Year	Study design	Participant	Intervention	Comparison	Outcome primary/ Secondary	Method of measurement	Outcome domain
Kim *et al.*/2014[11]	retrospective	37 pts (23±4 years)	SFOA in skeletal class III dentofacial deformities		Postoperative stability using IVRO	Lateral cephalograph	Morphological features
Park *et al.*/2014[27]	Retrospective	60 pts: 36 conventional jaw surgery (22.4±4.4 years) and 24 SFOA (22.4±4.6 years)	SFOA class III malocclusion	Conventional surgery, bimaxillary surgery	Dental change	Lateral cephalograph	Morphological features
Choi *et al.*/2015[28]	Retrospective	*n*, 35 pts; 24.7 years	SFOA clockwise MMC skeletal class III deformities		Posterior pharyngeal airway change	Lateral cephalograph cephalometric measurements	Morphological features
Choi *et al.*/2015[29]	Case–control prospective	56 pts (average age, 22.4 years: conventional jaw surgery (*n*, 24) and SFOA (*n*, 32)	Surgery-first approaches for patients with skeletal class III dentofacial deformity	Conventional surgery	Reliability of a surgery-first orthognathic approach without presurgical orthodontic treatment	Dental model, Cephalometric assessment	Morphological features
Yu *et al.*/2015[30]	Retrospective cohort	50 pts (16–37 years)	Skeletal malocclusions		Report experience with the SFA for skeletal malocclusion		Morphological features
Park *et al.*/2015[31]	Case-control retrospective	40 pts: 20 conventional jaw surgery (25.25±3.77 years) and 20 SFOA (22.60±5.39 years	SFOA bimaxillary surgery	Conventional surgery, bimaxillary surgery	Postoperative stability/relapse rate	Cephalometric radiographs	Morphological features
Park *et al.*/2015[32]	Retrospective	26 pts, Conventional jaw surgery (n, 15; 25.0±3.2 years) and SFOA (*n*, 11; 26.2±4.4 years)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	QoL	OQLQ	Oral health-related QoL
Rhee *et al.*/2015[33]	Retrospective	34 patients (23 men, 11 women; mean age, 26.2±6.6 years)	SFOA in skeletal class III dentofacial deformities		Skeletal and dental changes	Cone-beam computed tomography	Morphological features

(Contd...)

Table 2: *Continued*

Authors/Year	Study design	Participant	Intervention	Comparison	Outcome primary/ Secondary	Method of measurement	Outcome domain
Huang *et al.*/2016[34]	Prospective	50 pts: conventional jaw surgery (24.2±5.8 years) and SFOA (25.2±4.2 years)	SFOA class III malocclusion	Conventional surgery, bimaxillary surgery	Oral health related QoL and satisfaction between surgery-first and orthodontic-first orthognathic surgery patients	Two questionnaires: the dental impact on daily living and 14-item oral health impact profile	OHRQoL
Choi *et al.*/2016[35]	Retrospective cohort	37 pts, Conventional jaw surgery (*n*, 17; 20.8±0.9 years) and SFOA (*n*, 20; 21.1±0.7 years	SFOA in skeletal class III dentofacial deformities using IVRO	Conventional surgery using IVRO	Postoperative skeletal and dental changes	Lateral cephalograph cephalometric measurements	Morphological features
Wang *et al.*/2016[36]	Retrospective cohort	55 pts: conventional jaw surgery (*n*, 29; 22.2±3.8 years) and SFOA (*n*, 26; 21.6±3.3 years	Bilateral sagittal split ramus osteotomy for mandibular prognathism using OFA	Conventional surgery	Compare the postoperative changes of the condylar position after mandibular setback surgery	3D CT images	Morphological features
Akamatsu *et al.*/2016[37]	Retrospective cohort	38 pts (14 SFOA and 24 conventional surgery)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	Postsurgical stability	Lateral cephalograph cephalometric measurements	Morphological features
Jeong *et al.*/2017[38]	Prospective	52 conventional jaw surgery (29.7 Average age) and 45 pts in SFOA (23.7 average age)	SFOA bimaxillary surgery	Conventional surgery, bimaxillary surgery	Postoperative skeletal and dental changes	Lateral cephalograph cephalometric measurements	Morphological features
Feu *et al.*/2017[39]	Prospective	16 pts, Conventional jaw surgery (*n*, 8; 26.8±7.1 years) and SFOA (*n*, 8; 22.9±5.4 years)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	OQLQ and the OHIP-short version (OHIP-14)	OHIP-14	Oral health-related QoL
Wang *et al.*/2017[40]	Longitudinal prospective cohort	50 pts, Conventional jaw surgery (*n*, 25; 25.1±6.8 years) and SFOA (*n*, 25; 25.4±6.4 years)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	OHRQoL	OHRQoL questionnaire	Oral health-related QoL
Pelo *et al.*/2017[41]	Retrospective cohort	30 pts (30.2±4.3 years)	SFOA in skeletal malocclusion	Conventional surgery	Level of satisfaction and QoL	OHIP, orthognathic QoL questionnaire OQLQ-22	Oral health-related QoL

