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Review

Management of the anterior open bite using clear aligner therapy and surgery-first: Case example and scoping review of the literature

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ABSTRACT

Background: The anterior open bite is challenging skeletal facial discrepancy and often requires a combined orthodontic and surgical approach to treatment. Traditionally, such approaches have involved use of conventional fixed orthodontic appliances in-preparation, followed by orthognathic surgery, and subsequent refinement of the occlusion with orthodontic treatment after surgery. Surgery-first approaches to treatment of skeletal facial discrepancies exist and have been demonstrated to provide excellent treatment outcomes with often shorter overall treatment times. The use of clear aligner therapy rather than conventional fixed orthodontic appliances has also been described in the treatment of various skeletal facial discrepancies. As providers offer surgery-first and clear aligner treatment options more frequently, a review of the available literature regarding the combination of the two modalities is needed, particularly for treatment of the anterior open bite.
Objectives: The primary objectives of this report are to systematically review the available literature regarding the use of clear aligner therapy and a surgery-first approach to treatment of the anterior open bite and to provide a case example. Advantages of using clear aligners versus conventional fixed orthodontic appliances will also be discussed.
Eligibility Criteria: Articles included for review were studies addressing patients with an anterior open bite and the use of a surgery-first approach as well as clear aligner therapy.
Sources of Evidence: PubMed and Ovid were queried using the terms "clear aligners" AND "von Willebrand OR open bite"; "clear aligners" AND "surgery-first"; and "clear aligners" AND "orthognathic." Additional references relevant to the review were obtained from the reference lists of available articles ultimately deemed appropriate for inclusion in the review.
Methods: A recent example case of a patient with hemifacial microsomia and an anterior open bite undergoing a combined orthodontic and surgical approach to management is presented for consideration. A scoping review of the literature was undertaken for evaluation of available literature using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Review (PRISMA-ScR).
Results: Insufficient evidence exists for significant analysis of clear aligner therapy directly compared to conventional fixed orthodontic appliances in patients undergoing surgery-first, as was the strategy used for the case presented. A review of the available literature with reference to updated literature regarding management of patients with an open bite specifically undergoing surgery-first and clear aligner treatment yields one two case series. The results indicate that further study of the subject in question is warranted, but currently available literature demonstrates positive outcomes with no reported sequelae for patients with anterior open bites specifically.
Conclusions: The available literature supports the use of clear aligner therapy and surgery-first treatment approaches for patients with anterior open bite. In such patients, clear aligner therapy may be as effective as traditional fixed orthodontic appliances. Evidence already exists that clear aligners can be effectively used to manage the anterior open bite non-surgically in select patients. Based on the review of the literature, there is growing support for the combination of clear aligner therapy in the setting of surgery-first. Newer techniques for orthodontic and surgical approaches to patient management may allow for the expansion of procedures that can be safely considered in patients with anterior open bites and additional skeletal facial discrepancies.

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1. Introduction

Management of skeletal facial discrepancies in general and anterior open bite in particular often involves a combined orthodontic and surgical treatment approach. Traditionally, such approaches have involved use of conventional fixed orthodontic appliances in-preparation, followed by orthognathic surgery, and subsequent refinement of the occlusion with orthodontic treatment after surgery [1]. Surgery-first approaches to treatment of skeletal facial discrepancies exist and have been demonstrated to provide excellent treatment outcomes with often shorter overall treatment times [2,3]. The use of clear aligner therapy rather than conventional fixed orthodontic appliances has also been described in the treatment of various skeletal facial discrepancies [4,5].

Clear aligner therapy (CAT) has been used in both surgical and non-surgical correction of the anterior open bite [6–8]. Combining CAT and surgery-first offers potential benefits for patients with skeletal facial discrepancies [9]. The combination of CAT and orthognathic surgery in general has been described with various technique modifications [10–12]; however, the use of CAT and surgery-first is less well studied. The more specific and relatively newer use of a CAT and surgery-first approach to management of the anterior open bite would benefit from a scoping review of the literature.

The following report describes the combined orthodontic and surgical management of a patient with hemifacial microsomia and an anterior open bite skeletal facial discrepancy. The patient underwent segmental bimaxillary surgery with additional osseous genioplasty and transoral placement of a custom mandibular angle Medpor implant. The patient was treated with surgery-first and continued with orthodontic clear aligner therapy starting at six weeks postoperatively. Considerations of a scoping review of the literature are discussed.

1.1. Representative case

Patient consent was obtained. A 25-year-old female patient presented to the Department of Oral and Maxillofacial Surgery at The Dental College of Georgia at Augusta University for a combined approach to treatment of her skeletal facial discrepancy involving both Orthodontics and Surgery. The patient demonstrated maxillary hypoplasia with an absolute transverse deficiency and anterior open bite. The patient was also noted to have right hemifacial microsomia and neurofibromatosis type I. Her surgical history involved spinal fusion for correction of scoliosis.

