



Crown Lengthening Procedure in the Treatment of Gummy Smile: A Mini Review

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Abstract

A harmonious smile depends on the balance between the teeth, gingiva, and lips. Excessive gingival display, commonly termed “gummy smile”, is a frequent esthetic concern that can adversely impact facial harmony and patient confidence. Crown lengthening remains a cornerstone for the management of gummy smile, particularly in cases of dentogingival etiology such as altered passive eruption. Conventional surgical approaches have demonstrated predictable and stable results when performed according to established periodontal principles. Guided crown lengthening techniques have become a significant development in esthetic periodontal surgery, aiming for more predictable results in soft and hard tissue architecture. The primary advantage of these techniques lies in reducing human error, which can occur in traditional surgery. The materials used in guide fabrication, such as acrylic or vacuum-formed templates, provide the clinician with precise guidance in determining the desired gingival margin and bone recontouring, ensuring that the outcome is aligned with esthetic and functional goals. Future research should focus on long-term gingival stability, cost-effectiveness, and optimization of digital workflows to further refine clinical outcomes.

Keywords: Gummy Smile; Digital Dentistry; Surgical Guide; Crown Lengthening; Esthetic Dentistry

Introduction

A harmonious smile depends on the balance between the teeth, gingiva, and lips [1]. Excessive gingival display (EGD), commonly known as a “gummy smile,” is typically defined as exposure of more than about 3–4 mm of gingiva upon full smiling [2]. It is a prevalent cosmetic concern, reported in roughly 10–29% of the population, especially among young adult females [3]. Although a gummy smile is not a medical pathology, it can negatively impact facial esthet-

ics and psychosocial well-being – individuals with pronounced gingival display often report lowered self-confidence and dissatisfaction with their smile aesthetics [4]. Consequently, many patients seek treatment to enhance smile appearance.

The etiology of gummy smile is multifactorial, underscoring the importance of a careful diagnosis so that treatment can be tailored to the cause [5]. Key contributing factors include dento-

alveolar conditions such as altered passive eruption (APE), where gingiva fails to recede to the cemento-enamel junction (CEJ) during tooth eruption, resulting in short clinical crowns [6]. Non-dentoalveolar causes like a hypermobile or short upper lip and vertical maxillary excess (skeletal vertical overgrowth of the maxilla) can also produce EGD [7]. Less commonly, underlying bimaxillary dentoalveolar protrusion may contribute to excessive gingival show in certain populations [7]. Given this range of etiologies, management must be etiology-specific for predictable results. Mild to moderate EGD caused by dentogingival factors is often best addressed by periodontal surgery (crown lengthening), whereas EGD from skeletal or muscular causes may require alternative interventions [7].

Treatment options for gummy smile span multiple disciplines. Orthodontic intrusion can help in dentoalveolar extrusion cases, and orthognathic surgery (Le Fort I maxillary impaction) is considered the gold-standard for severe skeletal vertical maxillary excess [8]. However, orthognathic surgery is highly invasive – requiring hospitalization and carrying risks of significant complications – and is generally reserved for extreme cases (gingival display > ~8 mm) [8]. Less invasive alternatives have been developed for soft-tissue related EGD: for example, injection of botulinum toxin type-A into the lip elevator muscles can transiently reduce a hyperactive lip and thereby lessen gingival display [9]. Likewise, surgical lip repositioning, first described in 1973, reattaches the upper lip in a more coronal position to limit its upward movement; this technique has seen a resurgence in recent years due to its simplicity and effectiveness in appropriate cases [10,11]. Nevertheless, for the prevalent scenario of dentoalveolar APE, the established treatment of choice is esthetic crown lengthening surgery – essentially, raising the height of the clinical crowns by excising and/or repositioning the gingival tissues (and underlying bone if needed) to a more apical level [12]. This review focuses on crown lengthening procedures for managing a gummy smile, tracing the evolution from conventional surgical techniques to contemporary digital workflows.

Crown lengthening surgery

Crown lengthening in the context of a gummy smile refers to periodontal surgical procedures designed to expose more of the

clinical crown by apically repositioning the gingival margin. This procedure is particularly relevant in cases of altered passive eruption (APE), where the natural apical migration of the gingiva is incomplete, resulting in excessive gingival display [12]. Surgical crown lengthening aims to establish optimal esthetic proportions, improve smile balance, and provide adequate tooth structure for restorative procedures, while respecting the biologic width to prevent periodontal complications [12].