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Table 2: *Continued*

Authors/Year	Study design	Participant	Intervention	Comparison	Outcome primary/ Secondary	Method of measurement	Outcome domain
Zingler *et al.*/2017[42]	Prospective cohort	9 pts (26.7 years)	SFOA in skeletal class III and Class II dentofacial deformities		Psychological and biological changes in SFOA	OQLQ questionnaire, sense of coherence SOC-29 and longitudinal day-to-day. crevicular fluid by bead-based multiplex assays	Oral health-related QoL biomarkers assessment
Hernandez-Alfaro *et al.*/2017[43]	Prospective	8 pts (mean age 26.3 years)	Surgery-first class III patients	Surgery-early class III patients	Complications, final outcome	Plaque index, PPD, gingival recession, bleeding on probing, and CAL. satisfaction with treatment (VAS)	Effects of Tx/ Functional status/ QoL
Jeong *et al.*/2018[44]	Retrospective	104 Patients (23.3 years, mean age) with SFOA, and 51 with conventional surgery (23.1 years, mean age)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	long-term outcomes of vertical skeletal stability	Lateral cephalograph cephalometric measurements	Morphological features
Holzinger *et al.*/2018[45]	Prospective	16 patients aged 18–37 years (8 female, 8 male, mean age 26 years)	SFOA in skeletal malocclusion		Quantitative accuracy assessment	CT scan	Morphological features
Guo *et al.*/2018[46]	Retrospective cohort	Symmetry group (*n*, 17; 22.9±4.4 years) and asymmetry group (*n*, 12; 20.0±52.2 years)	SFOA mandibular prognathism with asymmetry	SFOA mandibular prognathism without facial asymmetry	Corrective outcomes and transverse stability	CT scan	Morphological features
Lian *et al.*/2018[47]	Retrospective	*n*, 37, females 24.0±4.9 years	2-step group in SFOA	3-step group in SFOA	Stability, and treatment efficiency	Lateral cephalograph cephalometric measurements	Morphological features
Liao *et al.*/2018[48]	Retrospective cohort	*n*, 41, 24.0±4.9 years	SFOA in Skeletal Class III facial asymmetry		Long-term outcomes of bimaxillary surgery	Photographs and study models	Morphological features

(Contd...)

Table 2: *Continued*

Authors/Year	Study design	Participant	Intervention	Comparison	Outcome primary/ Secondary	Method of measurement	Outcome domain
Brucoli *et al.*/2018[49]	Prospective	33 pts, Conventional jaw surgery (*n*, 25; 25.0±5.5 years) and SFOA (*n*, 8; 35.6±13.4 years)	SFOA in skeletal class III dentofacial deformities	Conventional surgery	Oral health impact profile questionnaire, TCI, RSA, Italian validation of the PIDAQ, BDIII, the RSES	Psychosocial well-being, self-esteem, anxiety, and QoL	Oral health-related QoL
Liao and Lo/2018[50]		*n*, 53 (*n*, 39 with genioplasty and *n*, 14 without genioplasty. Mean age, 25±6 years	Skeletal Class III patients surgery-first approach		Establish guidelines for the surgical occlusion setup of SFOA, evaluate accuracy	Study models and computer-aided surgical simulation	Guidelines, characteristics, and accuracy
Watanabe *et al.*/2019[51]	Retrospective study	5 patients (19–26 years) with facial asymmetry in hemifacial microsomia	Surgery-first approach combined with mandibular distraction		Soft tissue changes	Photographs	Morphological features

