

# DECISION-MAKING FACTORS IN THE MANAGEMENT OF MAXILLARY LATERAL INCISOR AGENESIS: SYSTEMATIC REVIEW

## *FATORES DE TOMADA DE DECISÃO NO MANEJO DA AGENESIA DOS INCISIVOS LATERAIS SUPERIORES: REVISÃO SISTEMÁTICA*

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### ABSTRACT

Deciding whether to close or open the space of missing maxillary lateral incisors remains a clinical challenge. This systematic review aims to study the decisive factors in decision-making in patients with agenesis of the maxillary lateral incisors. Following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines, this research was conducted using the PubMed, ScienceDirect, and Cochrane Library databases by selecting publications published from January 1, 2010 to September 30, 2024. The study protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO CRD42024532098), in accordance with Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines. The study was assessed using the Joanna Briggs Institute (JBI) tools base on each study's design. Our searches retrieved 56 bibliographical references. After removing duplicates, studying the titles and abstracts, and reading the articles in full, eight studies were included in this review. Therapeutic decision-making is primarily based on periodontal parameters, with studies suggesting that space closure is preferable when both treatment options are viable.

**Keywords:** Agenesis; Lateral incisor; Treatment choice.

### RESUMO

Fechar ou abrir o espaço de incisivos laterais superiores ausentes continua sendo um grande desafio para os dentistas. O objetivo desta revisão sistemática foi estudar os fatores decisivos no processo de tomada de decisão em pacientes com agenesis dos incisivos laterais superiores. Seguindo as diretrizes PRISMA, a pesquisa foi realizada nas seguintes bases de dados (PubMed, ScienceDirect, Cochrane Library), selecionando publicações publicadas de 1º de janeiro de 2010 a 30 de setembro de 2024. O protocolo foi registrado no registro prospectivo internacional de revisões sistemáticas (PROSPERO) em conformidade com as diretrizes PRISMA (PROSPERO CRD42024532098). De acordo com o desenho de cada estudo, a avaliação foi realizada utilizando as ferramentas do Joanna Briggs Institute (JBI) para os estudos incluídos. Foram identificadas 56 referências bibliográficas. Após a remoção de duplicatas, análise dos títulos e resumos e posterior leitura dos textos completos, oito artigos foram incluídos neste trabalho. A tomada de decisão terapêutica baseia-se principalmente em parâmetros periodontais e estudos demonstram que o fechamento de espaços é preferível quando ambas as opções de tratamento são viáveis.

**Palavras-chave:** Agenesia; Incisivo lateral; Escolha de tratamento.

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## INTRODUCTION

A tooth is considered congenitally missing when it has not erupted into the oral cavity, has not been accidentally lost or extracted, and is not visible on radiographic examinations (1). The prevalence of congenitally missing maxillary lateral incisors varies across studies (2,3). Swarnalatha et al. (4) recently reported a prevalence rate of 3.77% in a sample of orthodontic adolescent population, in which 62.16% had bilateral lateral incisor agenesis and women showed a higher percentage of upper lateral incisor hypodontia (2.8%) than men (0.9%).

Variation in the prevalence and pattern of agenesis may relate to differences in race and ethnicity between populations, environment, or sampling techniques (1,4). There are two possible options to manage congenital agenesis of maxillary lateral incisors: an orthodontic treatment to close the space by using a reshaped canine or an orthodontic treatment that opens a space and places cantilever resin-bonded fixed dental prostheses or restores an implant-supported fixed prosthesis (1,5). The decision on the most appropriate treatment modality should consider the type of malocclusion, the relation of the anterior teeth, the availability of space, and the condition of the adjacent tooth (6).

Regardless of the option, orthodontists mainly target a satisfactory functional and aesthetic outcome and long-term stability. This process involves many challenges and requires a careful assessment prior to a decision (1). This study aims to investigate the key factors that influence treatment planning for patients with agenesis of the maxillary lateral incisors to optimize both short- and long-term outcomes.

## MATERIAL AND METHOD

### *Registration of protocol*

The protocol of this study was registered with the international prospective register of systematic reviews in accordance with Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines (PROSPERO CRD42024532098).

