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ORIGINAL RESEARCH

GUMMY SMILE TREATMENT: SYSTEMATIC REVIEW OF THERAPEUTIC OPTIONS AND PROPOSAL OF A CLINICAL DECISION-MAKING ALGORITHM

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Abstract

Gummy Smile, or excessive gingival display, is a clinical condition characterized by an overexposure of the maxillary gingiva during smiling, typically exceeding 3 mm. Although not pathological, this condition can lead to aesthetic discomfort and negatively impact the patient's self-esteem.
In a normal, aesthetically pleasing smile, gingival exposure—defined as the distance between the lower margin of the upper lip and the cervical area of the upper central incisors—should not exceed 1–2 mm.[1] Gummy Smile affects approximately 10% of individuals aged 20–30, with a higher prevalence among females.[2] This condition has a multifactorial etiology, with each causative factor potentially acting independently or in combination with others, thereby complicating both the clinical presentation and case management.[3]
The main causes of excessive gingival exposure include:

1. Altered passive eruption (APE)
2. Dentoalveolar extrusion
3. Vertical maxillary excess (VME)
4. Gingival hyperplasia
5. Short upper lip
6. Hypermobility of the upper lip[4]

This study presents a systematic review of the scientific literature on therapeutic approaches for the treatment of Gummy Smile, offering a qualitative analysis of clinical indications, procedural techniques, aesthetic and functional outcomes, duration of results, post-treatment recovery, possible complications, and patient satisfaction.
Based on the emerging evidence, a clinical decision-making algorithm has been developed to guide clinicians in the selection and management of Gummy Smile cases, according to their etiological profile. This algorithm is proposed

Keywords: Gummy Smile, Periodontal surgery, Gingivectomy, Orthodontic treatment, orthognathic surgery, Plastic surgery, Aesthetic medicine, Lip repositioning, Botox

INTRODUCTION

1.1 Anatomy and Dynaics of the Smile

The human smile is the result of the coordinated activation of the mimetic muscles—cutaneous muscles originating from the second branchial arch and innervated by the facial nerve.

These muscles insert into the skin and, upon contraction, generate facial expressions, including smiling.[5]
The perioral musculature involved in smiling can be divided into three functional groups:
Group I *(Oral commissure muscles)*: act on the corners of the mouth and include the *buccinator*, *orbicularis oris*, *levator* and *depressor anguli oris*, *risorius*, and *zygomaticus major*;

Group II *(Upper lip elevators):* raise the upper lip and include the *levator labii superioris*, *levator labii superioris alaeque nasi*, and *zygomaticus minor*;
and **Group III *(Lower lip and chin muscles)*:** depress the lower lip and include the *depressor labii inferioris*, *mentalis*, and *platysma*.[6]
Through the synergistic action of these three groups, the smile develops in **two main phases**:
1) **Initial elevation of the upper lip**, exposing the maxillary incisors and
2) **Full elevation of the lips**, involving coordinated action of the *levator labii superioris*, *zygomaticus major*, and *buccinator* muscles—often accompanied by ***eye squeezing*** (partial eyelid closure), which enhances the expressive quality of the smile.[7–9]
An aesthetically pleasing smile depends on harmony among several components:

- The **incisal edge** of the anterior teeth and the **curvature of the lower lip;**
- The **lip line** (amount of tooth visible);
- The **buccal corridor**, **smile arc**, and **curvature of the upper lip;**
- **Smile symmetry** with respect to the interpupillary line;
- The **occlusal plane**, **dental esthetics** (tooth shape, color, alignment), and **gingival appearance** (color, contour, and health of gingival tissues).[9,10]

Different perspectives have been proposed in the literature to analyze the morphology and dynamics of the smile, both from an aesthetic and a functional standpoint.
In particular, according to **Ackerman**, the smile can be divided into two main types: the *Social Smile* (or posed smile), which is voluntary, reproducible, and characterized by moderate muscular contraction that partially exposes the dental elements and, in some cases, a minimal portion of the gingival architecture; and the *Spontaneous Smile* (or enjoyment smile), which occurs involuntarily in response to intense emotional stimuli, such as laughter or pleasurable moments, and is associated with maximum activation of the mimetic musculature, resulting in full exposure of the teeth and gingiva.[9,11,12]
Another classification, proposed by Tjan, is based on the vertical extent of dentogingival exposure during smiling. According to this model, a *High Smile* is identified when exposure reaches 100% of the incisal surface along with visible gingiva; a *Medium Smile* is defined when visibility ranges between 75% and 100%, generally limited to the visible part of the upper incisors and the interdental papillae; and finally, a *Low Smile* is observed when exposure is below 75%, resulting in a more contained display even during full muscle contraction.[9]
Rubin, in turn, described three smile styles based on the direction of lip movement and the distribution of muscular tension. *The Mona Lisa Smile*, also known as the commissure smile, is characterized by elevation of the mouth corners produced by the zygomaticus major muscle, conferring an arched shape to the upper lip, similar to the Cupid's bow. The *Canine Smile*, by contrast, presents a uniform elevation of the upper lip without significant involvement of the oral commissures. The third style, referred to as *Full Denture Smile* or complex smile, corresponds to the contemporary concept of *Gummy Smile*. In this case, the upper lip rises markedly while the midface appears particularly active during smiling.[9]

1.2 Definition of Gummy Smile and Incidence

Gummy Smile, or gingival smile, is an aesthetic condition characterized by excessive exposure of the maxillary gingival tissue during smiling. In a smile that is considered aesthetically harmonious, gingival display should not exceed 1–2 mm above the cervical margin of the maxillary central incisors. When this threshold is exceeded, the gingival tissue becomes the dominant element in the visual composition of the smile, surpassing the teeth and lips, and often leads to aesthetic dissatisfaction and psychosocial discomfort, even in the absence of any organic pathology. Gummy Smile may result from multiple causes, including eruptive alterations (*altered passive eruption*), *vertical maxillary excess*, *upper lip hypermobility*, *short upper lip*, *gingival hyperplasia*, or *dentoalveolar extrusion*. The etiology is frequently multifactorial, making an in-depth diagnostic process essential for the planning of an effective and personalized treatment strategy.[10–13]

