GRADUATION PROJECT

Degree in Dentistry

ORTHODONTIC TREATMENT OF GUMMY SMILE

Madrid, academic year 2025/2026

Identification number: 145

RESUMEN

Antecedentes: La exposición gingival excesiva (sonrisa gingival) es una alteración estética multifactorial causada por extrusión dentoalveolar o exceso vertical maxilar de origen esquelético. Su manejo incluye comúnmente la intrusión de incisivos asistida por mini-implantes ortodóncicos o la impactación maxilar quirúrgica; **Objetivo:** Comparar la eficacia de la intrusión ortodóncica con mini-implantes y la impactación maxilar quirúrgica en la reducción de la exposición gingival y la mejora de la estética de la sonrisa; **Materiales y métodos:** Se realizó una revisión comparativa basada en la literatura utilizando estudios revisados por pares publicados entre 2016 y 2026. Las bases de datos incluyeron PubMed, Scopus, SpringerLink, Google Scholar y ScienceDirect. Los estudios elegibles evaluaron la intrusión con mini-implantes o la impactación maxilar quirúrgica y reportaron resultados como reducción de la exposición gingival, cambios esqueléticos y de tejidos blandos, estabilidad y percepción estética. Once estudios cumplieron los criterios de inclusión y fueron analizados cualitativamente; **Resultados:** La intrusión con mini-implantes logró entre 1,6 y 3,8 mm de intrusión de incisivos, produciendo reducciones moderadas de la exposición gingival, especialmente en casos dentoalveolares. La impactación maxilar quirúrgica mostró una corrección mayor, frecuentemente superior a 5 mm, con reducciones gingivales de hasta 5–6 mm en casos esqueléticos. Los resultados quirúrgicos demostraron mayor estabilidad a largo plazo y mayor satisfacción estética, especialmente cuando la exposición gingival postoperatoria se redujo a 0–2 mm. Los enfoques ortodóncicos mostraron mejoras clínicas a corto plazo, pero con datos limitados sobre estabilidad a largo plazo; **Conclusiones:** Ambos enfoques son eficaces. La intrusión ortodóncica es adecuada para casos dentoalveolares leves a moderados, mientras que la impactación quirúrgica es preferible en discrepancias esqueléticas severas debido a su mayor magnitud de corrección y estabilidad.

PALABRAS CLAVE

Ortodoncia, sonrisa gingival, exposición gingival excesiva, cirugía, Le Fort I, TADs, mini implantes, impactación maxilar, exceso vertical maxilar, intrusión ortodóncica, exceso gingival.

ABSTRACT

Background: Excessive gingival display (gummy smile) is a multifactorial esthetic concern caused by dentoalveolar extrusion or skeletal vertical maxillary excess. Management commonly involves orthodontic mini-implant–assisted incisor intrusion or surgical maxillary impaction; **Objective:** To compare the effectiveness of orthodontic mini-implant intrusion and surgical maxillary impaction in reducing gingival display and improving smile aesthetics; **Materials and Methods:** A literature-based comparative review was conducted using peer-reviewed studies published between 2016 and 2026. Databases included PubMed, Scopus, SpringerLink, Google Scholar, and ScienceDirect. Eligible studies evaluated either orthodontic mini-implant intrusion or surgical maxillary impaction and reported outcomes such as gingival display reduction, skeletal and soft-tissue changes, stability, and aesthetic perception. Eleven studies met the inclusion criteria and were analyzed qualitatively; **Results:** Orthodontic mini-implant intrusion achieved 1.6–3.8 mm of incisor intrusion, leading to moderate reductions in gingival display, particularly in dentoalveolar cases. Surgical maxillary impaction produced greater correction, often exceeding 5 mm, with gingival reduction of up to 5–6 mm in skeletal cases. Surgical outcomes demonstrated greater long-term stability and higher aesthetic satisfaction, especially when postoperative gingival display was reduced to 0–2 mm. Orthodontic approaches showed effective short-term improvement but limited long-term data; **Conclusions:** Both approaches are effective. Orthodontic intrusion is suitable for mild to moderate dentoalveolar cases, while surgical impaction is preferred for severe skeletal discrepancies due to its greater correction and stability.

KEYWORDS

Orthodontics, gummy smile, excessive gingival display, surgery, le fort 1, TADs, Mini-screws, maxillary impaction, vertical maxillary excess, orthodontic intrusion, gingival excess.

INDEX

1. INTRODUCTION 1

1.1 Background 1

1.1.1 Gummy smile and smile aesthetics 1

1.1.2 Etiology and Classification 1

1.1.3 Psychosocial Impact 2

1.2 Treatment Possibilities 3

1.2.1 Treatment Overview 3

1.2.2 Orthodontic Management with Mini-implants 4

1.2.3 Surgical Maxillary Impaction 5

1.2.4 Comparative Considerations 6

1.3 Research Gap 6

2. OBJECTIVE 8

3. MATERIAL AND METHODS 9

4. RESULTS 13

5. DISCUSSION 22

6. CONCLUSIONS 25

7. SUSTAINABILITY 26

8. REFERENCES 27

9. ANNEXES 30

1. INTRODUCTION

1.1 Background

1.1.1 Gummy smile and smile aesthetics

A well-Balanced smile is often regarded as a universal indicator of health and vitality and contributes substantially to facial beauty (1,2). From an orthodontic viewpoint, framed within facial architecture, the harmonious relationship among lips, teeth and gingiva is reflected as a dynamic expression that forms the smile (2). Facial aesthetics can be altered by only a subtle disharmony in this triad; that's why one of the most common reasons patients seek cosmetic, orthodontic, or surgical consultation is excessive gingival exposure (3,4). Excessive gingival display (EGD), or gummy smile (GS) is defined as during a spontaneous smile 2 mm or more of the upper maxillary gingiva is visible (5). Most clinicians agree that gingival exposure that exceeds more that 4 mm during a spontaneous smile is unattractive, although there are some variations in opinions across cultures (2,3). Epidemiological studies show a higher prevalence in younger individuals and females; this is due to increased upper lip mobility and decreased of upper lip length. Studies estimate that the percentage of adults that have a gummy smile is around 10% to 30% worldwide (4). Individuals with gummy smile often are influenced in a negative way regarding their self -esteem and social behaviour due to the supressing of the smile to hide their excessive gingival display, additionally they have aesthetic concerns (4,7).

In modern day orthodontics, treatment goals prioritise patient confidence and facial harmony and are not only about occlusal function; that is why the management of GS has become one of the most important considerations when orthodontically treating patients (8,9). Treating excessive gingival display improves the psychological well-being of the patient, balances out and harmonises the facial thirds and increases smile attractiveness (4). For that reason, understanding the etiology and mastering treatments in both strategies, orthodontic and surgical, is essential for evidence-based care of gummy smile (5).