The choice of surgical technique is dictated by the anatomical subtype of APE. In Type I APE, where sufficient keratinized tissue exists but the gingival margin is positioned coronally, a simple gingivectomy may suffice. In contrast, Type II APE often involves osseous interference, necessitating an osteotomy to recontour the alveolar bone and allow proper repositioning of the gingival margin [13]. Preoperative planning should include careful measurement of the sulcus depth, probing to determine the location of the alveolar bone crest, and assessment of keratinized tissue width to ensure stable and healthy postoperative outcomes [13].

Traditionally, esthetic crown lengthening has been performed free-hand using various surgical modalities. Scalpel gingivectomy provides excellent tactile feedback and allows precise shaping of the gingival margin. However, achieving symmetry across multiple teeth can be challenging, particularly in patients with irregular gingival architecture or varying tissue thickness [14]. Electrosurgery offers improved hemostasis, reduces intraoperative bleeding, and may shorten operative time, though care must be taken to avoid thermal injury to the adjacent tissues, which can compromise healing and lead to delayed postoperative recovery [15]. Laser-assisted gingivectomy has gained popularity due to its ability to ablate soft tissue precisely while maintaining a bloodless field. It may also reduce postoperative discomfort, inflammation, and edema, potentially enhancing patient satisfaction [16].

Crown lengthening aimed at correcting a gummy smile sometimes requires the removal of alveolar bone, a procedure known as osseous recontouring or osteotomy, to establish proper gingival

and tooth proportions. This is particularly indicated in patients with altered passive eruption (APE) Type I-B, where the alveolar bone crest is positioned too close to the cemento-enamel junction (CEJ), preventing adequate apical repositioning of the gingival margin [12].

During the procedure, after reflecting a full-thickness flap, the surgeon evaluates the distance between the gingival margin and the alveolar bone crest to respect the supracrestal tissue attachment (previously named as 'biologic width'), typically 2–3 mm, which is critical for maintaining periodontal health and avoiding postoperative gingival rebound or attachment loss [12,17]. Bone removal is performed using rotary instruments or hand chisels to reduce the osseous crest, allowing the gingiva to be sutured at a more apical position while maintaining harmonious esthetic contours [18].

The ostectomy technique must be carefully planned and executed to avoid excessive bone removal, which can compromise tooth support or result in post-surgical sensitivity. Clinical studies have shown that crown lengthening with osseous recontouring provides more stable long-term gingival margins and predictable esthetic outcomes compared to soft tissue-only procedures, especially in cases of APE where the bone interferes with ideal crown exposure [17].

Clinical studies indicate that when surgical principles are strictly followed, the long-term position of the gingival margin remains consistent across scalpel, electrosurgery, and laser techniques. Success depends on meticulous respect for the supracrestal tissue attachment, which is critical for preventing gingival rebound, attachment loss, or bone resorption [17-19].

Postoperative care, including plaque control, anti-inflammatory therapy, and patient adherence to oral hygiene instructions, significantly influences healing and long-term stability. Complications, though uncommon, may include transient hypersensitivity, minor gingival recession, delayed epithelialization, or esthetic

asymmetry, all of which should be discussed with the patient during informed consent [19]. Overall, free-hand crown lengthening remains a versatile and effective approach for correcting gummy smiles when performed by skilled clinicians with careful planning and adherence to biologic principles [20].

Guided crown lengthening

Guided crown lengthening techniques have become a significant development in esthetic periodontal surgery, aiming for more predictable results in soft and hard tissue architecture. The primary advantage of these techniques lies in reducing human error, which can occur in traditional surgery. The materials used in guide fabrication, such as acrylic or vacuum-formed templates, provide the clinician with precise guidance in determining the desired gingival margin and bone recontouring, ensuring that the outcome is aligned with esthetic and functional goals [21,22].

Surgical guides were introduced based on diagnostic waxing, made with acrylic resin or vacuform transparent template [23]. The diagnostic wax-up is created on a dental cast to simulate the ideal gingival contour and tooth dimensions. This wax-up serves as the blueprint for the surgical procedure, allowing the clinician to visualize the final result. Afterward, a vacuum-formed stent is fabricated using heat and thermoplastic material to form a guide that aids in accurate tissue removal during the surgery. This process enhances precision, leading to improved esthetic and functional results for the patient [23,24].

