



Review

Stability of open-bite treatment in adult patients: A systematic review

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ABSTRACT

Background: Anterior open-bite in adults is a challenging malocclusion to be treated and many therapies have been advocated to increase the stability.

Objective: Review and compile evidence for the stability of anterior open-bite treatments in adult patients.

Methods: An electronic search was performed in PubMed, Cochrane Library, Lilacs, and SciELO, from January 1989 to April 2012. The following orthodontic treatment modalities were included: with or without extraction, combined with temporary anchorage devices, and orthognathic surgery. The overbite was assessed pretreatment, posttreatment, and at least 1-year posttreatment. Studies with growing patients or reporting less than 1 year of follow-up were excluded.

Results: Randomized control trials and systematic reviews have not been identified. Mean overbite relapse was -0.6 mm in the case series group (84% stability in orthodontic cases and 86% in surgical cases) and -0.39 mm in the case series and control groups (89% stability). Orthodontic treatment with extractions seemed to be more stable than nonextraction, as well as one-jaw surgery compared with bimaxillary surgery. The available data on orthodontics combined with temporary anchorage devices is still scarce.

Conclusions: Scientific available data on the stability of open-bite treatment reveals only weak evidence about certain treatment modalities, which is not enough to predict the success of clinical choices.

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1. Introduction

Anterior open bite in adults is known as one of the most challenging problems in orthodontics, especially regarding stability [1,2]. Such malocclusion develops as result of the combination of many etiologic factors, and when a treatment choice is made, it should consider the patient's age and the dental and skeletal discrepancies [3–8]. Early treatment of the open-bite usually provides the best results but adult patients represent a more difficult morphological problem to be solved [9–11].

Many therapies have been advocated to increase the stability of open-bite correction according to the malocclusion severity and facial disharmony, and orthognathic surgery combined with orthodontic treatment might play an important role in providing stability [2,12].

A previous systematic review with meta-analysis [13] on the stability of the open-bite treatment in growing and nongrowing

subjects concluded that higher-quality evidence controlled trials are needed to definitively answer how to best deal with these patients.

The purpose of this systematic review was to assess the available scientific literature on the stability of open-bite treatment modalities in adult patients.

2. Materials and methods

A survey of articles, published from January 1989 up to April 2012, about the stability of open-bite treatment was conducted on the following electronic databases: PubMed, Cochrane Library, Lilacs, and SciELO.

To determine the key words for electronic search, we designed a specific protocol and a question for research. Table 1 shows the patients-intervention-comparison-outcome format designed for a specific protocol and a question for the research [14]. The methods for this review were based on the guidelines of the preferred reporting items for systematic reviews and meta-analyses statement [15].

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Table 1
PICO format

P = Patients/problem	Adult patients with anterior open bite
I = Intervention	Undergoing orthodontic or orthodontic-surgical treatment
C = Comparison	Among different types of treatments performed
O = Outcome	Treatment with greater stability posttreatment
Question	What is the kind of treatment performed in adult patients with anterior open bite that provides greater stability after treatment?

The key words used in the electronic search were “anterior open bite,” “long face,” “vertical dentoalveolar problem,” “vertical skeletal problem,” combined with “orthodontic treatment” (MeSH Terms). The titles and abstracts of the identified studies in the electronic search were prescreened according to the relevance of the study’s topic. At this point, the rejected articles were registered.

The reference list of the retrieved articles was also screened in an attempt to identify any article that might have been missed in the primary search. No language restriction was applied during the identification process of the published studies.

To be included in this study, each article had to fulfill the following requirements: (1) systematic review and meta-analysis, randomized clinical trials, case series and control or, case series; (2) nongrowing patients, at least 14 years old for females and 16 years old for males at the beginning of treatment; and (3) a minimum of a 1-year follow-up period. The exclusion criteria included the following: (1) patients presenting craniofacial pathologies, syndromes, cleft lip and/or palate, or (2) case reports with less than eight patients.