All treatment options were reviewed with the patient, including no treatment, and particular risks discussed in the setting of orthognathic surgery. After review of existing literature and discussion with the patient, the patient decided to proceed with bimaxillary surgery involving a LeFort I level osteotomy in three-pieces for maxillary advancement with allogeneic bone grafting, bilateral sagittal split osteotomies of the mandible with rigid internal fixation, transoral placement of pre-bent titanium reconstruction plates and custom Medpor implant at the right mandible for correction of hemifacial microsomia asymmetry, and osseous genioplasty.

The surgical procedure was completed without complication. Preoperative and postoperative images at 6 weeks and at 5 months following surgery are provided in Figures 1–4 below. Passive conventional fixed orthodontic appliances were placed just prior to surgery to facilitate postoperative management. CAT was initiated at 6 weeks postoperatively.

2. Materials and methods

A scoping review of the literature was undertaken using the Preferred Reporting Items for Systematic Review and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR). PubMed and Ovid were queried using the terms “clear aligners” AND “open bite”; “clear aligners” AND “surgery-first”; “Invisalign” AND “surgery-first”; and “clear aligners” AND “orthognathic.” Additional references relevant to the review were obtained from the reference lists of available articles ultimately deemed appropriate for inclusion in the review. The purpose of the literature review was to identify management strategies for patients with anterior open bites and any reported sequelae of treatment approaches using surgery-first orthognathic surgery and clear aligner

Fig. 1. Preoperative patient presentation.

Fig. 2. Pre-contoured custom Medpor Implant.

Fig. 3. Postoperative presentation at 6 weeks and at the initiation of clear aligner therapy.

Fig. 4. Dentition after 3 months of CAT use. Total treatment time 4.5 months.

Table 1
Data charting of selected sources.

Authors	Kankam, et al	Amodeo, et al
Year of publication	2018	2020
Country of origin	USA	Italy
Population		Class III malocclusion
Surgery	Lefort I (7 segmental, 6 single-piece) and BSSO in a surgery-first approach	Lefort I and BSSO in a surgery-first approach
Intervention	Post-operative clear aligner therapy with Invisalign	Post-operative clear aligner therapy with Invisalign
Outcome	No complications. Successful segmental double-jaw surgery performed using Invisalign	Angle class I, no deep bite, no scissor or cross-bite and no open bite. Stable surgical and occlusal results in all patients
Evidence Level	4a - case series	4a - case series

therapy. Inclusion and exclusion criteria were as follows:

Inclusion Criteria

English language

Studies addressing patients with anterior open bite undergoing orthognathic surgery in a surgery-first approach followed by clear aligner therapy.

Exclusion Criteria

Non-English language

Studies addressing patients without anterior open bite.

Studies addressing patients who did not undergo orthognathic surgery.

Studies addressing patients who were treated with pre-surgical orthodontics (not surgery-first approach).

Studies addressing patients who were not treated with clear aligner therapy.

Studies with insufficient information to abstract data

Data charting was performed using a modification of the template from the Joanna Briggs Institute evaluating the details, characteristics, and results of the included articles. A subsequent analysis of the quality of evidence of each article was performed using the LEGEND: Evidence Appraisal of a Single Study guideline.

3. Results

Search results identified 208 articles using combinations of the terms “clear aligners,” “surgery-first,” and “orthognathic.” After removal of duplicate articles and application of exclusion criteria, 2 of the initial 208 articles met inclusion criteria, not enough data to provide a formal systematic review or analysis of the literature [13,14].

Data charting of the selected sources is presented in Table 1. A review of management strategies available demonstrated limited evidence for use of clear aligner therapy and a surgery-first approach to management of the anterior open bite. The primary article available for reference was published in the Journal Plastic and Reconstructive Surgery [13]. The case series of 13 patients included seven with an anterior open bite. The cohort was later compared to a group of 20 patients treated with conventional fixed appliances, and no perioperative outcomes or notable adverse sequelae were identified. Fig. 5 illustrates the review process and stepwise results. Analysis of the quality of evidence of each article using LEGEND: Evidence Appraisal of a Single Study demonstrated level 5a evidence for the included articles (Table 1).

4. Discussion

The present case demonstrates a deviation from conventional treatment algorithms for management of skeletal facial discrepancies with anterior open bites. Conventional treatment involves the use of fixed orthodontic appliances for preoperative orthodontic preparation, followed by orthognathic surgery, and then completed with additional orthodontic refinement. The present case and scoping review focus on the use of surgery-first techniques followed by the use of clear aligner therapy (CAT) for correction of the anterior open bite.

Only two articles were identified in the literature related to the use of CAT and surgery-first for treatment of the anterior open bite [13,14]. Consistent with the literature, the overall treatment time of the case presented with notably shorter at 4.5 months than what would be expected with conventional techniques. Also consistent with the literature, no adverse sequelae were noted with the application of CAT and surgery-first, even with the addition of complex transoral placement of a custom Medpor implant and pre-contoured titanium fixation. Efforts to identify studies through grey literature with the use of Opengrey.eu and Google Scholar similarly identified no studies that discussed management of the anterior open bite patient with surgery-first and clear aligner treatment. Potential biases of the above systematic review process that could limit results were the exclusion of non-English language articles and limited access to Scopus preventing additional searches.