### *Research strategy*

This systematic review was carried out in the PubMed, Cochrane Library, and ScienceDirect databases, selecting publications published from January 1, 2010 to September 30, 2024, according to the following keywords: (maxillary lateral incisor OR upper lateral incisor OR lateral incisor) AND (congenitally missing OR agenesis) AND orthodontics AND treatment choice. The research question was established using the Population, Intervention, Comparison, and Outcomes format (Figure 1).

Population	Patients with maxillary permanent lateral incisor agenesis (uni/bilateral)
Intervention	Treatment of maxillary lateral incisor agenesis
Comparison	Occlusal, periodontal, or aesthetic outcome of the two treatments
Outcomes	Factors affecting decision-making for patients with maxillary lateral incisor agenesis

**Figure 1** - Population, Intervention, Comparison and Outcomes question.

### *Inclusion and exclusion criteria*

The inclusion and exclusion criteria to choose the articles for analysis are summarized in Figure 2.

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"><li>Articles published from January 1, 2010, to September 30, 2024;</li><li>Full text availability;</li><li>Written in French or English;</li><li>Cohort, case-control, comparative, prospective, longitudinal, retrospective or cross-sectional studies, original articles, and randomized control trials;</li><li>Clinical studies about missing maxillary lateral incisors involving both methods (space opening and closure) in permanent dentition;</li><li>Studies regardless of gender or race.</li></ul>	<ul style="list-style-type: none"><li>Case reports;</li><li>Literature reviews;</li><li>Expert opinions;</li><li>Editorials;</li><li>Letters;</li><li>Case series;</li><li>Agenesis of maxillary lateral temporary incisors;</li><li>Studies treating a maxillary lateral incisor missing because of a trauma or caries.</li></ul>