The prevalence of Gummy Smile in the general population varies with age and sex. This condition affects approximately 10% of individuals aged between 20 and 30 years. It is more frequently observed in females, with a reported ratio of 2:1 compared to males. Prevalence decreases with age, primarily due to the physiological descent of the upper lip, which, with aging, tends to progressively cover the incisors and gingival tissues, thereby masking the condition. [1]

1.3 Diagnosis of Gummy Smile

The clinical evaluation of a patient affected by Gummy Smile is based on established diagnostic principles and involves the systematic collection and integration of information obtained through anamnesis and physical examination, conducted under both static and dynamic conditions. The primary objective of the diagnostic process is the accurate identification of the

etiology underlying the clinical condition reported by the patient. Only a precise etiological diagnosis allows the therapeutic approach to be correctly directed, guiding the clinician toward the most appropriate treatment option or options.[1]

The diagnostic evaluation of patients with Gummy Smile is structured in multiple phases, aimed at precisely identifying the cause of the condition. Facial analysis represents a fundamental first step. This must be conducted by observing the face in both frontal and sagittal views, dividing it into three thirds: upper (from the trichion to the glabella), middle (from the glabella to the subnasale), and lower (from the subnasale to the menton). An increase in the middle third may suggest the presence of vertical maxillary excess (VME), a hypothesis that requires confirmation through radiographic investigations, in particular via cephalometric analysis. In the latter, the distance between the palatal plane and the cemento-enamel junction of the upper incisors is measured, as this parameter is less influenced by dental wear compared to the incisal edge. [2,14]

The analysis of the upper lip and perioral musculature includes both static and dynamic evaluations. In static assessment, the length of the upper lip is measured, distinguishing between the cutaneous portion (15–16 mm) and the mucosal portion (5–6 mm); lower values are indicative of a short upper lip. In the dynamic evaluation, potential muscle hypermobility is assessed during both natural and forced smiling, by observing the extent of dentogingival exposure, which should not exceed 2–3 mm to remain within aesthetic standards.[15,16]

This is followed by dental and periodontal analysis. At rest, the three-dimensional position of the incisors is evaluated. Using the phonation of the sound “m”, the muscular resting position is identified, allowing assessment of incisal exposure. An incisal display greater than 4 mm may suggest VME or a short upper lip, while lower values may be indicative of dental wear or altered passive eruption. In this case, a thorough periodontal examination with probing and radiographic imaging is necessary to assess the position of the cementoenamel junction and the amount of excessive gingival tissue.[17–19]

Finally, it is essential to analyze the layout of the gingival smile, that is, to determine whether the exposure involves only the anterior region or extends to the entire arch. A localized presentation often allows for the use of minimally invasive treatments with satisfactory aesthetic outcomes, whereas a more extensive involvement may require more complex and invasive therapeutic approaches.[14]

1.4 Therapeutic Options

The planning of *Gummy Smile* treatment is based on the correct interpretation of clinical data collected during diagnostic evaluation. The therapeutic approach must be individualized according to the underlying *etiology*, which may sometimes be multifactorial, thus requiring the combination of multiple corrective strategies.

The available therapeutic options can be grouped into three main categories:

- **Periodontal surgery** (*gingivectomy* or *clinical crown lengthening*);
- **Orthodontic treatment and orthognathic surgery** (*intrusion* or *Le Fort I osteotomy*);
- **Plastic surgery and aesthetic medicine** (*lip repositioning* or *botulinum toxin*).[20]

a) Gingivectomy

Gingivectomy is indicated in cases of altered passive eruption *type IA*, where the free gingiva excessively covers the clinical crown. It can be performed using an external bevel technique (scalpel, laser, or electrosurgery) or through an internal bevel technique using a periodontal flap. In cases of type IB altered passive eruption, where the amount of keratinized tissue is less than 2 mm, an apically repositioned flap is performed.[21,22]

b) Clinical crown lengthening

Clinical crown lengthening is indicated in cases of altered passive eruption *type IB* or *IIB*. The technique involves raising a flap, performing selective osteotomy, and apically repositioning the gingival margin. Rotary instruments or lasers are used to remove excess bone, with possible application of postoperative periodontal dressings.[20]

c) Orthodontics and Orthognathic Surgery

In cases of dental extrusion or vertical maxillary excess, the following interventions may be considered:

- *Orthodontic intrusion of the anterior segment*, potentially with the use of temporary anchorage devices (TADs) to improve control. In such cases, retraction forces must be applied to prevent incisor proclination;
- *Total intrusion of the upper arch*, indicated in hyperdivergent patients or those presenting with lip incompetence;
- *Le Fort I osteotomy*, a surgical treatment that is invasive but effective in correcting vertical maxillary excess (VME); this involves repositioning the maxilla and achieving bone fixation.[20]

d) Lip Repositioning Surgery

In cases of Gummy Smile caused by vertical maxillary excess or hypermobility of the upper lip, *lip repositioning surgery* may be indicated. This technique reduces the depth of the oral vestibule, limiting the action of the upper lip elevator muscles responsible for excessive gingival exposure. The traditional technique involves removing a partial-thickness mucosal strip through two parallel

incisions: one along the mucogingival junction and the other near the bottom of the vestibule. The width of the mucosa to be removed is proportional to the degree of gingival display, equivalent to twice the gingival exposure per tooth. Subsequent refinements include muscle dissection and selective myotomy to enhance stability, along with the use of advanced polyester sutures to contain muscular forces and reduce relapse rates.

Laser-assisted lip repositioning, using diode or erbium lasers, allows for more precise incisions, reduced tissue trauma, and improved post-operative recovery.