1.1.2 Etiology and Classification

The etiology of gummy smile can be due to an independent or a combination of multiple factors that include skeletal, dentoalveolar and soft tissue components (9,10). Vertical maxillary excess

(VME) is the skeletal form of gummy smile. It increases the lower facial height and produces lower lip incompetence; this is all due excessive downwards growth of the maxilla (11,12). Patients that possess vertical maxillary excess display a shallow nasolabial fold, an obtuse nasolabial angle and a lengthened lower-third facial proportion. Whereas patients that display a gummy smile due to a dentoalveolar cause like altered passive eruption or anterior tooth over eruption, will have an increased tooth to gingiva ratio regardless of having normal skeletal proportions (6). As stated before, there are also soft tissue causes of GS which include drug induced gingival hypertrophy, hyperactive elevator muscles and a thin upper lip (< 21 mm in females, < 23 mm in males). Modifications in lip posture and perioral musculature can worsen the condition; these modifications can be produced due to environmental and functional factors like chronic mouth breathing (13).

Garber and Salma´s grading system is one of the most renowned grading systems used to this day to categorise gingival display. The classifications are as mild (2–4 mm), moderate (4–8 mm), or severe (> 8 mm) (4,14). Catigorisation of GS can also be done by region depending on where gingiva is most visible; anterior, posterior or mixed (5). Increase in N–ANS and ANS–Me in radiographic cephalometric studies validate a vertical maxillary excess. The skeletal diagnosis is supported by the union of a high mandibular plane and a clockwise mandibular rotation (14). Clinicians must customise the most effective treatment by understanding the diverse etiologies; the treatment can vary from orthodontic intrusion to orthognathic surgery, depending on the main etiological factor (11).

1.1.3 Psychosocial Impact

Even though gummy smile is mainly an aesthetic variance, the psychological impact can be intense. Patients that display a noticeable gummy smile have reported consistently feelings of embarrassment and self- consciousness when smiling (4,15). Shad Hamasdiq Faraj(2024) found that individuals with excessive gingival display had a decreased oral health related Quilty of life fields, these include satisfaction with appearance and social interactions (4). In another study by Ozra Niknam (2024) more than 50 % of the surveyed individuals associated their increased gingival display had a negative effect on their professional life and interpersonal relationships (7). Notably, a sociocultural emphasis on facial aesthetics was reflected when female participants critiqued and rated their smiles more cynically than their male counterparts (2,4). The negative psychological effects therefore fortify the need for multidisciplinary management that focus on emotional outcomes and not only morphological correction of the treatment (16).

Dramatic improvements of self-image and encouragement of spontaneous smiling can be achieved with a thorough management of GS; in addition to a positive contribution to overall mental well-being (4,7).

1.1.4 Diagnosis

For successful treatment planning accurate diagnosis is necessary. A seven-step diagnostic protocol is proposed by El-Bokle and Abdel Ghany (2022); lip mobility, incisor exposure at rest and smile, and vertical maxillary height are measured (10). This protocol allows an accurate identification the main etiological factor. It is done using a structured analysis distinguishing the proportional contribution of lip hyperactivity, dentoalveolar extrusion, and skeletal vertical excess. The evaluations start with measuring the incisors at rest, where the ideal is 1-3mm, after that gingival exposure when smiling is measured where the ideal is ≤ 2 mm (10). A shorter upper lip than the standardised values (23 mm in males and 21 in females) can be a key indicator of a soft tissue etiology. On the other hand, disproportionate anterior facial height can point to a skeletal etiology (VME) (17).

Vertical discrepancy is measures with the help of cephalometric radiography; excessive maxillary growth can typically be signified as N–ANS > 40 mm or ANS–Me > 62 mm (12,13). Three-dimensional photography or digital smile design can analyse the soft tissues and help determining the relationship between teeth, lips and gingiva when preforming facial movements (2,10). It is important to ensure realistic patient expectations regarding outcomes of treatments, and this can be optimized by accurate diagnosis. Accurate diagnosis can assist in decisions between orthodontic or surgical modalities (4,17).

1.2 Treatment Possibilities

1.2.1 Treatment Overview

The underlying etiology and degree of severity will determine the treatment of GS, which must be individualised (5). The aim of each treatment option is to decrease gingival exposure, balance smile line curvature and attain facial balance; however they are all different regarding long term stabilities, invasiveness and cost (17). Evaluation of the case must be multidisciplinary and done by different dental specialists like orthodontists, periodontists and maxillofacial surgeons to

propose and chose the best treatment plan (12,15). When altered passive eruption is the reason for the excessive gingival exposure, the restoration of normal physiological width and improvements of tooth proportions can be achieved by periodontal surgery (5,10). When the etiology is a soft tissue hypermobility, the treatment of choice will be injection of botulinum toxin type A which can lower the smile line by around 3 mm for four to six months; this is achieved temporarily relaxing the elevator muscles (levator labii superioris, zygomaticus minor, depressor septi nasi) (4). Another treatment option for soft tissue hypermobility is lip-repositioning surgery. It provides more long-lasting results by limiting upper lip elevation and shortening vestibular depth; however muscular adaptation might occur which may cause recurrence (16).

Orthognathic surgery, specifically maxillary impaction surgery techniques produce the most predictable and stable results when the etiology is skeletal (9,11). Orthodontic intrusion using temporary anchorage devices or TADs is now the minimally invasive choice when dealing with a mild to moderate dentoalveolar etiology (4).

1.2.2 Orthodontic Management with Mini-implants

Vertical control in orthodontics has been reshaped due to the development of skeletal anchorage. The advent of mini-implants in orthodontics allows true intrusion of anterior teeth without the correlative molar extrusion; this is done by providing absolute anchorage (8,9). A study done by El Namrawy et al. (2019) illustrates that mini screw supported intrusion greatly reducing overbite and gingival display and attained 2.6-2.9 mm of incisor intrusion after only five months (6). Improving smile aesthetics and achieving concurrent molar intrusions and occlusal plane levelling can be done using mid palatal mini screws in combination with a trans-palatal arch (8,18). Nilesh Shrikan Hegd (2024) used four TADS to achieve intrusion, retraction which successfully improved lip competence and facial balance in a case with vertical maxillary excess and class II hyper divergence (19). Another study by Manikandan et al. (2024) compared the usage of one versus two mini-screws to control the intrusion degree of upper incisors. The study found that the usage of two mini-screws achieved a more uniform intrusion and less root resorption (20,21). Like El Namrawy et al. (2019) study the average intrusion movement was about 2 mm per incisor (20).

Similarly, but limited in comparison to surgical impaction, orthodontic intrusion can aesthetically enhance the lower face third, by the secondary effect of mild mandibular counterclockwise rotation (8). One of the main limitations of orthodontic intrusion using TADs is the chance of apical root resorption, however this depends on screw stability which is determined by bone quality. Another limitation is the possibility of relapse especially when the retention is insufficient (20,21). Nonetheless, for correction of mild to moderate GS, TAD assisted intrusion procedures show to be efficient, cost effective and comfortable for patients; it continues to be the treatment of choice for patients looking for a non-surgical and minimally invasive treatment (6).