The preferred reporting items for systematic reviews and meta-analyses flow diagram of the included and excluded studies is illustrated in Figure 1. The selection was done by two independent reviewers (LFA and RBM), who had access to the full text of each potentially relevant study. In a consensus meeting, an agreement was settled on which studies to include with the support of a third or fourth reviewer. When necessary, the authors were contacted for further information.

From the selected articles, the following study characteristics were recorded: author and year, sample size, gender, treatment modality, age and overbite in mm in T1 (pretreatment), T2 (post-treatment) and T3 (at least 1-year of follow-up).

A methodological quality scoring process was used to identify which selected studies would be most valuable and was based on the data from Nguyen et al [16] and Baratieri et al [17].

The articles selected for eligibility were assessed on the basis of study design, study measurements, and conclusion (Tables 2 and 3). The methodological quality assessment scores ranged from 0 to 16 points. Studies were qualified as having high (≥ 13), moderate (≥ 8 and < 13), or low (> 8) methodological quality.

3. Results and discussion

The primary search strategy returned 1909 potential articles. After evaluating titles, 1377 studies were discarded, and after reading the abstract 430 were also excluded. Figure 1 outlines the search results, the number of selected studies, and the reasons for exclusion. The main reasons for excluding an article included a short follow-up period (less than 1 year), the patients’ age, and lack of overbite information.

According to the inclusion and exclusion criteria, 14 studies were selected, comprising 8 case series and 6 case series with control. No randomized control trials or systematic reviews were identified concerning the stability of the open-bite treatment in adults until April 2012.

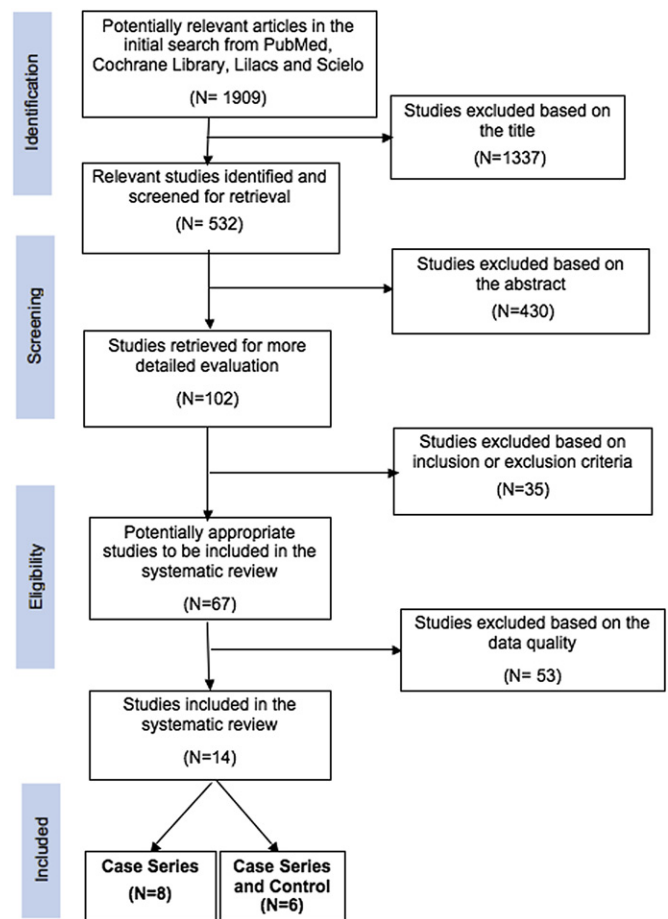


Fig. 1. The preferred reporting items for systematic reviews and meta-analyses flow diagram of the search results from the databases.

Table 4 provides the data collected from 174 patients in the 8 case series studies, with the mean age of 23.8 years before treatment. The mean overbite was -2.72 mm in T1, $+1.92$ mm in T2, and $+1.32$ mm in T3. The average follow-up period was 3.5 years and the relapse rate 0.6 mm. The orthodontic treatment modalities were nonextraction [4], extraction and nonextraction [18], temporary anchorage devices [19,23], and orthognathic surgery [2,20–22].