SFOA: Surgery-first orthognathic approach, IVRO: Intraoral vertical ramus osteotomy, MMC: Maxillomandibular complex, QoL: Quality of life, OQLQ: Orthognathic quality of life questionnaire, OHIP: Oral health impact profile, SOC-29: 29-Item scale, PPD: Probing pocket depth, CT: Computed tomography, CAL: Clinical attachment level, VAS: Visual analogue scale, OHRQoL: Oral health-related quality of life, 3D: 3-Dimensional, OQLQ: Orthognathic quality of life questionnaire, VAS: Visual analog scale, TCI: Temperament and character inventory, RSA: Resilience scale for adults, PIDAQ: Psychological impact of dental aesthetics questionnaire, BDIII: Beck depression inventory second edition, RSES: Rosenberg self-esteem scale, MC: Modified-conventional, Tx: Treatment

Table 3: Studies excluded from the scoping review (*n*=19).

Study author	Reason for exclusion
Nagasaka *et al.* 2009[13]	Case report
Yu *et al.* 2010[52]	Case report
Liou *et al.* 2011[20]	Technique article
Villegas *et al.* 2012[53]	Case report
Kim *et al.* 2013[54]	Presurgical phase duration unclear or more than 1 month before surgery
Joh *et al.* 2013[55]	Presurgical phase duration unclear or more than 1 month before surgery
Park *et al.* 2013[27]	Case report
Uribe *et al.* 2013[56]	Case report
Teng and Liou 2014[57]	Animal study
Aristizábal *et al.* 2015[58]	Case report
Huang *et al.* 2015[59]	Opinion article
Uribe *et al.* 2015[60]	Case report
Pelo *et al.* 2016[61]	Opinion article
Zhou *et al.* 2016[62]	Case report
Zhou *et al.* 2016[63]	Pre surgical phase more than 1 month before surgery
Gandedkar *et al.* 2016[15]	Case series
Larson *et al.* 2017[64]	Presurgical phase duration unclear or more than 1 month before surgery
Choi and Bradley 2017[65]	Opinion article
Aristizábal *et al.* 2018[66]	Case report

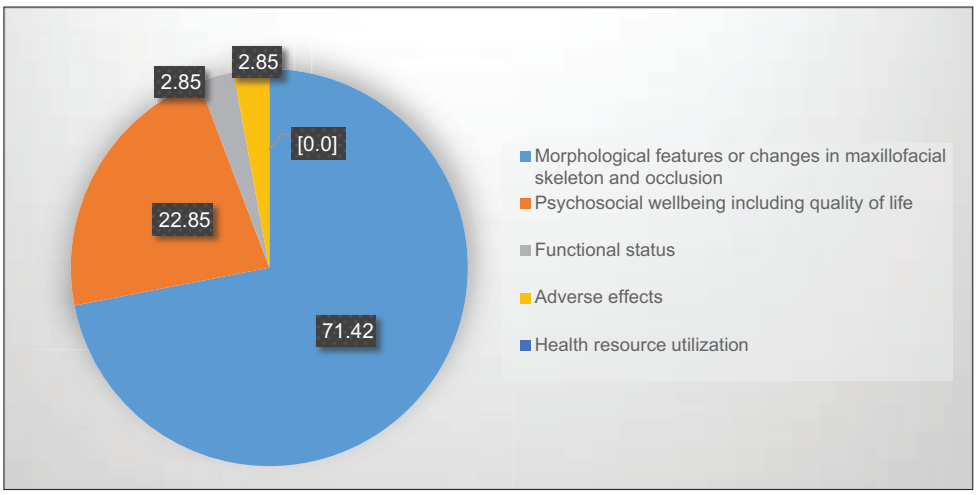

Figure 2: Pie chart showing surgery-first orthognathic approach outcome domains.

Furthermore, this scoping review did not identify any RCT within the SFOA research, indicating that more pertinent research encompassing RCTs are required to arrive at formulating COS. However, the fact that many prospective studies are being carried out is itself promising in nature, and in the future, this will allow researchers and readers to make best use of the available reported trails to formulate the research question.