**Figure 2** - Inclusion and exclusion criteria.

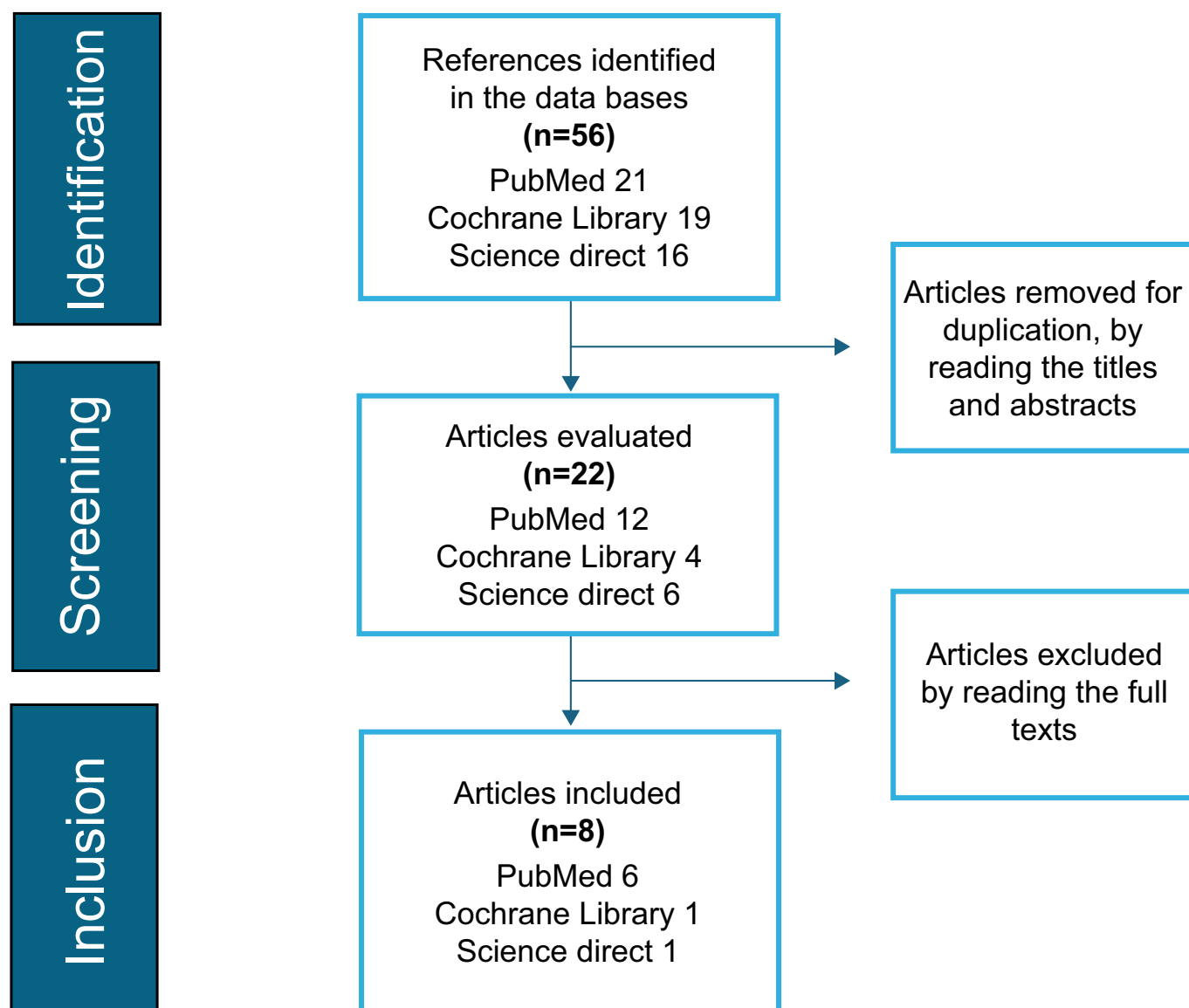
### *Data extraction method*

A.A and E.R, two independent reviewers, performed a qualitative synthesis by discussing

their conclusions stemming from their evaluation of the titles and abstracts of the chosen studies. Zotero was used to detect duplicates

(www.zotero.org). After their removal, other studies were removed based on an initial review of titles and abstracts. Articles that failed to meet the inclusion criteria of this study were excluded. Then, the texts of the remaining articles were read in full to ensure their eligibility. The reference list of the included articles in this review is shown in the references.

Then, A.A and E.R independently extracted data from the selected studies by a data-extraction sheet that contained the following information: authors' name, year of publication, study design, aim of the study, treatment modalities, participants, parameters evaluated, and results. Moreover, two other researchers, Y.O and Z.F, reevaluated the collected data. The selection process is shown in the flowchart below (Figure 3).



**Figure 3** - Flowchart of the article inclusion process.

### *Methodological and risk of bias assessments*

Risk of bias was independently evaluated by two researchers: A.A and E.R. In case of any conflict of opinions, reviewers Y.O and Z.F were to reexamine the results of the evaluation. According to the design of each study, evaluations followed the Joanna Briggs Institute (JBI) tools for the included studies (retrospective, case-control, and cross-sectional studies) (7).

## **RESULTS**

### *Study selection*

This review found 56 studies. After eliminating duplicates, 47 remained in its final corpus. The analysis of their titles and abstracts retained 22 articles. Further studies were excluded after full-text reading due to methodological concerns

or unclear reporting. Thus, this systematic review included eight articles. The flowchart above

illustrates this study selection process (Figure 1). Table 1 summarizes the included articles.