1.2.3 Surgical Maxillary Impaction

Maxillary impaction surgery techniques remain to be the best permanent solution for skeletal cases of GS, especially severe ones (9,11). The surgery includes superior displacement of the maxilla; this decreases the lower facial third length and enhances the chin prominence by triggering counterclockwise rotation of the mandible (22). An anterior segmental maxillary osteotomy was performed by Kouja et al. (2025) where the surgeon successfully decreased gingival exposure by 95 %; the procedure simultaneously improved the nasolabial angle and led to great patient satisfaction (17). A combined orthodontic and surgical approach was introduced by Nilesh Shrikant Hegde et al. (2024) where skeletal anchorage was used after surgical impaction in a patient with class II hyper divergence, resulting an excellent occlusion and aesthetics after 6 months (12,19). Additionally, repositioning of the maxilla superiorly can cause improvements in muscular leverage; this is due to mandibular rotation that improves the bite force and temporomandibular-joint co-ordination (22). To prevent nasal-base widening and airway narrowing Khojasteh and Mohaghegh (2022) suggests adjunctive partial turbinectomy when the surgical impaction is going to exceed 7 mm (14). Modification such as horseshoe and pyramidal osteotomies can improve safety of the surgery and prevent the injury of the descending palatine artery (11).

Le fort I impaction is one of the most stable orthognathic surgeries, with long-term studies showing that the relapse rate is on average less than 1 mm (22). Even though general anaesthesia and hospitalisation is required, it is still a justifiable selection for severe cases of vertical maxillary excess due to the functional improvements. Which include a harmonised smile arc, improved lip competence and corrected facial proportions (9,11).

1.2.4 Comparative Considerations

Orthodontic and surgical methods can both attain significant improvements aesthetically regarding in the reduction of gingival excess however they are not similar in outcomes regarding instability, invasiveness and magnitude (6). For moderate vertical maxillary excess, intrusion achieved by mini-implants would be ideal; there is no surgical morbidity, and it can offer 2 – 4 mm of gingival reduction (8,18). Orthodontic intrusion using TADs is performed with local anaesthesia, less invasive and in general more affordable (13). On the other hand, 10 mm of vertical maxillary excess can be reduced by le fort I impaction, while also correcting occlusal plan canting and facial proportions (11). However, rigorous retentive protocols and soft tissue adaptation is required for the stability of the treatment (20,21). Surgical maxillary impaction allows a permanent immediate correction with minimal relapse, even though it is more invasive (9,14).

Systemic review studies show that there are great improvements in smile aesthetics and patient satisfaction in both treatment modalities, with orthodontic intrusion offering a more comfortable treatment with little to no recovery time and surgical impaction providing better skeletal harmony (5).

Considerations of patient age, severity of the case, aesthetic expectations are needed to be able to decide between the two modalities (2,4). In some cases, combining both orthodontic and surgical provides the most stable correction, where pre-surgical orthodontic alignment is done before surgical impaction (12,17).

1.3 Research Gap

The management of gummy smile has several reviews and case reports, yet there is still a lack of clinical studies comparing and evaluating the effectiveness of surgical maxillary impaction and orthodontic mini-implant intrusion (11,12). Offering a conservative and patient friendly alternative, orthodontic intrusion is an alternative to surgery, however restricted to the attainable amount of intrusion and possible relapse on the long run (21,22). Even though surgical impaction is a definitive treatment it is accompanied with operative risk, high cost and demanding recovery (9,14).

Additionally, there is little evidence concerning results such as patient satisfaction and psychological well-being after each treatment modality (7). The goal of this research is to connect the gap and offer a direct comparison between the two treatment options; mini-implant-assisted orthodontic intrusion and Le Fort I surgical impaction. This research will evaluate effectiveness, stability and aesthetic improvement overtime.

2. OBJECTIVE

Primary Objective

To compare the results of incisors orthodontic intrusion using mini-implants and surgical maxillary impaction osteotomy in decreasing gingival display and enhancing smile aesthetics in patients that have gummy smile/excessive gingival display.

Research question

"In patients with excessive gingival display, how does orthodontic intrusion using mini-implants compare to surgical maxillary impaction in terms of gingival display reduction?"

3. MATERIAL AND METHODS

Study Design

This research follows a documentary (literature based) research design, with the intention to evaluate, compare and combine pre-existing scientific data related to the management of gummy smile/excessive gingival display, via orthodontic intrusion with mini-implants and surgical maxillary impaction. The design will focus on assessing published data from both treatment methods on skeletal, soft tissue and dentoalveolar results. The design will be qualitative, analytical and comparative.

No laboratory procedures or clinical interventions on humans or any other species will be carried out. Alternatively, the study will gather and examine critically the outcomes from peer-reviewed surgical and orthodontic research. This will include case series, systematic reviews, cephalometric studies, radiographic analyses and clinical trials. This will respond to the PICO question:

“In patients with excessive gingival display, how does orthodontic intrusion using mini-implants compare to surgical maxillary impaction in terms of gingival display reduction?”

Data Sources

Data was collected solely from **primary scientific sources**, giving priority to superior quality publications from the last **10 years, 2016 to 2026,** guaranteeing significance. The following sources were used:

Scientific Databases:

- PubMed
- Scopus
- SpringerLink
- Google Scholar
- ScienceDirect

Institutional and Professional Sources :

- American Association of Orthodontists (AAO)
- American Association of Oral and Maxillofacial Surgeons (AAOMS)
- European Orthodontic Society (EOS)
- International Association of Oral and Maxillofacial Surgeons (IAOMS)

Academic and Clinical Research Publications

Priority was given to peer-reviewed orthodontic and surgical journals such as:

- American Journal of Orthodontics & Dentofacial Orthopaedics (AJO-DO)
- Angle Orthodontist
- Journal of Cranio-Maxillofacial Surgery
- Journal of Clinical Orthodontics (JCO)
- Seminars in Orthodontics
- Journal of Oral and Maxillofacial Surgery (JOMS)
- Journal of Orofacial Orthopaedics

Search Strategy

A structured, systematic search strategy was employed using keyword combinations and Boolean operators. Keywords included:

“Gummy smile,” “excessive gingival display,” “vertical maxillary excess,”“mini-implant intrusion,” “TAD-assisted intrusion,” “skeletal anchorage,” “Le Fort I osteotomy,” “maxillary impaction,” “orthognathic surgery,”“incisor intrusion,” “occlusal plane cant,” “mandibular autorotation,”“smile aesthetics,” “gingival display reduction,” “nasolabial angle changes”

Examples of search strings:

“Mini-implant intrusion and gummy smile correction”, “Le Fort I maxillary impaction and vertical maxillary excess”, “TAD-assisted intrusion”, “anterior intrusion and smile line reduction”, “Gummy smile and orthodontic vs surgical treatment”, “Maxillary impaction and soft-tissue outcomes”

Filters Applied:

- Publication date: **2016–2026**
- Language: **English**
- Document type: peer-reviewed articles, clinical trials, systematic reviews, cephalometric studies
- Availability: **full text required**

Inclusion and Exclusion Criteria

Inclusion Criteria

Studies were eligible if they met the following criteria:

- Examined **orthodontic intrusion with mini-implants**, surgical **maxillary impaction**, or **both** as treatment approaches for **excessive gingival display**.
- Documented measurable results in the criteria of gingival display in mm, soft-tissue profile changes, intrusion magnitude, smile-line position, skeletal changes (e.g., ANS repositioning), patient satisfaction or aesthetic ratings
- Contained human clinical trials, retrospective/prospective cohorts or CBCT/cephalometric analyses
- Published in trustworthy orthodontic or surgical journals.