Finally, combining the surgical approach with *botulinum toxin* injection helps reduce post-operative muscular traction, thereby preventing relapses and hypertrophic scarring, and may eliminate the need for more invasive myotomies.[23–25]

e) Botulinum Toxin Injection

The use of *botulinum toxin type A* (*BTX-A*) represents an effective ***non-surgical therapeutic* option** for the management of **Gummy Smile** caused by **upper lip hypermobility**. Its mechanism of action is based on the **temporary inhibition** of the contraction of the upper lip elevator muscles, leading to a reduction in gingival exposure during smiling.

The safest injection site is the so-called ***Yonsei point,*** an anatomical reference located along the **nasolabial fold**, near the region of the **levator labii superioris alaeque nasi (LLSAN)** muscle. The identification of the injection site is performed by observing the patient's face in frontal view and locating the origin of the nasolabial fold, situated laterally to the nostril. The Yonsei point is located approximately **1 cm lateral to the nostril**, along the course of the nasolabial fold. **Vertically**, it is positioned **midway between the infraorbital margin and the upper border of the upper lip**. To ensure accurate localization of the injection site, it is helpful to invite the patient to smile, thereby visually and manually identifying the contraction of the ***levator labii superioris alaeque nasi* (LLSAN)** muscle, which represents the main target of the treatment.[26]

The traditional technique involves intramuscular administration of botulinum toxin type A (BTX-A), diluted in accordance with the manufacturer's instructions. However, the determination of the optimal dose remains a subject of debate in the literature, primarily due to the use of different botulinum toxin formulations. The two most commonly employed are **OnabotulinumtoxinA (ONA-BoNTA)**, marketed as ***Botox*®**, and **AbobotulinumtoxinA(ABO-BoNTA)**, marketed as ***Dysport*®**. A conversion ratio of **1:1 or 1:3 international units** has been established between the two products, serving as a useful reference for dose equivalence.

On average, the total dose administered per hemiface ranges from **1.25 to 6 units** for ONA-BoNTA and from **2.5** to 5 units for ABO-BoNTA.[27–29]

Some authors recommend adjusting the injection technique based on the degree of gingival exposure. Specifically, for exposures less than 5 mm, the recommended dose is 2 units administered to the levator labii superioris alaeque nasi (LLSAN) muscle. In cases of gingival exposure between 5 and 7 mm, a dose of 2.5 units is suggested. For exposures greater than 7 mm, additional 2.5-unit injections should be administered to the levator labii superioris (LLS) and zygomaticus minor (ZMi) muscles, as these patients typically exhibit increased gingival display in both the anterior and posterior regions.[30,31]

The duration of the corrective effect achieved with botulinum toxin treatment generally ranges between 12 and 36 weeks. Gingival exposure reaches its minimum approximately two weeks after injection, then progressively increases over the subsequent six months. Finally, some authors suggest that the repetition of the treatment may prolong its efficacy over time, hypothesizing that the persistence of the therapeutic effect could be attributed to the progressive atrophy of muscles subjected to repeated paralysis.[32–34]

1.5 Introduction to the use of the decision-making algorithm

The variety of therapeutic options available can complicate clinical decision-making, especially for less experienced dental practitioners. Currently, there is no structured and shared decision-making model that systematically supports the selection of the most appropriate treatment based on the specific etiology.

In light of this, one of the main objectives of this study is to develop a critical review of the existing literature and, based on the evidence gathered, to propose a clinical decision-making algorithm. This tool is intended to guide the practitioner in both diagnostic evaluation and in selecting the most appropriate treatment for each patient affected by Gummy Smile.The proposed decision-making diagram is designed to be easily consultable, also thanks to the integration of an explanatory legend and glossary (Figures 1 and 2). The process begins with the identification of Gummy Smile and continues with the determination of the predominant etiological factor. Based on the identified cause, two therapeutic options are suggested, which may both be surgical or may include a non-surgical solution. Additionally, the algorithm includes an important indication: in the presence of multifactorial etiologies, it may be appropriate to adopt a combined therapeutic approach.

LEGEND – Decision-making algorithm for the treatment of gummy smile:

= NON SURGICAL TREATMENT

= SURGICAL TREATMENT

Glossary:

1. **BTX-A:** Type A botulinum toxin, indicated in cases of muscular hyperfunction.

2. **Lip Repositioning:** Mucosal surgery aimed at reducing the muscular pull of the upper lip.

3. **Orthognatic Surgery:** Le Fort I osteotomy with maxillary impaction.

4. **Orthodontics:** Intrusion of anterior teeth using skeletal anchorage

5. **Gingivectomy / Clinical crown Lengthening:** Periodontal surgical procedures.

6. **Causal Therapy:** Removal of the etiological factor (e.g., drug suspension or improvement of oral hygiene).

7. **Osseous Surgery:** Surgical procedures involving the alveolar bone to correct GS when associated with skeletal discrepancies or dentoalveolar extrusion. Types:

- Alveolar osteotomy or osteoplasty to remove excess bone in cases of extrusion.

- Corticotomies or orthognatic surgery in severe cases involving skeletal structures.

8. **Multimodal Approach:** Combination of multiple techniques (e.g., orthodontics + surgery, BTX-A + gingivectomy) in complex cases.

Figure 1. Legend and Glossary for the interpretation of the proposed decision algorithm

It should be noted that the algorithm is presented as a guiding proposal, the application of which must be assessed in light of the practitioner's competence and the clinical needs of the patient. Further studies will be necessary to validate its effectiveness, improve its structure, and possibly adapt it to new clinical scenarios.