**Table 1 - Results of studies included in the review**

Authors	Study design	Aim of study	Treatment modalities	Participants	Evaluated parameters	Results
Jamilian A. et al (2015) (8)	Retrospective study	To compare the aesthetic, periodontal, and functional outcomes.	- SC - SO + implant	Study group: 10 patients SC (19y ± 2.1) and 10 SO+implant (20years ± 1.4).	- Aesthetic, periodontal, and functional outcomes.	- Well-accepted aesthetic results for the two modalities. - Infraocclusion in implant patients. - Better periodontal health with SC.
Hvaring C. et al (2016) (9)	Retrospective study	To compare soft tissue morphology and crowns.	- SC - SO + implant - SO + fixed prosthesis	- 50 patients - Mean age, 25.6 years).	- Mucosal discoloration - Crown morphology - The color and papilla index.	- Mucosal discoloration only occurred in implants - Higher papilla index for orthodontic SC.
Josefsson et al (2019) (10)	Cross-sectional study	To evaluate the best treatment option.	- SC - SO + implant	44 patients: 22 SC, 22 SO + implant Mean age: 24.6-33.7 years.	- Aesthetics - Periodontal Status - Occlusal morphology.	- No significant aesthetic differences between the groups. - Gingival color was better in the SC group. - Gingival recession was more common in implant group
Barber et al (2014) (11)	Case control	To establish whether patients preferred aesthetic outcomes .	- SC - SO	- 102 patients (14-16 years)	Aesthetics	Most examiners chose SO.
Shneider et al (2016) (12)	Case control	To determine how dentists, orthodontists, and laypersons judge the aesthetic outcome.	- SC - SO + implant	- 9 patients: 3 SC, 3SO + implant, 3 Control group	Aesthetics	Dentists ranked SO and SC as equally aesthetic, laypersons chose SC.
De Marchi et al (2014) (13)	Case control	To evaluate the smile attractiveness.	-SC - SO + implant	- 68 patients: 26 SC, 20 SO, 22 control group	aesthetics	- Patients with SC were significantly more satisfied.
Qadri et al (2016) (14)	Cross sectional study	To investigate the opinions of laypersons.	- SC - SO	- 21 patients: 11 SC, 10 SO	Aesthetics	Aesthetics after SC is statistically more pleasant than SO.
Kafantaris et al (2020) (15)	Retrospective study	To investigate the factors affecting decision-making.	- SC - SO	- 46 patients (31 women > 17 years et 11 men > 18 years).	- Soft tissue response - Aesthetic outcome - TMJ response - Periodontal and peri-implant status	- Decision-making is directly dependent on patients' age, individual characteristics, and participating specialists in the treating team.

SO: Space opening – SC: Space closure – TMJ: Temporomandibular joint.

### Study characteristics and risk of bias assessment

The included studies consisted of retrospective, case-control studies, and cross-sectional studies. These eight studies shared a common objective: to study parameters related to the management of maxillary lateral incisor agenesis. They compared aesthetic, periodontal, and functional outcomes.

Following the Joanna Briggs Institute critical appraisal checklist, this review classified the risk of bias of its chosen studies as high when they obtained up to 49% of “yes” responses; as moderate, if from 50 to 69%; and as low, if over 70%. A “✓” means yes, an “X” denotes no, and a “?” indicates unclear. Therefore, this review categorized five studies as under moderate risk and three, as having low risk (Tables 2, 3 and 4).

**Table 2 - The Joanna Briggs Institute critical appraisal for retrospective studies**

Checklist questions	1	2	3	4	5	6	7	8	9	10	% yes	Risk
Jamilian A. et al. (2015) (8)	✓	✓	✓	X	✓	X	X	X	✓	✓	60%	Moderate
Hvaring C. et al. (2016) (9)	✓	X	✓	✓	✓	X	X	✓	✓	✓	70%	Low
Kafantaris et al. (2020) (15)	✓	✓	✓	X	✓	X	X	X	X	✓	50%	Moderate

**Table 3 - The Joanna Briggs Institute critical appraisal for case control studies**

Checklist questions	1	2	3	4	5	6	7	8	% yes	Risk
Quadri et al. (2016) (14)	X	✓	✓	✓	X	?	✓	✓	64%	Moderate
Barber et al. (2014) (11)	✓	✓	✓	X	✓	X	✓	✓	75%	Low
Shneider et al. (2016) (12)	✓	✓	X	✓	✓	X	X	✓	63%	Moderate

**Table 4 - The Joanna Briggs Institute critical appraisal for cross sectional studies**

Checklist questions	1	2	3	4	5	6	7	8	9	10	% yes	Risk
De Marchi et al. (2014) (13)	✓	✓	✓	X	✓	X	X	X	✓	✓	60%	Moderate
Josefsson et al. (2019) (10)	✓	✓	X	✓	✓	X	✓	✓	✓	✓	80%	Low

## DISCUSSION

The management of congenitally missing permanent maxillary lateral incisors involves either space closure or opening. Practitioners' decision-making should consider the canine dimensions, facial profile, and the gingival height. Most studies evaluated periodontal parameters and assessed results by comparing the two techniques. According to Rosa et al. (2015) (16), orthodontic space closure in cases with lateral incisor agenesis offers no long-term risks for periodontal tissues and the temporo-mandibular joint. Previous findings agree with Šikšnelytė et al. (2021) (6) and Jamilian et al. (2015) (8).