Exclusion Criteria

Studies were excluded if they:

- Focused on treatments of gummy smile that are irrelevant to the comparison (e.g., crown lengthening, lip repositioning).
- Provided not enough quantitative data, unclear methodology, or lacking outcome results.
- Are non-peer-reviewed sources, conference abstracts, promotional materials, or opinion pieces.
- Concentrated on only other facial or dental conditions without addressing excessive gingival display.
- Were published before **2016** or not available in English.

Article Screening and Selection Process

The screening is performed in a **three-phase method** modelled after PRISMA principles.

1. Identification

All obtained articles were imported into a reference management software (Zotero). Duplicate records were identified and eliminated.

2. Screening

Titles and abstracts were evaluated for significance to excessive gingival display correction, mini-implant intrusion, surgical maxillary impaction

Irrelevant articles to the comparative management of excessive gingival display were illuminated.

3. Eligibility & Inclusion

Full texts were checked to examine methodological clarity, measurable outcomes, sample characteristics, reliability of imaging/cephalometric data, presence of bias or conflict of interest. Only studies complying with all inclusion requirements were included in the final dataset

Data Extraction Process

The creation of a consistent extraction template was made to guarantee consistency among the reviewed studies. Extracted data involved:

- Authers, study type (randomized clinical trial, case report, CBCT analysis, retrospective cohort), and publication year
- Number of patients and characteristics (severity of gummy smile, skeletal patterns, age range, dentoalveolar characteristics)
- Treatment information (type and position of mini-implants, force direction and magnitude, whether intrusion was anterior-only or whole-arch, surgical technique standard Le Fort I, horseshoe modification, segmented ASMO)
- Outcome measurements (gingival display decrease (mm), amount of intrusion accomplished, skeletal changes (mandibular rotation, vertical maxillary height), soft-tissue modifications (nasolabial angle, lip mobility), complication rates, aesthetic evaluations (clinician vs patient perspectives)
- Study conclusions

This extraction template allows comparison of orthodontic and surgical results upon various research designs.

Data Synthesis and comparative approach

Evaluation of the final data base was made using a **qualitative thematic synthesis**, comparing both treatment modalities across shared clinical outcomes: intrusion capacity, vertical maxillary reduction, soft-tissue aesthetic changes, smile line and gingival display, risk profiles such as root resorption and surgical morbidity, Stability after treatment and patient satisfaction.

Findings of studies are combined to make an **evidence-based comparative framework** where patterns are recognised and similarities and differences are revised.

This developed the base for the documentary component, in which orthodontic and surgical representing cases are presented in a table format to optimise clinical interpretation.

4. RESULTS

PRISMA 2020 flow chart for new systematic reviews which include searches of databases and registers only.

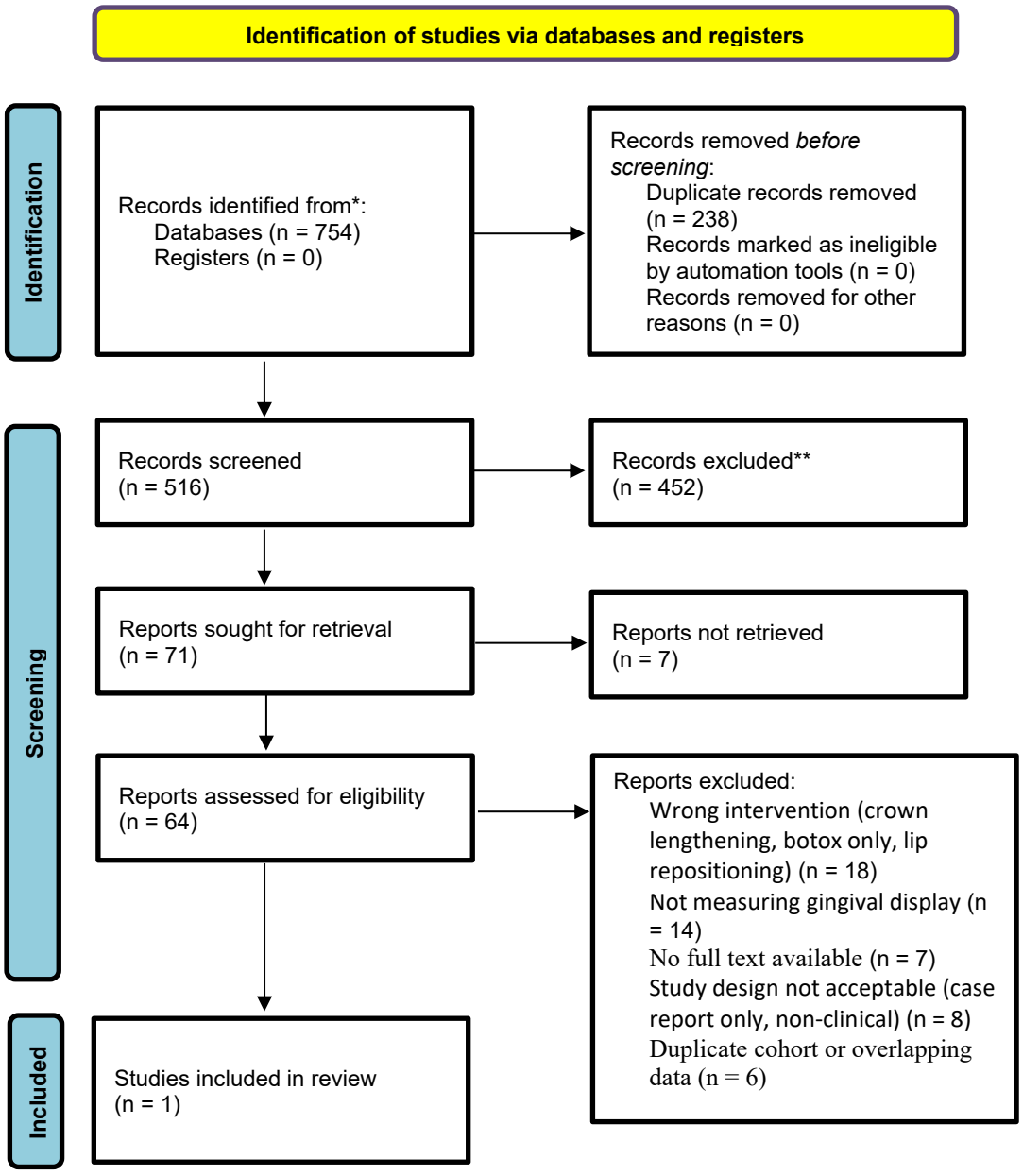


Figure 1. PRISMA Flowchart of the included reports in the study Source : Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Table 1. Characteristics of included studies