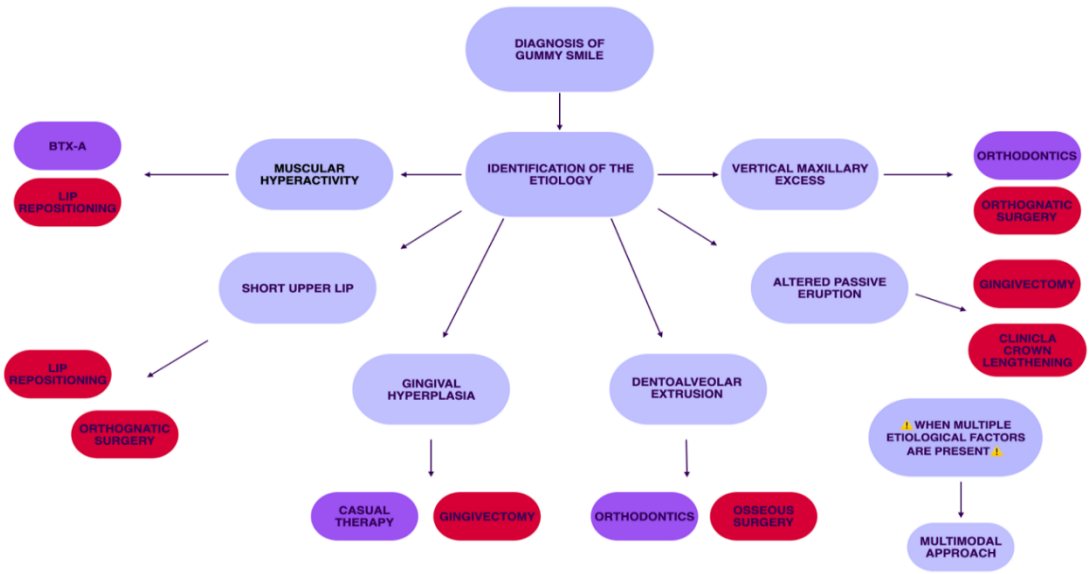

Figure 2. Decision-making algorithm for the treatment of gummy smile

MATERIALS AND METHODS

The present work aims to conduct a systematic review of the literature with the objective of identifying and clarifying the existing correlations between the nature of excessive gingival exposure and the therapeutic options available for the treatment of this condition. The ultimate objective of this process of research and analysis is to propose a clinical decision-making algorithm that may assist the dental practitioner in selecting among the possible treatments for Gummy Smile, allowing the most appropriate choice to be made based on the etiology and the specific characteristics of the clinical case under examination.

2.1 Study Design

The protocol for this systematic review was developed a priori in accordance with the guidelines for registration on the PROSPERO platform, following internal discussions among the team members, and registered with PROSPERO, the International Prospective Register of Systematic Reviews, under the ID CRD420251047332. The systematic review was conducted in compliance with the Cochrane Handbook for Systematic Reviews of Interventions**.** The included studies (Observational Studies and RCTs) were identified between October 2024 and May 2025**,** and the results were reported in accordance with the PRISMA 2020 statement.

2.2 Literature Search Process

The systematic review of the literature was initiated by searching for scientific articles aimed at answering the following research question:

"Can surgical treatment always be considered the most appropriate therapeutic approach for the management of Gummy Smile?"

To identify the articles relevant to this research question, two reviewers queried the following databases: *PubMed* (https://pubmed.ncbi.nlm.nih.gov), *Scopus* (https://www.elsevier.com/products/scopus), and *Cochrane* (https://www.cochranelibrary.com). Six possible treatment strategies for Gummy Smile were considered, and for each, a dedicated folder was created to organize the selected articles. The treatments evaluated were:

- Botulinum toxin injection
- Gingivectomy or clinical crown lengthening
- Orthognathic surgery
- Lip repositioning surgery
- Orthodontic treatment
- Multimodal approach

The search process was structured into three distinct phases:

- Phase 1: preliminary search for scientific articles related to the topic of interest;
- Phase 2: selection of articles meeting the predetermined inclusion criteria;
- Phase 3: critical analysis of the collected information.

The preliminary search in the three platforms was conducted by applying the following selection filters:

- Articles published from 2010 to 2025 (the last 15 years)
- Articles classified as: RCTs, Clinical Trials, Case Series

The PubMed search engine was queried using MeSH (Medical Subject Headings)**.** Articles related to the investigated treatments were identified using Boolean operators (“OR” and “AND”), which enabled the combination of terms related to the research question, resulting in the following queries:

- “Gummy smile” OR “excessive gingival display” AND “botulinum toxin”
- “Gummy smile” OR “excessive gingival display” AND “gingivectomy” OR “clinical crown lengthening”
- “Gummy smile” OR “excessive gingival display” AND “lip repositioning”
- “Gummy smile” OR “excessive gingival display” AND “orthognathic surgery”
- “Gummy smile” OR “excessive gingival display” AND “orthodontic treatment”

The Scopus database was queried using the “Search within Article Title, Abstract, Keywords” function, searching for the keywords: “Gummy smile”, “excessive gingival display”, “botulinum toxin”, “gingivectomy”, “clinical crown lengthening”, “lip repositioning”, “orthognathic surgery”, and “orthodontic treatment”, combined using Boolean operators.

To obtain specific results for each treatment modality, the final keyword was replaced each time with one of the different descriptors corresponding to the individual therapeutic techniques.

In the Cochrane database, the advanced search mode was applied, requesting the software to identify publications containing the following keywords: “Gummy smile”, “excessive gingival display”, “botulinum toxin”, “gingivectomy”, “clinical crown lengthening”, “lip repositioning”, “orthognathic surgery”, and “orthodontic treatment”.

The terms were combined using Boolean operators, replacing the final keyword in each search to obtain results specific to each therapeutic approach.
At the end of this preliminary search phase, the total number of retrieved articles amounted to 691. A manual duplicate removal process was then conducted, reducing the number of articles admitted to the second phase of the search process to 313.

2.3 Inclusion and Exclusion Criteria
The second phase of the search process involved reading each article with the objective of assessing its compliance with the inclusion criteria defined using the PICO model (Table 1).
Table 1. PICO criteria

Acronym	Definition	Description
P	Patient or problem	Can be any one patient, a group of patients with a particular condition or a heath problem
I	Intervention	Represents the intervention of interest, which can be therapeutic (e.g. several kinds of dressing), preventive (e.g. blood vaccination), diagnostic (e.g. blood pressure measure), prognostic, administrative correlated to economic issues
C	Control or comparison	Defined as a standard intervention, the most used intervention or no intervention
O	Outcome	Expected Results

Patients: Eligible studies included randomized controlled trials, controlled clinical studies, cohort studies, and case series conducted on a population included adult individuals with Gummy Smile (gingival exposure greater than 2 mm), with no rare genetic abnormalities or particular syndromes.