However, challenges with guided crown lengthening techniques do exist. One of the issues is a slight discrepancy in accuracy due to the thickness of vacuum guides, leading to minor variations in the gingival margin position. Additionally, these guides may lack precision at the interproximal level, affecting the final outcome. Despite these challenges, the technique remains valuable for achieving optimal gingival margin positioning and offers a higher level of predictability and patient satisfaction compared to free-hand techniques [25,26].

Digital advances in crown lengthening

Digital advances in crown lengthening have revolutionized the field of esthetic periodontal surgery. With the advent of Digital Smile Design (DSD) and the integration of cone beam computed tomography (CBCT), it is now possible to plan procedures with high accuracy by visualizing the final result before surgery even begins. These digital tools allow for the integration of both hard and soft tissue data into a 3D virtual model of the patient, ensuring precise surgical planning [25,26].

The use of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) has transformed surgical planning, allowing for the creation of custom surgical guides tailored to the patient's specific anatomy. These digital workflows also reduce manual labor and streamline the process by eliminating traditional impression techniques, thus enhancing the accuracy of the treatment and reducing patient discomfort [27,28].

One of the key innovations in digital crown lengthening is Intra-oral Scanning (IOS), which captures highly detailed digital impressions of the teeth and surrounding tissues. This technique not only improves patient comfort but also enables more accurate treatment planning by integrating with CAD/CAM systems for the fabrication of restorations such as crowns, bridges, and surgical guides. Digital planning begins with 2D simulations and transitions into 3D virtual designs produced in CAD software, which can then be used to manufacture guides for the surgery, enhancing predictability and reducing surgery time [29,30].

Furthermore, DSD (Digital Smile Design) has transformed how clinicians approach esthetic planning. By using specialized software, dentists can create personalized treatment plans that take into account the individual characteristics of the patient's smile and face. This technique improves communication with the patient, ensuring that both the clinician and the patient have a clear vision of the expected outcome before starting any treatment [31,32].

Digital workflows also facilitate interdisciplinary collaboration by allowing orthodontists, periodontists, prosthodontists, and dental technicians to work seamlessly together, improving both the efficiency of the treatment process and the final esthetic outcome. The integration of DSD with CAD/CAM technologies has enabled more accurate and stable results, with patient education playing a central role in setting realistic expectations [33,34].

Several clinical studies have evaluated the use of digital surgical guides in crown lengthening and reported favorable outcomes. Alhumaidan, *et al.* 2020 demonstrated that 3D-printed guides based on CBCT measurements allow accurate osteotomy and gingival margin positioning with minimal postoperative complications [35]. Similarly, Alazmi, *et al.* 2022 and Gonçalves, *et al.* 2025 reported that digitally fabricated guides significantly improve surgical precision, reduce operative time, and enhance esthetic results compared to traditional free-hand methods [36,37]. These findings suggest that digital guides are a reliable choice for predictable esthetic crown lengthening, especially in complex cases.

However, digital dentistry faces challenges, such as high initial costs, specialized equipment, and the need for advanced technical expertise. Despite these hurdles, the use of 3D printing in dental surgery has shown considerable potential in producing precise, customized surgical guides with minimal material waste, offering great flexibility in complex procedures like crown lengthening. Although still evolving, digital workflows in crown lengthening surgery are expected to continue improving clinical outcomes and patient satisfaction [38,39].

Conclusion

Crown lengthening remains a cornerstone for the management of gummy smile, particularly in cases of dentogingival etiology such as altered passive eruption. Conventional surgical approaches have demonstrated predictable and stable results when performed

according to established periodontal principles. The introduction of digital workflows – including intraoral scanning, CBCT imaging, and CAD/CAM guides – provides enhanced precision, particularly in controlling the gingival zenith and standardizing osseous recontouring. While digital techniques offer advantages in complex or multi-tooth esthetic cases, conventional crown lengthening continues to be effective for straightforward situations. Future research should focus on long-term gingival stability, cost-effectiveness, and optimization of digital workflows to further refine clinical outcomes.

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