Author (Year)	Study design	Sample size	Etiology of gummy smile	Treatment modality
Alteneiji et al. (2018)	Retrospective clinical study	69 patients	Vertical maxillary excess / long face pattern	Orthodontic treatment with extra-alveolar TADs (infrazygomatic crest ± mandibular miniscrews)
Miyazawa et al. (2024)	Retrospective clinical study	16 patients	Dentoalveolar extrusion / mixed etiology	Midpalatal miniscrews with modified transpalatal arch (orthodontic intrusion)
Manikandan et al. (2024)	Randomized clinical trial	43 patients	Dentoalveolar extrusion (deep bite-related gummy smile)	Maxillary incisor intrusion with one vs two anterior miniscrews
El Namrawy et al. (2019)	Prospective clinical trial	30 patients	Dentoalveolar extrusion (deep bite-related gummy smile)	Miniscrew-supported intrusion vs intrusive arch
Sharma et al. (2024)	Prospective clinical study	30 patients	Dentoalveolar extrusion	Anterior miniscrew intrusion (one vs two miniscrews)
Verma & Jain (2020)	Prospective clinical study	20 patients	Dentoalveolar extrusion	TAD-assisted anterior intrusion
Kouja & Khalil (2025)	Prospective clinical study	10 patients	Vertical maxillary excess (skeletal)	Anterior segmental maxillary osteotomy (ASMO)
Peleg et al. (2019)	Retrospective clinical study	20 patients	Vertical maxillary excess (skeletal)	Le Fort I maxillary impaction
Goguet et al. (2023)	Retrospective clinical study	15 patients	Long face syndrome / vertical maxillary excess	Horseshoe osteotomy (maxillary impaction)
Rizzi et al. (2022)	Retrospective observational study	16 patients	Vertical maxillary excess / long face pattern	Orthognathic surgery (Le Fort I) vs miniplate-

				assisted orthodontic impaction
Borba et al. (2024)	Retrospective comparative study	26 patients	Mixed etiology (skeletal and soft tissue factors)	Botulinum toxin vs Le Fort I maxillary impaction

Ultimately, 11 studies were included and met all the inclusion criteria for the final analysis. These studies included primary data from prospective and retrospective clinical studies and randomised clinical trials. The sample sizes in these studies ranged from 10 to 69 cases. Among the different studies, the etiology of excessive gingival display differed. This included vertical maxillary excess, dentoalveolar extrusion, long face pattern and mixed skeletal-soft tissue factors. The assessed orthodontic treatment modality was orthodontic mini-implant assisted intrusion. The assessed surgical treatment modalities were surgical maxillary impaction procedures including Le Fort I osteotomy, anterior segmental maxillary osteotomy and horseshoe osteotomy.

Table 2. Orthodontic mini-implant intrusion outcomes

Author (Year)	Type of TAD / location	Measured incisor intrusion (mm)	Rate of intrusion (mm/month)	Treatment duration (months)	Root resorption (mm)
Manikandan et al. (2024)	Anterior miniscrews (1 midline vs 2 bilateral)	1 MS: ~1.6 | 2 MS: ~2.1	CI: 0.52 vs 0.71 | LI: 0.45 vs 0.69	3 (intrusion phase)	CI: 0.73 ± 0.27 (1 MS); LI: 0.89 ± 0.31 (2 MS)
El Namrawy et al. (2019)	Anterior miniscrews (labial)	2.6 ± 0.8	0.49	5.3 ± 1	NR
Sharma et al. (2024)	Anterior miniscrews (1 between centrals vs 2 between lateral–canine)	1 MS: 2.61 | 2 MS: 3.81	NR	4	NR
Verma & Jain (2020)	Anterior miniscrews (between lateral & central incisors)	2.3 ± 0.53	0.38	6	NR

Table 2 encapsulates quantitively the orthodontic results in the studies evaluating incisor intrusion using mini-implants. Incisor intrusion measurements where approximately in the ranges of 1.6 mm to 3.81 mm among the studies. The rate of intrusion varied from 0.38 mm and 0.71 mm per month was reported, with duration of treatment of active intrusion phase varying from 3 to 6 months. Only one randomised clinical trial measured root resorption, where lower values appeared when using two mini-screw configurations compared to using a single mini-screw. Numerical figures for intrusion rate and root resorption where not reported in some studies.

Table 3. Orthodontic skeletal, dentoalveolar and clinical outcomes following mini-implant intrusion

Author (Year)	Treatment modality	Skeletal changes	Dentoalveolar changes	Clinical gingival display outcome
Manikandan et al. (2024)	Anterior miniscrews (1 vs 2)	—	Buccal alveolar crest height; alveolar bone thickness; incisor inclination	Significant reduction reported; greater improvement with two miniscrews
El Namrawy et al. (2019)	Anterior miniscrews	—	↓ overbite; incisor inclination change	Significant reduction reported
Miyazawa et al. (2024)	Midpalatal miniscrews + modified TPA	↑ occlusal plane angle; ↑ prosthion position	Maxillary molar intrusion	4.6 ± 1.2 → 1.6 ± 1.6 mm
Alteneiji et al. (2018)	Extra-alveolar TADs (IZC ± buccal shelf)	↓ lower anterior facial height; ↓ mandibular plane angle	Upper-lip position change	Clinical reduction reported
Sharma et al. (2024)	Anterior miniscrews (1 vs 2)	—	↓ overbite; ↑ incisor proclination	Improvement reported; greater effect with two miniscrews
Verma & Jain (2020)	TAD-assisted anterior intrusion	—	↑ molar extrusion; incisor inclination change	Improvement reported

Table 3 is a summary of the results of dentoalveolar, skeletal and clinical outcomes after orthodontic intrusion using mini-implants. Dentoalveolar outcomes in the included studies mainly involved incisor inclination modifications, overbite reduction, changes in molar position and alveolar crest adaptation. The skeletal effects in the included studies primarily involved anterior facial height reduction, increase in occlusal plane inclination, prosthion angle increase and mandibular plane angle decrease. All studies documentezd decrease in gingival display clinically; one study reported a reduction of 4.6 ± 1.2mm to 1.6 ± 1.6 mm. The use of two mini-screws in comparison to one mini-screw configuration generally had greater outcomes.