Intervention: The treatment proposed in the included studies consisted of the administration of botulinum toxin type A aimed at reducing gingival exposure in the treated patients.

Control: The interventions used for comparison were grouped as follows:
- Surgical treatment: gingivectomy, clinical crown lengthening, lip repositioning, orthognathic surgery
- Orthodontics: orthodontic treatment

Outcomes: For all the included studies, the following outcomes were considered:
- Clinical indications for treatment
- Technique of execution
- Aesthetic and functional outcomes
- Duration of therapeutic effects
- Post-treatment recovery protocol
- Presence of intra- or post-operative complications
- Patient satisfaction

Studies were deemed "not eligible" and therefore excluded if they reported non-relevant outcomes, or were ongoing studies with no results**,** or conducted on an inappropriate population (children or individuals with rare genetic abnormalities or specific syndromes), or if they involved treatments not included among those mentioned.

2.4 Study Selection and Methodological Quality Assessment

Two reviewers carried out the study selection process, following the outlined research protocol. The analysis of each study led to the identification of **23 articles** eligible for evaluation. The reading of the publications made it possible to define an additional category of studies, labeled **"Comparative Studies"**, which included those works that explicitly compared the different therapeutic modalities under analysis.

This systematic review was carried out according to the **PRISMA 2020** guidelines (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*), in order to ensure transparency, reproducibility and methodological rigor in the selection and analysis of studies. (Figure 3)

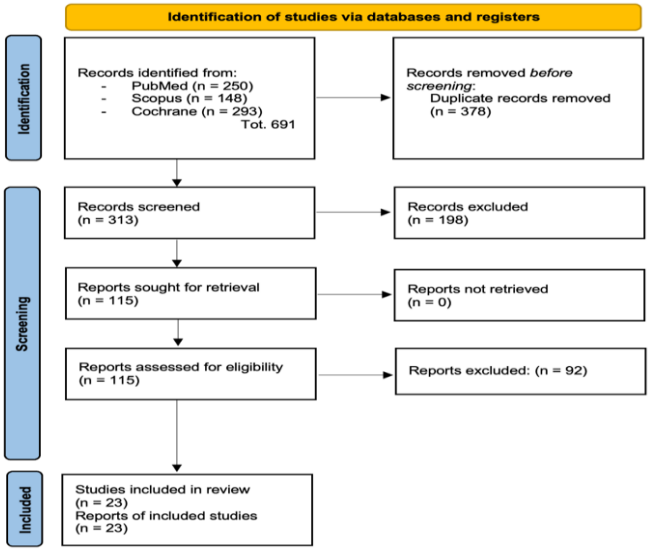

Figure 3. PRISMA 2020 flow diagram for new systematic reviews which included searches ofdatabases and registers only.

The assessment of the methodological quality of the included studies was conducted using validated tools recommended by the Cochrane Collaboration**,** differentiated according to the design of each selected study. Specifically, the RoB 2.0 tool (Risk of Bias version 2) was used for randomized controlled trials (RCTs), and the ROBINS-I tool (Risk Of Bias In Non-randomized Studies – of Interventions) was applied to non-randomized observational studies.

The evaluation was conducted independently by two reviewers. In case of disagreement, discrepancies were resolved with the intervention of a third reviewer. The results of the assessments were graphically presented using visual representations to facilitate immediate consultation. (Figures 4, 5)

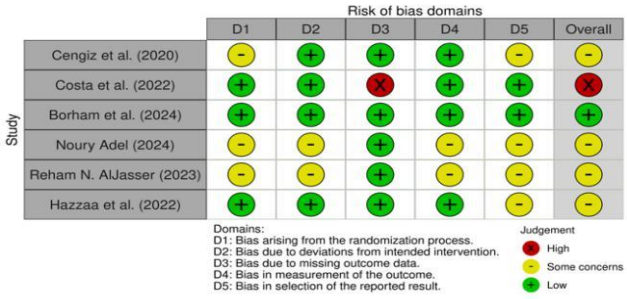

Figure 4. Traffic-light plot for RoB2

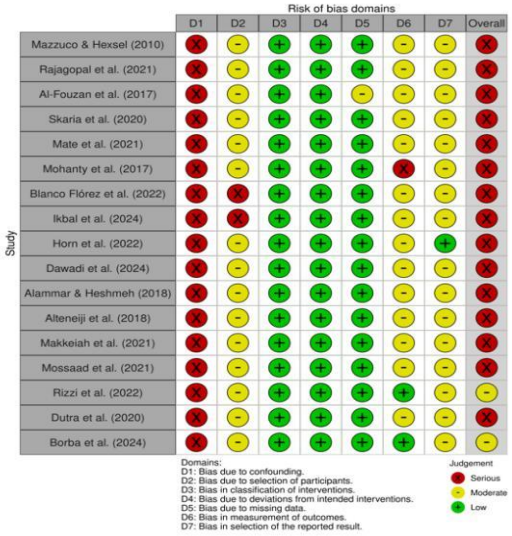

Figure 5. Traffic-light plot for ROBINS-I

Given the types of studies included in this research project, it is important to clarify that although the present review follows a rigorous systematic approach, the clinical and methodological heterogeneity of the selected studies—in terms of design, population, treatment modalities, and measured outcomes—only allowed for a purely descriptive synthesis of the results. Therefore, the findings from the entire cohort of selected studies were subjected to a narrative synthesis.

2.5 Comparative Analysis

At the conclusion of the selection process, the literature review proceeded with a meticulous analysis of each selected article, identifying the information necessary to perform a qualitative comparison among the various treatment modalities for Gummy Smile.