The shortcomings of this scoping review are predetermined outcomes and exclusion of studies having sample size <5. With outcomes being predetermined, this could have precluded from exploring other domains. Nonetheless, this is the first of its kind scoping review intended for mapping outcomes and provides plausible recommendations to develop COS for SFOA, and hence, it was essential to identify the more common outcomes and interventions. The decision to exclude case reports and studies involving less than five cases was deliberate to involve more meaningful data which could assist in identifying the more common outcome domains.

CONCLUSIONS

The scoping review shows that limited research has been carried out in SFOA. The outcome domains that are over-represented are morphological features or changes in maxillofacial skeleton and occlusion and psychosocial well-being including quality of life outcome. However, outcomes such as functional status, health resource utilization, and adverse effects of SOFA were under-represented. Future SFOA clinical trials should consider these aforementioned under-represented outcome domains to address the SFOA treatment modality in a comprehensive way to better understand the treatment approach and enhance the outcome consistency.

Declaration of patient consent

Patient's consent not required as there are no patients in the study.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA, *et al.* A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. Res Synth Methods 2014;5:371-85.
2. Davis K, Drey N, Gould D. What are scoping studies? A review of the nursing literature. Int J Nurs Stud 2009;46:1386-400.
3. Daudt HM, van Mossel C, Scott SJ. Enhancing the scoping study methodology: A large, inter-professional team's experience with arksey and O'malley's framework. BMC Med Res Methodol 2013;13:48.
4. Fulop N. Studying the Organisation and Delivery of Health Services: Research Methods. London: Routledge, Psychology Press; 2001.
5. Arksey H, O'Malley L. Scoping studies: Towards a methodological framework. Int J Soc Res Methodol 2005;8:19-32.
6. Levac D, Colquhoun H, O'Brien KK. Scoping studies: Advancing the methodology. Implement Sci 2010;5:69.
7. Peiró-Guijarro MA, Guijarro-Martínez R, Hernández-Alfaro F. Surgery first in orthognathic surgery: A systematic review of the literature. Am J Orthod Dentofacial Orthop 2016;149:448-62.
8. Baek SH, Ahn HW, Kwon YH, Choi JY. Surgery-first approach in skeletal class III malocclusion treated with 2-jaw surgery: Evaluation of surgical movement and postoperative orthodontic treatment. J Craniofac Surg 2010;21:332-8.
9. Hernández-Alfaro F, Guijarro-Martínez R, Molina-Coral A, Badía-Escriche C. "Surgery first" in bimaxillary orthognathic surgery. J Oral Maxillofac Surg 2011;69:e201-7.
10. Hernández-Alfaro F, Guijarro-Martínez R, Peiró-Guijarro MA. Surgery first in orthognathic surgery: What have we learned? A comprehensive workflow based on 45 consecutive cases. J Oral Maxillofac Surg 2014;72:376-90.
11. Kim JY, Jung HD, Kim SY, Park HS, Jung YS. Postoperative stability for surgery-first approach using intraoral vertical ramus osteotomy: 12 month follow-up. Br J Oral Maxillofac Surg 2014;52:539-44.
12. Liou EJ, Chen PH, Wang YC, Yu CC, Huang CS, Chen YR, *et al.* Surgery-first accelerated orthognathic surgery: Postoperative rapid orthodontic tooth movement. J Oral Maxillofac Surg 2011;69:781-5.
13. Nagasaka H, Sugawara J, Kawamura H, Nanda R. "Surgery first" skeletal class III correction using the skeletal anchorage system. J Clin Orthod 2009;43:97-105.
14. Sugawara J, Nagasaka H, Yamada S, Yokota S, Takahashi T, Nanda R. The application of orthodontic miniplates to Sendai surgery first. Semin Orthod 2018;24:17-36.
15. Gandedkar NH, Chng CK, Tan W. Surgery-first orthognathic approach case series: Salient features and guidelines. J Orthod Sci 2016;5:35-42.
16. Clarke M. Standardising outcomes for clinical trials and systematic reviews. Trials 2007;8:39.
17. Tugwell P, Boers M, Brooks P, Simon L, Strand V, Idzerda L, *et al.* OMERACT: An international initiative to improve outcome measurement in rheumatology. Trials 2007;8:38.
18. Schmitt J, Apfelbacher C, Spuls PI, Thomas KS, Simpson EL, Furue M, *et al.* The harmonizing outcome measures for eczema (HOME) roadmap: A methodological framework to develop core sets of outcome measurements in dermatology. J Invest Dermatol 2015;135:24-30.
19. Tsichlaki A, O'Brien K, Johal A, Fleming PS. A scoping review of outcomes related to orthodontic treatment measured in cleft lip and palate. Orthod Craniofac Res 2017;20:55-64.
20. Liou EJ, Chen PH, Wang YC, Yu CC, Huang CS, Chen YR, *et al.* Surgery-first accelerated orthognathic surgery: Orthodontic guidelines and setup for model surgery. J Oral Maxillofac Surg 2011;69:771-80.
21. Liao YF, Chiu YT, Huang CS, Ko EW, Chen YR. Presurgical orthodontics versus no presurgical orthodontics: Treatment outcome of surgical-orthodontic correction for skeletal class III open bite. Plast Reconstr Surg 2010;126:2074-83.
22. Wang YC, Ko EW, Huang CS, Chen YR, Takano-Yamamoto T. Comparison of transverse dimensional changes in surgical skeletal class III patients with and without presurgical orthodontics. J Oral Maxillofac Surg 2010;68:1807-12.
23. Ko EW, Hsu SS, Hsieh HY, Wang YC, Huang CS, Chen YR, *et al.* Comparison of progressive cephalometric changes and postsurgical stability of skeletal class III correction with and without presurgical orthodontic treatment. J Oral Maxillofac Surg 2011;69:1469-77.
24. Ko EW, Lin SC, Chen YR, Huang CS. Skeletal and dental variables related to the stability of orthognathic surgery in skeletal class III malocclusion with a surgery-first approach. J Oral Maxillofac Surg 2013;71:e215-23.