Table 4. Surgical maxillary impaction outcomes

Author (Year)	Surgical technique	Amount of impaction (mm)	Gingival display reduction (mm)	Reported relapse
Kouja & Khalil (2025)	Anterior segmental maxillary osteotomy (ASMO)	4–6 mm anterior segment repositioning	Incisors: 7.00 → 1.20 mm (↓ 5.8 mm) | Canines: 6.30 → 1.40 mm (↓ 4.9 mm)	NR (6-month follow-up only)
Peleg et al. (2019)	Le Fort I maxillary impaction	Anterior: 2–7 mm (mean 5.3 mm) | Posterior: 3–9 mm (mean 4.8 mm)	NR (gingival display not measured directly)	Relapse associated with lack of mandibular autorotation; no numeric relapse value reported
Goguet et al. (2023)	Horseshoe osteotomy (HS)	Point P: mean 5.0 ± 1.7 mm | Point C: mean 6.1 ± 2.1 mm (max 9.5 mm)	NR (reported as significant improvement, not measured in mm)	< 1 mm non-significant relapse at mean 20.7 months

Table 4 summarizes the quantitative results of the management of excessive gingival display using surgical maxillary impaction techniques. Depending on the surgical technique used, the reported outcomes of maxillary impaction ranged from 2 mm to 9.5 mm. Gingival exposure was reduced by 5.8 mm over incisors and 4.9 mm over canines when anterior segmental osteotomy was performed. Even though some studies did not give numerical values for gingival display reduction in millimetres, the documentation of skeletal repositioning was clear. There were minimal relapses reported; one study revealed less than 1 mm of inconsiderable relapse over 20.7 months of a mean follow-up period.

Table 5. Skeletal and soft tissue changes in surgical maxillary impaction

Author (Year)	Treatment modality	Skeletal variables assessed	Soft tissue / functional variables assessed	Direction of change reported
Kouja & Khalil (2025)	Anterior segmental maxillary osteotomy (ASMO)	—	Gingival exposure above incisors and canines; nasolabial angle; patient-reported satisfaction	↓ gingival exposure; ↑ nasolabial angle; ↑ patient satisfaction
Peleg et al. (2019)	Le Fort I maxillary impaction	Mandibular plane angle; occlusal plane angle; facial height ratios	Incisor exposure at rest	↓ mandibular plane angle; ↓ occlusal plane angle; ↓ incisor exposure
Goguet et al. (2023)	Horseshoe osteotomy (HS)	Vertical maxillary position at anterior (Point P) and posterior (Point C) regions	Lip competence; smile parameters	↓ vertical maxillary height; ↓ lip incompetence; ↓ gingival smile

Table 5 represents soft tissue and skeletal changes related to procedures of surgical maxillary impaction. The skeletal changes that were reported included modifications in mandibular plane angle, occlusal plane, facial height proportions and vertical repositioning of the maxilla. Meanwhile, soft tissue results evaluated changes in gingival exposure, nasolabial angle, incisor exposure at rest and lip competence. Overall, In the studies included, there was superior repositioning of the maxilla, improvements in lip competence, positive changes in facial profile parameters and reduction of excess gingival display.

Table 6. Aesthetic perception outcomes following surgical correction of excessive gingival display

Author (Year)	Treatment modality	Sample size	Initial gingival exposure (mm)	Post-treatment gingival exposure (mm)	Aesthetic assessment method	Main aesthetic outcome
Borba et al. (2024)	Botulinum toxin vs Maxillary impaction surgery	26 (13 BTX / 13 Surgery)	BTX: 5.18 ± 1.51 | Surgery: 5.21 ± 1.55	BTX: 0.61 ± 1.03 | Surgery: 0.12 ± 0.44	VAS (0–10) by orthodontists, dentists, laypeople	Significant aesthetic improvement in both groups; surgery showed greater reduction in gingival exposure
Rizzi et al. (2022)	Orthognathic surgery (Le Fort I) vs Miniplate-assisted impaction	16	~4–6 mm range	Reduced to 0–2 mm range	VAS (100-mm scale) by OMS, orthodontists, laypeople	0–2 mm gingival display rated most aesthetic; no major aesthetic difference between techniques
Kouja & Khalil (2025)	Anterior segmental maxillary osteotomy (ASMO)	10	Incisors: 7.00 ± 0.82 | Canines: 6.30 ± 1.16	Incisors: 1.20 ± 0.79 | Canines: 1.40 ± 0.70	Patient-reported satisfaction (Likert scale 1–5)	Mean patient satisfaction: 4.70 ± 0.48; significant reduction in gingival display and improved facial harmony

Table 6 is a representation of the aesthetic results reported following reduction of gingival display using surgical maxillary impaction methods. Gingival exposure is reduced considerably after surgical correction in the studies included. Mean gingival exposure is reduced from roughly 5 mm to less the 1 mm in Borba et al.(2022) in both treatment groups, however a bigger reduction is still observed in the surgically treated group. In Rizzi et al. (2022) gingival exposure was

decreased to a 0-2 mm range after the procedure; this range was rated most favourable aesthetically. Lastly in Kouja and Khalil (2025) there was a mean post-operative score over incisors of 7.00 mm to 1.20 mm with a mean of 4.70 out of 5 in patient satisfaction. There is an overall association with improved aesthetic ratings after surgical correction.

5. DISCUSSION

This review is to directly analyse the management of excessive gingival display between the two treatments modalities, orthodontic mini-implant intrusion and surgical maxillary impaction. Even though both modalities exhibited success in decreasing gingival display, there were differences in biomechanical mechanism, extent in correction, aesthetic outcome perception and stability. There is a close relation between these differences and the etiology of the gummy smile; weather it is a dentoalveolar extrusion or skeletal vertical maxillary excess.

In patients with dentoalveolar etiology, orthodontic mini-implant assisted intrusion regularly achieved measurable decrease in incisor display. In a randomised clinical trial, incisor intrusion ranged from 1.6 mm o 2.1 mm when using one mini-screw and 3.81 mm when using two mini-screws (20). A mean of 2.3 mm intrusion with a rate of 0.38 mm per month was reported in a prospective cohort study when using TADs (29). Another study reported demonstrates a total intrusion of 2.6 ± 0.8 mm with a mean rate of 0.49 mm per month when assisted by mini-screws (6). These values demonstrate that controlled anterior intrusion can be achieved with skeletal anchorage over a relatively short treatment time. Nonetheless the extent of correction achieved orthodontically remains limited when compared to surgical skeletal repositioning.

Alongside linear intrusion, mechanical dentoalveolar and skeletal adaptation were associated with the usage of orthodontic mini-implant assisted intrusion. When midpalate mini-screws were used for intrusion, there was a decrease in gingival display from 4.6 ± 1.2 mm to 1.6 ± 1.6 mm; alongside upward prosthion movement and modifications of the occlusal plane (13). When extra-alveolar TADs were used in hyperdivergent patients, enhancements of smile dynamics and facial proportions was observed. This is due to the counterclockwise mandibular rotation that achieved a reduction of anterior lower facial height (12). Alongside tooth movement, these results show that orthodontic intrusion using TADs can enhance facial aesthetics. However, this is not true maxillary skeletal repositioning, but rather an indirect, biomechanically mediated effect.