The comparative analysis of the considered therapeutic options was carried out by extracting data related to the following comparison criteria:

1. Clinical indications
2. Execution technique
3. Aesthetic and functional outcomes
4. Duration of results
5. Post-treatment recovery modalities
6. Presence of intraoperative or postoperative complications and risks
7. Patient satisfaction

The data extraction was performed by responding to guiding questions formulated to facilitate the critical reading of the available documents. For the first criterion (clinical indications), the questions guiding the data analysis were:
"In what situation was surgical treatment performed?"
"Under what conditions was a minimally invasive approach sufficient?"

"In which cases was orthodontic treatment carried out?"
Information regarding the execution technique was obtained by answering the following questions:
"What procedures or surgical techniques were performed?"
"Was it necessary to administer anesthetics?"
"What was the duration of the intervention?"

The remaining criteria (aesthetic and functional outcomes, duration of results, post-treatment recovery protocols, presence of intra- or post-operative complications, patient satisfaction) were investigated by asking:
"What were the outcomes of the performed treatment?"
"What was the duration of the results obtained?"
"What adverse events occurred?"
"Were the treated patients satisfied with the treatment?"
The information gathered was summarized in a summary table (Table 2)

Table 2. Summary of Comparative Analysis of the Selected Articles

Article n.	Author and year of pubblication	Clinical Indicartions	Execution technique	Aesthetic and functional outcomes	Duration of results	Post-treatment recovery modalities	Complications and risks	Patient satisfaction
1	Mazzuco et al. (2010)	Anterior, posterior, mixed, or asymmetric GS	Doses of 2.5–5 U of ABO-BoNTA at LLSAN/ZM points	Average gingival reduction of 75%, improved nasolabial fold	3–5 months		2 patients with mild asymmetry and overactive DAO	Good, except for the 2 cases with complications
2	Cengiz et al. (2020)	EGD >2 mm, alternative to surgery	5 U (LLSAN) or 2.5 U (OO),	Gingival reduction,	Maximum effect at 15			VAS increased from 36–46

			diluted in 2 ml	increased smile index	days–1-month, slow regression up to 6 months			mm to 76–78 mm
3	Costa et. (2022)	EGD >=3 mm, smile dissatisfaction	4 or 2 points, 2 U/point, LLSAN ± LLS	EGD reduction as early as 2 weeks, lasting up to 25 weeks	G1: 25 weeks, G2: 16 weeks	Mild post-injection discomfort (G1: 3.5; G2: 5.0)		High satisfaction up to 21–16 weeks
4	Rajagopala et al. (2021)	EGD >2-3 mm (groups <=5 mm e >5 mm)	3–5 U/side at the Yonsei Point, 2 cycles over 7 months	Visible reduction within 3 months, improved smile	Good results for 3 months, gradual relapse by 7 months			High, motivated to repeat
5	Al-Fouzan et al. (2017)	GS due to LLSAN hyperfunction	2.5 U in LLSAN, 3 mm lateral to the alar-facial groove	99.65% GS reduction at 2 weeks	4–6 months	Avoid massage/exercise for 4 hours		High, improved quality of life
6	Skaria et al. (2020)	EGD >3 mm due to muscular hyperfunction	2.5 U/side at the Yonsei Point, including allergy test	EGD reduced from 4.93 to 3.63 mm at 12 weeks	3–6 months			Satisfactory
7	Mate et al. (2021)	EGD >3 mm (anterior, posterior, mixed, or asymmetric GS)	1.25 U/site (LLSAN, LLS, ZM, ZMn), EMG-guided	Reduction from 6.2 to 3.3 mm, partial relapse at 6 months	Maximum effect at 2 weeks, reduction sustained up to 6 months	Immediate recovery, post-treatment precautions		0% very satisfied
8	Borham et al. (2024)	Gummy smile due to APE 1B	Conventional crown lengthening vs digital-guided	GS reduction + stable crown lengthening	Stability at 6 months	Clinical healing within 7–14 days		Comparable in both groups
9	Mohanty et al. (2017)	Skeletal GS	Le Fort I – Surgery First Approach vs conventional	Improved facial aesthetics (especially with SFA), enhanced masticatory function	Short- to mid-term stability in both groups	Hospitalization for 5 days, splint and elastics for 2 weeks	Paresthesia, tingling, TMJ pain, difficulty opening mouth (not impactful)	SFA: 100% satisfied; Conventional: 81.81% satisfied
10	Noury	Gummy	Standard lip	Gingival	Peak	Antibiotics,	Upper lip	Disappoint

	Adel (2024)	smile du to upper lip hyperactivity or short lip	repositioning + modified with double-layer sutures	exposure reduced in first 3 months, relapse at 6 months	effectiveness in first 3 months, full relapse at 6 months	intramuscular corticosteroids, mouthwash, limit lip movements	tightness, edema	ment due to relapse
11	Reham N. AlJasser (2023)	Excessive Gingival Display (EGD) due to upper lip hypermobility	LipStaT® vs MLRS with periosteal sutures	Significant reduction in gingival exposure, more stable with MLRS	Stable without significant relapse at 12 months in the MLRS group	Painkillers, chlorhexidine, ice, soft diet, limit lip movements		Greater satisfaction in the MLRS group
12	Flórez et al. (2022)	Gummy smile due to short/hypermobile lip	Mucosal laser peeling and muscle detachment	Gingival exposure reduction without relapse	Up to 12 months without relapse	Post-operative laser therapy		Extremely high
13	Ikbal et al. (2024)	Gummy smile due to HUL or mild VME	Lip repositioning with two incisions	Mean reduction of 3.67 mm	Mild relapse after 3 months	Medications and reduced mobility		High satisfaction
14	Hazzaa et al. (2022)	Gummy smile due to HUL and/or VME	Modified LRS with muscle suturing	Significant gingival exposure reduction	Stable at 12 months	Edema and pain management	Mild tension for 3–5 weeks	Very high
15	Horn et al. (2022)	Gummy smile with mixed etiologies (HUL, VME, APE)	Lip repositioning + polyester sutures	Mean reduction of 4.42 mm at 6 months	Stable up to 12 months	Recovery assisted with sutures at 1 month		Extremely high
16	Dawadi et al. (2024)	Gummy smile >4 mm due to HUL	Modified lip repositioning without frenulum	Reduction of 3.14 mm	Stable at 6 months	Swelling control and antibiotics	Mild scarring	Very high
17	Alammar et al. (2018)	Moderate gummy smile due to short lip/hyperactive muscles	V-shaped lip repositioning + myotomy	Stable reduction in gingival exposure	Stable for 6 months	Controlled healing	Flap dehiscence, numbness	High level of satisfactio
18	Alteneiji et al. (2018)	VME + edentulism	Anterior/posterior TSADs, Clarity brackets	Exposure reduction and dental intrusion	2 years	TSADs maintained	TSAD mobility + resorption	Very high
19	Makkeiah et al. (2021)	Gummy smile due to hyperactive lip (>4 mm)	Lip surgery vs BTX-A	BTX-A: fast and significant; Surgery: visible but	BTX-A: max at 2 weeks, lasts 2–6 months; Surgery: >80%	BTX-A: fast; Surgery: high relapse	BTX-A: none; Surgery: high relapse	Higher with BTX-A, many wish to repeat