25. Kim CS, Lee SC, Kyung HM, Park HS, Kwon TG. Stability of mandibular setback surgery with and without presurgical orthodontics. J Oral Maxillofac Surg 2014;72:779-87.
26. Lee J, Kim YI, Hwang DS, Kim KB, Park SB. Effect of occlusal vertical dimension changes on postsurgical skeletal changes in a surgery-first approach for skeletal class III deformities. Am J Orthod Dentofacial Orthop 2014;146:612-9.
27. Park HM, Lee YK, Choi JY, Baek SH. Maxillary incisor inclination of skeletal class III patients treated with extraction of the upper first premolars and two-jaw surgery: Conventional orthognathic surgery vs surgery-first approach. Angle Orthod 2014;84:720-9.
28. Choi JW, Park YJ, Lee CY. Posterior pharyngeal airway in clockwise rotation of maxillomandibular complex using surgery-first orthognathic approach. Plast Reconstr Surg Glob Open 2015;3:e485.
29. Choi JW, Lee JY, Yang SJ, Koh KS. The reliability of a surgery-first orthognathic approach without presurgical orthodontic treatment for skeletal class III dentofacial deformity. Ann Plast Surg 2015;74:333-41.
30. Yu HB, Mao LX, Wang XD, Fang B, Shen SG. The surgery-first approach in orthognathic surgery: A retrospective study of 50 cases. Int J Oral Maxillofac Surg 2015;44:1463-7.
31. Park KH, Sandor GK, Kim YD. Skeletal stability of surgery-first bimaxillary orthognathic surgery for skeletal class III malocclusion, using standardized criteria. Int J Oral Maxillofac Surg 2016;45:35-40.
32. Park JK, Choi JY, Yang IH, Baek SH. Patient's satisfaction in skeletal class III cases treated with two-jaw surgery using orthognathic quality of life questionnaire: Conventional three-stage method versus surgery-first approach. J Craniofac Surg 2015;26:2086-93.
33. Rhee CH, Choi YK, Kim YI, Kim SS, Park SB, Son WS, *et al.* Correlation between skeletal and dental changes after mandibular setback surgery-first orthodontic treatment: Cone-beam computed tomography-generated half-cephalograms. Korean J Orthod 2015;45:59-65.
34. Huang S, Chen W, Ni Z, Zhou Y. The changes of oral health-related quality of life and satisfaction after surgery-first orthognathic approach: A longitudinal prospective study. Head Face Med 2016;12:2.
35. Choi SH, Hwang CJ, Baik HS, Jung YS, Lee KJ. Stability of pre-orthodontic orthognathic surgery using intraoral vertical ramus osteotomy versus conventional treatment. J Oral Maxillofac Surg 2016;74:610-9.
36. Wang T, Han JJ, Oh HK, Park HJ, Jung S, Kook MS, *et al.* Comparison of orthodontics-first and surgery-first approach in positional changes of the condyle after mandibular setback surgery using three-dimensional analysis. J Oral Maxillofac Surg 2016;74:2487-96.
37. Akamatsu T, Hanai U, Miyasaka M, Muramatsu H, Yamamoto S. Comparison of mandibular stability after SSRO with surgery-first approach versus conventional ortho-first approach. J Plast Surg Hand Surg 2016;50:50-5.
38. Jeong WS, Choi JW, Kim DY, Lee JY, Kwon SM. Can a surgery-first orthognathic approach reduce the total treatment time? Int J Oral Maxillofac Surg 2017;46:473-82.