Contrarily, surgical maxillary impaction treats vertical maxillary excess directly. Anterior maxillary osteotomy resulted in about 5-6 mm of vertical correction, with reductions of 7.00 mm to 1.20mm over incisors and of 6.30 mm to 1.40 mm over canines (17). Meanwhile horseshoe osteotomy produced an upward movement of the maxilla of 9.5 mm at the maximum, with a mean maxillary impaction of 5.0 mm at the prosthion and 6.1 mm at the molar region (27). These finding are significantly higher than outcomes of orthodontic intrusion using TADs. This shows

the great capability of surgical procedures to displace the whole maxillary skeletal base. In long-face pattern patients, le fort I impaction techniques show predictable results in autorotation of the mandible and vertical face proportions improvement (24).

When comparing both treatment modalities, a critical factor is stability. Insignificant relapse is reported after long-term assessment of horseshoe osteotomy, reporting values of 0.8 ± 1.7 mm after a mean follow-up of 20.7 months (27). This indicates success in vertical stability and therefore in cases of vertical maxillary excess, surgical correction shows to offer predictable maintenance. Orthodontic intrusion studies, on the contrary, mainly assessed results in shorter periods of active treatment, usually around four to six months (28,29). Long-term data in orthodontic studies was not reported consistently. Although intrusion is affective during the active phase of the orthodontic treatment, the long-term stability of gingival reduction remains uncertain. This stability may depend on retention strategies and patient´s individual growth pattern.

Differences between both treatment modalities are emphasised when considering the perception of aesthetic results. There was a decrease of gingival exposure from 5.21 ± 1.55 mm to 0.12 ± 0.44 mm after surgical correction; when compared to botulinum toxin treatment, it produced a considerably greater rating in smile attractiveness (25). When clinicians and laypersons were asked to assess smile attractiveness, exposure of the gingiva within the range of 0-2 mm was continuously rated most aesthetically pleasing (26). After anterior segmental osteotomy, great ratings of patient satisfaction were noted, giving a mean of 4.70 ± 0.48 on a five-point Likert scale (17). Even though there was a demonstration of clinical gingival display reduction following orthodontic intrusion, there was not a consistent standardised scales of aesthetic perception integrated in those studies. This hinders the direct comparison between the two treatment modalities.

From a clinical point of view, orthodontic mini-implant assisted intrusion shows to be the best treatment option in patients displaying adequate skeletal proportions, and mild to moderate excessive gingival display as a result to dentoalveolar extrusion. It does not require hospitalization and reduces morbidity, offering an alternative to treat excessive gingival display that is minimally invasive. Nevertheless, if there is an association with true skeletal vertical maxillary excess or lower facial height increase accompanied by an exposure of the gingival surpassing 4-5 mm, surgical maxillary impaction offers a greater extent of correction and increases skeletal harmony. Surgical impaction is more appropriate in moderate to severe

skeletal cases due to the superior displacement of the maxilla that provokes mandibular autorotation.

There are various limitations that must be recognised. The studies assessed were different in design, measurement protocols and sample size. Surgical studies varied in techniques of impaction, measurements and sample characteristics; while orthodontic studies had a shortage of standard aesthetic assessment and long-term follow up. There was limited direct prospective analysis between surgical impaction and orthodontic TAD assisted intrusion. To fortify the comparison between the treatment modalities, future research needs to integrate standard millimetric measurements of gingival display, extend follow-up periods and use valid aesthetic perception instruments.

To reduce excessive gingival display, both orthodontic mini-implant -assisted intrusion and surgical maxillary impaction showed to be effective. For mild cases, orthodontic intrusion offers controlled dentoalveolar correction. Meanwhile, surgical impaction can attain a larger vertical repositioning of the maxilla accompanied with long-term skeletal stability. To provide ideal management, individualised diagnosis is required. This should include severity of gingival exposure, skeletal analysis and patient expectations regarding aesthetic and functional results.

6. CONCLUSIONS

Within the limitations of this documentary review, both orthodontic mini-implant–assisted incisor intrusion and surgical maxillary impaction were shown to be effective in reducing excessive gingival display and improving smile aesthetics. Orthodontic intrusion using mini-implants measurable dentoalveolar correction, typically achieving 2–4 mm of incisor intrusion and associated gingival reduction, making it a suitable option for patients presenting with mild to moderate dentoalveolar etiology. In contrast, surgical maxillary impaction allowed significantly greater vertical correction, with reductions in gingival display reaching approximately 5–6 mm and superior repositioning of the maxilla exceeding 5 mm in many cases, demonstrating its effectiveness in managing moderate to severe skeletal vertical maxillary excess.

Aesthetic perception outcomes also favoured surgical correction in severe cases, particularly when gingival exposure was reduced to the 0–2 mm range. Nevertheless, orthodontic mini-implant intrusion remains a minimally invasive and effective alternative for appropriately selected patients. Therefore, treatment selection should be individualized based on the underlying etiology, severity of gingival display, skeletal pattern, and patient expectations to achieve optimal functional and aesthetic outcomes.

7. SUSTAINABILITY

Sustainability in healthcare focuses on promoting long-term patient well-being while ensuring responsible use of clinical resources and avoiding unnecessary interventions. In the management of excessive gingival display, both orthodontic mini-implant intrusion and surgical maxillary impaction can support sustainable outcomes, as they improve functional balance, smile aesthetics and psychological well-being, in accordance with Sustainable Development Goal 3 (Good Health and Well-being).

Orthodontic mini-implant intrusion is a minimally invasive treatment option that can be performed in an outpatient setting with reduced resource use. It is associated with lower costs, does not require general anaesthesia and involves shorter recovery time, making it appropriate for mild to moderate dentoalveolar cases. However, its long-term stability depends on proper retention, as relapse may occur if follow-up is not adequately managed.

On the other hand, surgical maxillary impaction is more invasive and requires greater clinical resources, but it provides more significant correction and improved long-term stability in skeletal cases. By achieving definitive skeletal repositioning with minimal relapse, it may reduce the need for future interventions despite the higher initial cost.

Overall, sustainable management depends on accurate diagnosis, appropriate case selection and an individualised treatment approach to ensure effective and patient-centred outcomes.

8. REFERENCES

1. Mousavi M, Saeidi P, Kazemi P, Rakhshan V. Impact of fixed orthodontic treatment with and without premolar extraction on gingival display index in men and women. Sci Rep. 2025;15:24017.

2. Sybaite J, Sharma P, Fine P, Blizard R, Leung A. The influence of varying gingival display of maxillary anterior teeth on the perceptions of smile aesthetics. *J Dent*. 2020;103:103504.