				relapse >80%	relapse within 6 months			
20	Mossaad et al. (2021)	EGD >3 mm due to hyperactive lip (>4 mm)	Laser gingivectomy vs BTX-A	Both effective: Laser > BTX-A in mm reduction	Laser: ≥6 months; BTX-A: 4–6 months	Laser: 1 week; BTX-A: effect in 7 days	Laser: mild discoloration	High
21	Rizzi et al. (2022)	VME in women aged 20–30 with Long Face Pattern	Le Fort I vs Orthodontics + miniplates	EGD reduced in both groups				
22	Dutra et al. (2020)	VME >1 mm; patients in favor or against surgery	BTX-A vs Le Fort I	Chirurgia: Surgery: complete EGD coverage; BTX-A: partial improvement	BTX: 4–6 months; Surgery: definitive	BTX: avoid exertion, heat, and cosmetics for 24 hours		
23	Borba et al. (2024)	EGD ≥3 mm in adults ≥18 years old	BTX-A vs Le Fort I + mandibular osteotomy	Surgery: superior improvement	BTX: 3–6 months, relapse at 8 months; Surgery: stable			

3. RESULTS

3.1 Qualitative Analysis

The comparison between the various treatment modalities for Gummy Smile highlights that the therapeutic choice must be guided by the underlying etiology, which may be muscular, skeletal, dento-gingival, or mixed. The injection of botulinum toxin type A (BTX-A) represents a minimally invasive solution, particularly indicated in cases of hyperactivity of the upper lip elevator muscles. Some studies propose its use even in multifactorial forms, with gingival exposure greater than 2–3 mm. Injections are usually administered at the Yonsei Point or directly into the target muscles (LLS, LLSAN, ZMi, ZM), with an average dosage of 2.5 U per site. The clinical effect becomes evident within two weeks and lasts on average 3–6 months, with high patient satisfaction and a very low incidence of complications. In cases where Gummy Smile is caused by altered passive eruption, periodontal surgery (gingivectomy or clinical crown lengthening) represents an effective option. Techniques vary from the use of traditional scalpel to laser devices or digitally guided procedures, with stable results at six months and an average healing time of approximately 14 days, in the absence of significant complications. In the presence of severe skeletal components, orthognathic surgery—specifically maxillary osteotomy according to the Le Fort I technique—allows for the definitive correction of the aesthetic defect, with additional benefits on the facial profile. Results remain stable over the long term (up to 10 years), although recovery times are longer and associated with possible complications (paresthesia, pain, functional difficulties), especially with the traditional approach compared to the Surgery First protocol, which has demonstrated higher patient satisfaction.

Upper lip repositioning surgery proves effective in cases sustained by hypermobility, short upper lip, altered passive eruption (APE), or mild-to-moderate vertical maxillary excess (VME). Techniques such as LipStaT®, laser-assisted variants, or approaches involving myotomy and periosteal sutures enable a significant reduction of gingival exposure, with average clinical stability of 12 months. Healing typically occurs within 10–14 days, and side effects are mild and transient. Finally, orthodontic treatment is indicated in patients with mild to severe VME, hypermobile or short upper lip, often associated with complex malocclusions.

The use of fixed appliances, in combination with temporary anchorage devices (TADs), enables vertical control of the occlusal plane, retraction of the upper incisors, and improvement of the facial profile, with long-term stable results. The main complications include root resorption and mini-screw failure, though patient satisfaction is generally high.

Comparative studies included in the review assessed the effectiveness of BTX-A versus surgical interventions (periodontal, orthognathic, or lip repositioning), showing that although all techniques produce a significant reduction in Gummy Smile, the duration of the effects varies considerably. Botulinum toxin yields rapid but transient results; lip repositioning surgery provides greater stability, albeit with a risk of recurrence; orthognathic surgery guarantees long-lasting outcomes but is more invasive; whereas periodontal surgery, when well planned, ensures stability with relatively short recovery times. Lastly, one study compared orthognathic surgery with orthodontic treatment using skeletal anchorage through miniplates, concluding that both approaches are effective, although the orthodontic strategy is less invasive while maintaining high aesthetic and functional efficacy.

4. DISSCUSION

Gummy Smile is a condition characterized by increased exposure of gingival tissues. Generally, the observation of a gingival display of at least 2 mm during smiling is considered aesthetically pleasing. Therefore, the excessive visualization of the soft tissues surrounding the dental elements is identified as an aesthetic disharmony that can compromise the patient's self-perception, undermining their self-esteem and psychosocial well-being.[24,35]

Various etiological factors underlie the condition. The causes of Gummy Smile can be categorized as follows:

- Mucosal-muscular or anatomical: gingival hyperplasia, hyperactivity of the upper lip, or short upper lip
- Dental: altered passive eruption or dentoalveolar extrusion
- Skeletal: vertical maxillary excess

Two or more of these etiologic factors may coexist and simultaneously contribute to the development of Gummy Smile.[36,37]

Restoring a correct gingival display can be achieved by planning and executing the therapeutic strategy most appropriate to the characteristics and nature of Gummy Smile. Therefore, identifying the underlying causes of the condition is of fundamental importance in order to select the most effective and definitive treatment.