39. Feu D, de Oliveira BH, Palomares NB, Celeste RK, Miguel JAM. Oral health-related quality of life changes in patients with severe class III malocclusion treated with the 2-jaw surgery-first approach. Am J Orthod Dentofacial Orthop 2017;151:1048-57.
40. Wang J, Chen W, Ni Z, Zheng M, Liang X, Zheng Y, *et al.* Timing of orthognathic surgery on the changes of oral health-related quality of life in Chinese orthognathic surgery patients. Am J Orthod Dentofacial Orthop 2017;151:565-71.
41. Pelo S, Gasparini G, Garagiola U, Cordaro M, Di Nardo F, Staderini E, *et al.* Surgery-first orthognathic approach vs traditional orthognathic approach: Oral health-related quality of life assessed with 2 questionnaires. Am J Orthod Dentofacial Orthop 2017;152:250-4.
42. Zingler S, Hakim E, Finke D, Brunner M, Saure D, Hoffmann J, *et al.* Surgery-first approach in orthognathic surgery: Psychological and biological aspects a prospective cohort study. J Craniomaxillofac Surg 2017;45:1293-301.
43. Hernández-Alfaro F, Nieto MJ, Ruiz-Magaz V, Valls-Ontañón A, Méndez-Manjón I, Guijarro-Martínez R, *et al.* Inferior subapical osteotomy for dentoalveolar decompensation of class III malocclusion in "surgery-first" and "surgery-early" orthognathic treatment. Int J Oral Maxillofac Surg 2017;46:80-5.
44. Jeong WS, Lee JY, Choi JW. Large-scale study of long-term vertical skeletal stability in a surgery-first orthognathic approach without presurgical orthodontic treatment: Part II. J Craniofac Surg 2018;29:953-8.
45. Holzinger D, Juergens P, Shahim K, Reyes M, Schicho K, Millesi G, *et al.* Accuracy of soft tissue prediction in surgery-first treatment concept in orthognathic surgery: A prospective study. J Craniomaxillofac Surg 2018;46:1455-60.
46. Guo J, Wang T, Han JJ, Jung S, Kook MS, Park HJ, *et al.* Corrective outcome and transverse stability after orthognathic surgery using a surgery-first approach in mandibular prognathism with and without facial asymmetry. Oral Surg Oral Med Oral Pathol Oral Radiol 2018;126:22-30.
47. Lian YK, Hsieh AM, Tsai MS, Jiang HR, Yen CY, Hsia YJ, *et al.* Treatment efficiency and stability of skeletal class III malocclusion with a surgery-first approach. Orthod Craniofac Res 2018;21:90-5.
48. Liao YF, Chen YF, Yao CF, Chen YA, Chen YR. Long-term outcomes of bimaxillary surgery for treatment of asymmetric skeletal class III deformity using surgery-first approach. Clin Oral Investig 2019;23:1685-93.
49. Brucoli M, Zeppegno P, Benech R, Boffano P, Benech A. Psychodynamic features associated with orthognathic surgery: A comparison between conventional orthognathic treatment and "surgery-first" approach. J Oral Maxillofac Surg 2019;77:157-63.
50. Liao YF, Lo SH. Surgical occlusion setup in correction of skeletal class III deformity using surgery-first approach: Guidelines, characteristics and accuracy. Sci Rep 2018;8:11673.
51. Watanabe Y, Sasaki R, Matsuno I, Akizuki T. Surgery-first orthognathic surgery for severe facial asymmetry combined with mandibular distraction osteogenesis using a three-dimensional internal distractor. J Craniofac Surg 2019;30:39-46.
52. Yu CC, Chen PH, Liou EJ, Huang CS, Chen YR. A surgery-