3. Impellizzeri A, Palmigiani R, Horodynski M, D'alfonso T, Polimeni A, De Stefano A, et al. Is there a correlation between gingival display and incisal inclination in a gummy smile? Study on cephalometric parameters. *Healthcare*. 2023;11:344.

4. Faraj SH, Zardawi FM. Excessive gingival display, prevalence, and its impact on patient's psychological status and quality of life: a questionnaire-based survey. *Front Health Inform*. 2024;13(6):569-576.

5. Venugopal A, Manzano P, Ahmed F, Vaid N, Bowman SJ. Gummy smiles: etiologies, diagnoses & formulating a clinically effective treatment protocol. *Semin Orthod*. 2024;30:482-501.

6. El Namrawy MM, El Sharaby F, Bushnak M. Intrusive arch versus miniscrew-supported intrusion for deep bite correction. *Open Access Maced J Med Sci*. 2019;7(11):1841-1846.

7. Niknam O, Yousefi Hafshejani S, Rakhshan V. Attractive combinations of female gingival displays, buccal corridor sizes, and facial heights according to orthodontists, dentists, and laypeople of different ages and sexes: a psychometric study. *Head Face Med*. 2024;20:17.

8. Alshammery D, Alqhtani N, Alajmi A, Dagriri L, Alrukban N, Alshahrani R, Alghamdi S. Non-surgical correction of gummy smile using temporary skeletal mini-screw anchorage devices: a systematic review. *J Clin Exp Dent*. 2021;13(7):e717-23.

9. Krishnaswamy NR. Vertical control with TADs: procedures and protocols. *Semin Orthod*. 2018;24(1):108-122.

10. El-Bokle D, Abdel Ghany AH. A systematic diagnostic scheme for excessive gingival display "gummy smile". *AJO-DO Clin Companion*. 2022;XX:1-10.

11. Nasrun NE, Takeda S, Minamida Y, Hiraki D, Horie N, Nagayasu H, Shimo T. Surgical procedures for correcting vertical maxillary excess: a review. *Int J Surg Case Rep*. 2021;86:106354.

12. Alteneiji M, Liaw JJL, Vaid NR, Ferguson DJ, Makki L. Treatment of vertical maxillary excess using extra-alveolar TADs: quantification of treatment effects. *Semin Orthod*. 2018;24(1):123-134.

13. Miyazawa K, Tamada Y, Tabuchi M, Kawaguchi M, Shibata M, Sato T, et al. Effective approach for improving a gummy smile: upward movement of the maxillary occlusal plane using midpalatal miniscrews and a modified transpalatal arch. *J Orofac Orthop*. 2024;85:167-180.

14. Khojasteh A, Mohaghegh S. Orthognathic surgery for management of gummy smile. *Dent Clin North Am*. 2022;66(3):385-398.

15. Al Sayed AA, Alshammari BZ, Alshammari AR, Aldajani MB, Alshammari FR. Gummy smile prevalence among Ha'il City female young adults and its impact on quality of life: a cross-sectional study. *Cureus*. 2023;15(12):e51302.

16. Inchingolo AD, Inchingolo AM, Viapiano F, Netti A, Ciocia AM, Ferrara I, et al. Effectiveness and personalized approaches in the correction of gummy smile: a systematic review of orthodontic and surgical treatments. *J Clin Med*. 2024;13:6843.

17. Kouja M, Khalil AK. Evaluation of the effectiveness of anterior segmental maxillary osteotomy in management of anterior vertical maxillary excess associated with gummy smile: a clinical study. *Oral Maxillofac Surg Cases*. 2025;11:100414.

18. El-Chekie MR, Zeno KG, Ghafari JG. Maxillary full arch intrusion using temporary skeletal anchorage devices for nonsurgical management of excessive gingival display. *Am J Orthod Dentofacial Orthop Clin Companion*. 2023;3:176-189.

19. Hegde NS. Treatment of vertical maxillary excess in skeletal Class II hyperdivergent face using skeletal anchorage—an IBO case report. *J Indian Orthod Soc*. 2024;58(2):183-193.

20. Manikandan M, Das SK, Barik AK, Raj SC, Mishra M, Rath SK, Sah S. Evaluation of dentoalveolar changes following maxillary incisor intrusion with one vs two anterior miniscrews in subjects with gummy smile: a randomized clinical trial. *Angle Orthod*. 2024;94:522-531.

21. Ahuja D, Shetty S, Gautam R, Batra P, Lego T. Efficacy of single versus double miniscrew-assisted maxillary anterior intrusion in subjects with gummy smile or deep bite: a systematic review and meta-analysis. *Int Orthod*. 2025;23:100996.

22. Mote N, Malandkar A, Toshniwal NG, Mani S, Dhanjani V. Effects of LeFort I maxillary impaction surgery on surrounding structures in vertical maxillary excess patients: a review article. *IOSR J Dent Med Sci*. 2019;18(8):59-65.

23. Selvi AK, Kannan MS, Chaturvedula BB. Non-surgical management of a young adult with Class II skeletal base and vertical maxillary excess using mini-implants. *Clin Dent*. 2021;15:31-35.

24. Peleg O, Mijiritsky E, Manor Y, Inchingolo F, Blinder D, Mortellaro C, et al. Predictability of mandibular autorotation after Le Fort I maxillary impaction in case of vertical maxillary excess. J Craniofac Surg. 2019;30(4):1102–1104.

25. Borba DBM, Fialho T, Oliveira RCG, Oliveira RCG, Valarelli FP, Pinzan-Vercelino CRM, et al. Comparison of smile attractiveness in cases with gummy smile treated with botulinum toxin and maxillary impaction surgery: a retrospective study. J Cranio Maxillofac Surg. 2024;52:999–1005.

26. Rizzi RI, Portes MIP, Ertty E, Meloti F, An TL, Cardoso MA. Aesthetic perception of smile in long face pattern patients who underwent maxillary impaction with miniplates or orthognathic surgery. J Stomatol Oral Maxillofac Surg. 2022;123:498–504.

27. Goguet Q, Mercier J, Longis J, Bonnet R, Perrin JP, Corre P, et al. Long-term vertical stability of horseshoe osteotomy for the correction of large vertical excess of the maxilla: a retrospective assessment in 15 patients. J Stomatol Oral Maxillofac Surg. 2023;124:101474.

28. Sharma P, Raghav P, Khera AK, Wadhwa P. Comparative evaluation of one mini-implant versus two mini-implant assisted maxillary incisor intrusion: a randomized clinical trial. J Contemp Orthod. 2024;8(4):520–525.

29. Verma P, Jain RK. Intrusion effects on maxillary anteriors using mini implant anchorage and K-Sir loop in subjects with deep overbite: a cohort study. J Clin Diagn Res. 2020;14(12):ZC21–ZC25.

9. ANNEXES