Table 2
Methodological quality assessment of included studies [16,17]

	Points
Study design (10)	
A- Description of objective	1
B- Population adequately described (age, sex,)	1
C- Selection criteria described	1
D- Sample size: < 30 /group (1) or ≥ 30 /group (2)	2
E- Randomized study	2
F- Control Group	1
G- Follow-up definition and length	2
Study measurements (5)	
H- Withdrawals mentioned	1
I- Measurement defined	1
J- Blinding: examiner and statistician	1
K- Reliability described and adequate	1
L- Presentation of data	1
Conclusion (1)	
M- Reasonable conclusion for study power	1
Total score	16

Table 3
Score of selected articles according to methodological quality

Author	A	B	C	D	E	F	G	H	I	J	K	L	M	Total	Quality
Kucukkeles et al [4]	1	1	1	1	0	0	1	0	1	0	0	1	1	8	Moderate
Fischer et al [20]	1	1	1	2	2	0	2	1	1	0	1	1	0	13	High
Kim et al [18]	1	1	1	1	0	0	2	0	1	1	1	1	1	11	Moderate
Sugawara et al [19]	1	1	1	1	0	0	1	0	1	0	0	1	1	8	Moderate
Ding et al [21]	1	1	0	1	0	0	2	0	1	0	0	1	1	8	Moderate
Espeland et al [2]	1	0	1	2	1	0	2	0	1	0	1	1	1	11	Moderate
Stansbury et al [22]	1	0	1	1	1	0	1	0	1	0	1	1	0	8	Moderate
Baek et al [23]	1	1	1	1	0	0	2	0	1	0	1	1	1	10	Moderate
McCance et al [24]	1	0	1	1	0	1	1	0	1	0	1	1	1	9	Moderate
Hoppenreijts et al [25]	1	1	1	2	0	1	2	1	2	0	1	1	1	14	High
Lo et al [26]	1	1	1	2	0	1	2	0	2	0	1	1	0	12	Moderate
Proffit et al [27]	1	1	1	2	0	1	2	0	2	0	0	1	1	12	Moderate
Moldez et al [28]	1	1	1	1	2	1	2	0	2	0	1	1	1	14	High
Teittinen et al [29]	1	1	0	1	2	1	2	0	1	1	1	1	1	13	High
Mean score														10.8	Moderate

Table 5 presents the following information from the six case series with control studies [24–29]: total sample, 396 patients; mean overbite of –3.02 mm in T1, +1.16 mm in T2, and +1.01 mm in T3; and mean follow-up of 4.3 years and relapse of 0.39 mm. These six articles were on orthognathic treatment modality, but different criteria were used to compare the variable features according to each study’s objectives.

McCance et al [24] compared 21 patients treated with bimaxillary orthognathic surgery according to the angle’s Class II or III classification. Hoppenreijts et al [25] divided a sample of 234 patients according to the following purposes: (1) type of surgery (maxilla only vs. two jaw); (2) segmentation of the maxilla (one piece vs. multiple segments); and (3) type of fixation (semi-rigid vs. rigid). Lo et al [26] compared 40 patients treated with LeFort I surgery according to the segmentation of the maxilla (one piece vs. multiple segments). Proffit et al [27] divided the sample studied into 28 patients with a one-jaw procedure versus 26 patients with a two-jaw surgical procedure. Moldez [28] compared 13 patients with Class III impaction versus 10 patients with clockwise rotation of the maxilla during the surgical procedure. Teittinen et al [29] compared 12 patients with rigid fixation maxillary rotation versus 12 patients with two-jaw surgical procedures.

This systematic review displays an overview and the level of evidence of the available studies on different treatment modalities regarding stability for the open bite in adults.

The overbite was used to assess the stability of the open-bite treatment because it reflects a skeletal and/or dental relapse, and is commonly described in different studies. Cephalometric measurements may vary in different analysis and fail to detect dental changes.