first approach in surgical-orthodontic treatment of mandibular prognathism a case report. Chang Gung Med J 2010;33:699-705.
53. Villegas C, Janakiraman N, Uribe F, Nanda R. Rotation of the maxillomandibular complex to enhance esthetics using a "surgery first" approach. J Clin Orthod 2012;46:85-91.
54. Kim JW, Lee NK, Yun PY, Moon SW, Kim YK. Postsurgical stability after mandibular setback surgery with minimal orthodontic preparation following upper premolar extraction. J Oral Maxillofac Surg 2013;71:1968.e1-1968.
55. Joh B, Bayome M, Park JH, Park JU, Kim Y, Kook YA, *et al.* Evaluation of minimal versus conventional presurgical orthodontics in skeletal class III patients treated with two-jaw surgery. J Oral Maxillofac Surg 2013;71:1733-41.
56. Uribe F, Chugh VK, Janakiraman N, Feldman J, Shafer D, Nanda R, *et al.* Treatment of severe facial asymmetry using virtual three-dimensional planning and a "surgery first" protocol. J Clin Orthod 2013;47:471-84.
57. Teng GY, Liou EJ. Interdental osteotomies induce regional acceleratory phenomenon and accelerate orthodontic tooth movement. J Oral Maxillofac Surg 2014;72:19-29.
58. Aristizábal JF, Martínez Smit R, Villegas C. The "surgery first" approach with passive self-ligating brackets for expedited treatment of skeletal class III malocclusion. J Clin Orthod 2015;49:361-70.
59. Huang CS, Chen YR. Orthodontic principles and guidelines for the surgery-first approach to orthognathic surgery. Int J Oral Maxillofac Surg 2015;44:1457-62.
60. Uribe F, Agarwal S, Shafer D, Nanda R. Increasing orthodontic and orthognathic surgery treatment efficiency with a modified surgery-first approach. Am J Orthod Dentofacial Orthop 2015;148:838-48.
61. Pelo S, Saponaro G, Gasparini G, De Angelis P, Spota A, Garagiola U, *et al.* The medical legal aspects of surgery first and a new model of consent form. J Craniofac Surg 2016;27:1750-3.
62. Zhou Y, Zhou Y, Wang X, Li Z. Minimal presurgical orthodontics for a skeletal class III patient with mandibular asymmetry. Am J Orthod Dentofacial Orthop 2016;149:99-113.
63. Zhou Y, Li Z, Wang X, Zou B, Zhou Y. Progressive changes in patients with skeletal class III malocclusion treated by 2-jaw surgery with minimal and conventional presurgical orthodontics: A comparative study. Am J Orthod Dentofacial Orthop 2016;149:244-52.
64. Larson BE, Lee NK, Jang MJ, Yun PY, Kim JW, Kim YK, *et al.* Comparing stability of mandibular setback versus 2-jaw surgery in class III patients with minimal presurgical orthodontics. J Oral Maxillofac Surg 2017;75:1240-8.
65. Choi JW, Bradley JP. Surgery first orthognathic approach without presurgical orthodontic treatment: Questions and answers. J Craniofac Surg 2017;28:1330-3.
66. Aristizábal JF, Martínez-Smit R, Díaz C, Pereira Filho VA. Surgery-first approach with 3D customized passive self-ligating brackets and 3D surgical planning: Case report. Dental Press J Orthod 2018;23:47-57.
67. Sinha I, Jones L, Smyth RL, Williamson PR. A systematic review of studies that aim to determine which outcomes to measure in clinical trials in children. PLoS Med 2008;5:e96.
68. Williamson PR, Altman DG, Blazeby JM, Clarke M, Devane D, Gargon E, *et al.* Developing core outcome sets for clinical trials: Issues to consider. Trials 2012;13:132.
69. Webbe J, Sinha I, Gale C. Core outcome sets. Arch Dis Child Educ Pract 2018;103:163-6.

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