It is important to underline that in cases where the psychological impact of the condition is considerable, the effectiveness of a potential therapeutic option must be balanced with the patient's expectations and actual level of compliance.[38–40]

The systematic literature review conducted allowed for the investigation and clarification of the logical relationship between the etiological factors underlying Gummy Smile and the proposed therapies, while also enabling a comparison between the different available treatment strategies. The analysis of the data obtained allows for the classification of possible treatments into three categories:

1. Non-surgical treatments
2. Minor surgical treatments
3. Major surgical treatments

Non-surgical treatments include botulinum toxin injection and orthodontic treatment. Botulinum toxin type A is used in the treatment of Gummy Smile when gingival tissue exposure exceeds 2–3 mm and when the increased gingival display is attributable to hyperactivity of the upper lip elevator muscles (LLS, LLSAN, ZMi, ZM). Some studies have also shown the efficacy of botulinum toxin injection in managing Gummy Smile caused by skeletal or dento-gingival factors. Moreover, botulinum toxin treatment is indicated in patients seeking non-invasive solutions as an alternative to surgery. Compared to surgical strategies, botulinum toxin injection represents a minimally invasive, outpatient, well-tolerated approach that does not involve a significant postoperative course. No recovery time is required, and complications or risks are rare. Results are visible within 2–14 days post-injection and persist for 3–6 months. The treatment is reversible, but the high level of results achieved, combined with the ease of execution, often motivates the patient to repeat the sessions following physiological relapse.[33,41,42]

Orthodontic treatment also represents a non-surgical option for the management of Gummy Smile. However, this therapeutic approach is indicated in the presence of Gummy Smile supported by vertical maxillary excess, upper lip hypermobility, or the presence of a short upper lip. Compared to botulinum toxin injection, orthodontics is a more demanding alternative due to the prolonged duration of treatment and the possible reluctance of patients to wear orthodontic appliances.

Nonetheless, the literature reports minimal and predictable risks, and the results obtained are satisfactory. These factors support the consideration of orthodontic treatment as a valid option for patients who do not wish to undergo surgical interventions, especially when occlusal or dento-skeletal conditions already require orthodontic correction.[35,38,43]

Minor surgical treatments represent an intermediate therapeutic strategy between minimally invasive

approaches and orthognathic surgery. They are indicated in cases where Gummy Smile is due to dento-gingival or mucosal-muscular causes. Specifically, gingivectomy and clinical crown lengthening are performed in patients with altered passive eruption or gingival hyperplasia, resulting in immediate and stable aesthetic improvement, especially when integrated into correct prosthetic or restorative treatment plans. The choice between flapless technique, reflected flap with osteotomy depends on the amount of tissue to be removed and the location of the cemento-enamel junction.[36,37,44]

Lip repositioning surgery, on the other hand, is proposed as an alternative to botulinum toxin in patients with Gummy Smile due to hyperfunction of the upper lip elevator muscles who desire a more lasting solution. The procedure can be performed using the traditional technique (LipStaT®) or via laser-assisted modifications, partial myotomy, or muscle-periosteal sutures to improve the stability of the result over time. Following these minor surgical interventions, healing is generally rapid and occurs without complications. Patients are advised to take antibiotics, analgesics, and chlorhexidine mouth rinses for short periods, and to temporarily limit hygiene maneuvers in the treated area. A soft diet for 1 week and cold compresses during the first 24 hours post-surgery may also be recommended.[24,37,45]

Thus, minor surgical treatments offer greater result stability compared to botulinum toxin injection; however, they require the patient to undergo an actual surgical procedure with a subsequent postoperative recovery period. Additionally, unlike orthodontics, minor surgical treatments are faster and more localized, but they do not allow for the correction of cases characterized by more complex skeletal or occlusal conditions.[37,40]

Orthognathic surgery represents the most invasive option for the treatment of Gummy Smile and is the only therapeutic strategy classified among major surgical treatments. In cases where Gummy Smile is caused by severe vertical maxillary excess, often associated with skeletal malocclusions and disharmony of the midface, the treatment of choice is Le Fort I osteotomy with maxillary impaction.

This surgical procedure allows for the reduction of gingival exposure through cranial repositioning of the maxillary bone segment, simultaneously improving the facial profile, occlusion, and smile aesthetics. Compared to the aforementioned therapeutic approaches, orthognathic surgery provides the highest level of correction, with stable and definitive long-term results. However, it is an invasive procedure requiring hospitalization, general anesthesia, and a complex pre- and post-operative phase that also includes subsequent orthodontic rehabilitation.

Therefore, this therapeutic approach is reserved for patients with marked skeletal disharmonies and strong treatment motivation.

The literature reports high satisfaction rates among patients undergoing orthognathic surgery, due to the simultaneous improvement in function, aesthetics, and self-perception. However, the risk of surgical complications—although low in specialized centers—and the long overall treatment duration must always be considered in the decision-making process.[35,38,43]

Finally, in cases where multiple conditions contribute to the development of Gummy Smile, a multimodal approach can be adopted, personalizing the treatment plan to match the patient's morphological characteristics and expectations. This therapeutic strategy requires careful interdisciplinary diagnostic evaluation, significant patient compliance, and typically greater commitment in terms of time and postoperative follow-up. Nevertheless, this type of approach allows for better aesthetic outcomes and higher satisfaction rates.[36,37]

5. CONCLUSION

This systematic review of the literature has highlighted a close correlation between the etiological factor underlying Gummy Smile and the available therapeutic strategies. A valuable aid in selecting the most appropriate treatment plan is represented by the proposed decision-making algorithm, which integrates the collected evidence into a clinical, logical, and personalized pathway.

In accordance with the principle of "*primum non nocere*," the treatment plan should be oriented toward the least invasive and safest effective option. Therefore, the dental practitioner is required to avoid disproportionate solutions in relation to the etiology of the defect and the actual discomfort perceived by the patient.

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