The reviewers evaluated the full text of the 67 studies. The main reasons for exclusion were a short follow-up period (< 1 year),

patients who are still growing, and lack of data. Eight case series studies and six case series with control were selected.

No randomized control trials or systematic reviews were identified on the stability of the open-bite treatment in adults until April 2012.

The main difficulty challenging this study was data obtained at different time points in surgical studies. The follow-up at T3 should be at least 1 year after the removal of orthodontic appliances, but surgery studies commonly used the surgical procedure as a reference. Even though it is possible to assess surgical stability within 1 year after surgery, postsurgical orthodontic movement with dental compensation and lack of follow-up without braces might have also influenced the results. In some cases there is an overbite increase from T2 (the end of treatment) to T3 (posttreatment period), and this unusual increase in millimeters in the overbite can be seen in Tables 4 and 5.

Table 4 provides information from four studies that treated patients with orthodontic approaches only, and 4 studies that treated patients with orthognathic surgery. The average stability can be considered very similar in both groups (84% vs. 86%).

In the orthodontic treatment group [4,18–20], a relapse ranging from –0.25 to –1.25 mm on average was observed, which means a 78% to 96% stability in the period evaluated.

The stability was higher (96%) in patients who had extractions performed as needed [18] compared with 78% in the patients treated without extraction [4], but it should be noted that the sample size and the observation time are small.

When studies that used orthodontics combined with temporary anchorage devices (TADs) [19,23] were compared, relapse ranged from –0.90 to –1.20 or from 82% to 78% in stability. It should be noted that the time monitoring the two studies were 1 and 3 years, respectively.

Table 4
Case series

Author, year	N	Gender		Age	Treatment			Overbite (mm)			T3–T2		Stability	Mean Stability
		F	M		Ort	TAD	Sur	T1	T2	T3	Time (y)	Relapse (mm)		
Kucukkeles et al, 1999 [4]	10	—	—	19	X			–4.05	+1.75	+0.50	1	–1.25	78%	84%*
Kim et al, 2000 [18]	10	—	—	26	X			–2.23	+3.63	+3.38	2	–0.25	96%	
Sugawara et al, 2002 [19]	9	7	2	19.3		X		–2.80	+2.10	+1.20	1	–0.90	82%	
Baek et al, 2010 [23]	9	8	1	23.7		X		–3.91	+1.65	+0.45	3	–1.20	78%	
Fischer et al, 2000 [20]	58	40	18	23			X	–0.80	+2.2	+0.80	2	–1.40	53%	86%†
Ding et al, 2007 [21]	10	8	2	24.4			X	–3.20	+1.6	+1.50	15	–0.10	98%	
Espeland et al, 2008 [2]	40	—	—	25.8			X	–2.60	+1.4	+1.10	3	–0.3	92%	
Stansbury et al, 2010 [22]	28	22	6	29.2			X	–2.2	+1.1	+1.70	1	+0.6	100%	
Total/average	174	—	—	23.8	2	2	4	–2.72	+1.92	+1.32	3.5	–0.6	—	85%

N, number of patients; Ort, nonextraction and extraction orthodontics; TAD, orthodontics combined with temporary anchorage devices; Sur, orthognathic surgery; y, years.
* Four studies that treated patients only with orthodontic approaches.
† Four studies that treated patients with orthognathic surgery.

Table 5
Case series and control – surgical treatment

Author, year	N	Malocclusion			Fixation			Intervention			Overbite (mm)			T3–T2		Stability*
		I	II	III	WIF	RIF	Maxilla			T1	T2	T3	Time (y)	Relapse (mm)		
							1 p	Ms	IM						Ro	
McCance et al, 1992 [24]	10		X													100%
	11			X												92%
Hoppenreijts et al, 1997 [25]	122															91%
	112															82%
	151															89%
	83															87%
	136															86%
Lo et al, 1998 [26]	98															91%
	19															72%
	21															84%
Proffit et al, 2000 [27]	28															99%
	26															86%
Moldez, 2000 [28]	13															78%
	10															92%
Teittinen et al, 2012 [29]	12															100%
	12															92%
Total/average	396															89%

N, number of patients; WIF, wire internal fixation; RIF, rigid internal fixation; 1 p, one piece LeFort I; MS, multi-segment LeFort I; IM, maxillary impaction; RO, maxillary rotation; Mx only, maxilla only; BiM, bimaxillary; Y, years.
* Difference between correction and relapse.