According to Josefsson et al. (2019) (10), the space closure group showed better gingival coloration and the implant group presented gingival recession. Nevertheless, these groups showed no significant aesthetic differences. The authors concluded that space closure is advantageous if both options are feasible. These results agree with the systematic reviews of Kilidiaris et al. (2016) (17), Silveira et al. (2016) (18), and Al Qahtani (2021) (19), which reported that space closure is preferable over space opening and prosthodontic rehabilitation whenever possible.

The use of dental implants in growing individuals remains a topic of ongoing debate in the literature. Some studies have reported changes in the relative position of the implant in the vertical and sagittal direction. Jamilian et al. (2015) (8) have reported that all implants had infraocclusions greater than 1 mm five years after treatment. These findings resemble those in Bernard (20) and Jemt (21), who showed

that the surrounding alveolar bone and the adjacent teeth continue developing vertically 19 years after implantation, causing its infraocclusion. According to Oesterle and Croning (22), facial growth ceases at age 17 in girls, whereas it may still continue up to age 25 in men. Thus, placing implants before the end of facial growth may increase the infraocclusion of the implant crown.

Ciarlantini and Melsen (2017) (23) have suggested mini-screws with pontics, suggesting that this approach enables the development of the alveolar process. Michelogiannakis et al. (2020) (24) reported that mini-screws could stimulate the bone crest in toothless sites, reporting a development in the vertical direction of the alveolar bone. So, mini-screws with pontics might represent a useful temporary substitution for congenitally missing permanent maxillary lateral incisors in space openings in growing patients.

Lacarbonara et al. (2021) (25) evaluated mini-implants for 10 years, reporting no signs of infraocclusion, good status of the peri-implant tissue, and satisfactory marginal bone resorption. The authors concluded mini-implants may configure a good solution for severe bone atrophy.

Implant replacement may have additional drawbacks. For example, Hvaring et al. (2016) (9) reported mucosal blue discoloration in implant patients and Dueled et al. (2009) (26) found that volunteers' labial gingiva had turned blue in more than 50% of single-implant crowns in follow ups over four years.

The current clinic recommendations suggest fixed resin-bonded partial dentures as the gold



standard (due to their more pleasant aesthetics and lesser invasiveness). Kafantaris et al. (2020) (15) reported that such bilaterally attached or cantilevered dentures offer better results than implants regarding soft tissue response, aesthetics, and function. According to Antonarakis et al. (2014) (27) conducted a comparative financial evaluation of many treatment modalities for congenitally missing lateral incisors. The least cost-effective treatment refers to full-coverage fixed partial dentures.

This review has some limitations. First, it only chose articles that were published in French and English, potentially leaving out significant data from other languages. Another limitation refers to the significant variability in study quality as some showed methodological inconsistency. Furthermore, this review focused on available evidence, which may fail to fully represent real-world clinical decision-making. Finally, study heterogeneity prohibited a meta-analysis or quantitative synthesis, hindering the meaningful combination of data.

## CONCLUSION

According to the analyzed studies, therapeutic decision-making mainly stems from periodontal parameters, preferring space closure when both therapeutics are possible. In case of space opening, studies deem resin-bonded fixed partial dentures as more aesthetic and less invasive, showing more satisfactory functional and periodontal results than implantations. Treatment must involve a multidisciplinary approach to achieve optimal occlusion and a natural smile with long-term stability. However, further studies with larger sample sizes and standardized approaches must be carried out to strengthen therapeutic recommendations and improve management strategies.

**No competing interests have been declared.**

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