5. Conclusions

Limited evidence exists in the literature for use of clear aligner therapy and a surgery-first approach to management of the anterior open bite skeletal facial discrepancy. No notable adverse sequelae have been noted with such approaches thus far, and the associated case presented demonstrates several advantages of the approach when appropriately applied. The overall treatment time of a combined orthodontic and surgery approach may be shortened with use of CAT and surgery-first. Esthetics afforded by CAT use during postoperative management are improved relative to conventional orthodontic appliances without compromising occlusal outcomes [15]. A body of evidence exists to support the use of clear aligner therapy for treatment of the anterior open bite without the use of surgery, and the use of clear aligner therapy with traditional orthognathic surgery after initial orthodontic treatment has been demonstrated to be an effective treatment option for various skeletal facial discrepancies. A significant body of literature does not exist yet for use of surgery-first treatment approaches and CAT for anterior open bite patients specifically as evidenced by the above review; however, the above review and reported experience of multiple institutions now provides reasonable support to consider application of this treatment protocol. Long-term follow up is not yet available, and randomized controlled trials would be most beneficial for comparing treatment protocols of specific skeletal facial discrepancies.

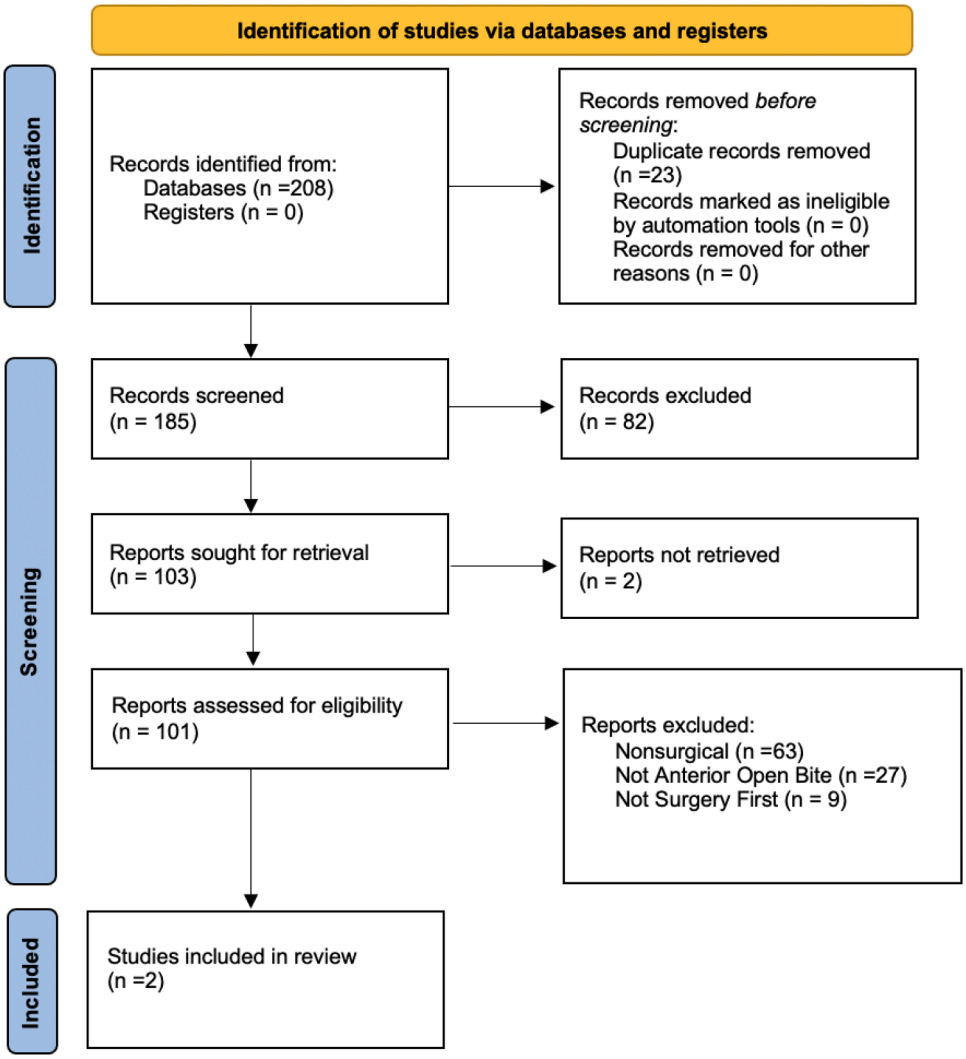

Fig. 5. PRISMA flow chart illustrating selection process for studies reviewed.

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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