The reports of orthodontic treatment combined with TADs are scarce, mostly due to insufficient follow-up period. In one study [19] the authors alleged that the selection criteria included only cases of success. Although the results present only favorable and, though, biased outcomes, the authors' fair judgment on reporting the exclusion of unsuccessful treatment should be taken under consideration.

Both studies reporting TADs agree that most relapse occurred during the first year of retention, so it would be reasonable to consider overcorrecting patients treated with this modality, and plan an appropriate retention method [19,20].

In four studies of the case series group (Table 4), surgical treatment was performed for correction of open bite, and relapse ranged from +0.6 mm to -1.40 mm, with a variation in the stability from 53% to 100% [2,21–23].

Table 5 presents the six case series with control involving orthognathic surgery. A mean -3.02-mm pretreatment overbite can be considered low for patients undergoing orthognathic surgery, which led to the supposition that the surgical decision had not been made only due to open-bite severity, but also based on skeletal disharmony and facial esthetic impact.

The open-bite correction in Class II malocclusion seems to be more stable (100% stability) than in Class III malocclusion (92% stability) [24].

One-jaw surgical intervention in the maxilla seemed to be more stable (91%) than two-jaw surgical procedures (82%), and one piece Le Fort I seemed more stable (89%) than multi-segment maxillary surgery (87%). Treatment with the wire internal fixation was less stable (86%) than rigid internal fixation (91%) [25].

In contrast, one study [26] indicated that multi-segment osteotomies would have a lower tendency to relapse than one-piece Le Fort I surgery. However, poor stability reported for Le Fort I might have been influenced by highly unstable orthodontic biomechanics with incisors extrusion combined with bimaxillary surgery that was performed in this sample.

Proffit et al [27] confirmed that the surgery performed in the maxilla only did have higher overbite stability (99%) than bimaxillary surgery (86%). Teittinen et al [29] reported similar results and reported that the maxillary rotation had greater overbite stability (100%) when compared with bimaxillary surgery (92%).

The stability provided by the surgical studies in the case series with control might be higher (89%) but, when compared with the group of case series (85%) and with the orthodontic treatment alone or combined with temporary anchorage devices (84%), it remains similar.

The stability reported in the recent available data may be considered optimistic, but it must be considered that all the studies included in this systematic review are retrospective. Actually, a greater relapse rate could be expected in dental practice. Even if the selection of the patients based on the availability of the records seems unbiased, it is important to be aware that a patient's recall will probably diverge from the successfully and unsuccessfully treated ones. A randomized or consecutively treated sample group is of great importance to reach conclusions based on evidence.

Even considering the stability around 80% to 90%, it should be taken into account that a relapse of 1 to 2 mm in overbite compromises the functional aspects of dental occlusion.

Higher quality evidence, which includes standard methods of assessment, controlled trials, randomized samples, and a longer observation period are needed to guide orthodontists in their clinical decisions. The latter recommendation is based on the short follow-up period of this sample obtained from the available data in the scientific literature.

4. Conclusions

Scientific available data on the stability of open-bite treatment provides only weak evidence about certain treatment modalities, which is not enough to predict the success of clinical choices. Orthodontic treatment with extractions seemed to be more stable than nonextraction, as well as one-jaw surgery compared with bimaxillary surgery. The available data on TADs is still scarce. Nevertheless, the decision to treat with orthognathic surgery is not limited to the malocclusion, because it also addresses correction of dentofacial deformities that will improve facial aesthetics.

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