Case report

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DIGITAL WORKFLOW FOR THE CORRECTION OF A GUMMY SMILE

Ana Jevremović[1], Danimir Jevremović[1]

[1]University of Buisness Academy in Novi Sad, Faculty of Dentistry Pančevo, Pančevo, Serbia

Contact: Ana Jevremović

179 Žarka Zrenjanina St., Pančevo, 26000, Serbia

E-mail: ana.jevremovic@stomatoloski.rs

Excessive gingival display during smiling, known as a "gummy smile," can negatively affect the patient's aesthetic appearance and self-confidence. The digital workflow in the correction of this condition involves the use of technologies such as intraoral scanning, CBCT diagnostics, and CAD/CAM systems for the fabrication of surgical guides. This paper presents a clinical case in which a digital protocol was used for the planning and execution of gingivoplasty with the help of a surgical guide. The results demonstrated high precision, minimal invasiveness, and predictable aesthetic correction. The application of digital technologies enhances communication with patients, reduces treatment time, and increases procedural safety, making it an effective approach in aesthetic dentistry.

Keywords: Digital planning, CAD/CAM, Gummy smile, Gingivoplasty, Surgical guide, Aesthetics

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DIGITALNI PROTOKOL U KOREKCIJI PREEKSPONIRANIH DESNI

Ana Jevremović[1], Danimir Jevremović[1]

[1]Univerzitet Privredna akademija u Novom Sadu, Stomatološki fakultet Pančevo**,** Pančevo, Srbija

Kontakt: Ana Jevremović

Žarka Zrenjanina 179, 26000 Pančevo, Serbia

E-mail: ana.jevremovic@stomatoloski.rs

Preeksponirana gingiva prilikom osmeha, poznata kao „gummy smile", može negativno uticati na estetski izgled i samopouzdanje pacijenata. Digitalni tok rada u korekciji ovog stanja uključuje primenu tehnologija poput intraoralnog skeniranja, CBCT dijagnostike i CAD/CAM sistema za izradu hirurških vodiča. Ovaj rad prikazuje klinički slučaj u kojem je korišćen digitalni protokol za planiranje i izvođenje gingivoplastike uz pomoć hirurškog vodiča. Rezultati su pokazali visoku preciznost, minimalnu invazivnost i predvidivu estetsku korekciju. Primena digitalnih tehnologija poboljšava komunikaciju sa pacijentima, smanjuje vreme tretmana i povećava sigurnost u izvođenju zahvata, čineći ga efikasnim u estetskoj stomatologiji.

Ključne reči: Digitalno planiranje, CAD/CAM, Preeksponirane desni, Gingivoplastika, Hirurški vodič, Estetika

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Introduction

A perfect smile is not solely the result of harmony between white and pink aesthetics but rather a balance between teeth, gingiva, and lips. Excessive gingival display—commonly referred to as a "gummy smile" (GS)—is an aesthetic concern that may also have psychosocial implications for the patient. The overall prevalence of GS in the general population is estimated at approximately 10–15%, with a higher incidence reported in females (1). The etiology of GS is multifactorial and includes various anatomical and functional causes such as vertical maxillary excess, anterior dentoalveolar extrusion, altered passive eruption, hyperactive upper lip, short upper lip, and excessive compensatory tooth eruption (2). In many cases, a combination of these etiological mechanisms is present, complicating both diagnosis and treatment planning (3).

The correction of GS can be achieved through a variety of therapeutic modalities depending on the underlying etiology and the degree of severity. Available options include orthodontic treatment, periodontal surgery (gingivectomy and gingivoplasty), clinical crown lengthening, lip repositioning surgery, botulinum toxin application, orthognathic surgery, digitally guided periodontal surgery, and piezosurgery (1–4).

Contemporary approaches integrate digital planning aided by CBCT, intraoral and extraoral scanning, as well as the use of piezosurgical instruments for precise and minimally invasive intervention. These techniques facilitate the development of a personalized treatment plan with high aesthetic predictability (4).

Given the increasing demand for aesthetic and minimally invasive procedures, the concept of digital workflow enables improved communication with both the patient and the dental technician. For the clinician, it serves as a diagnostic tool to select the most appropriate therapeutic approach and to plan treatments with greater precision and predictability (5–7). Digital planning relies on diagnostic tools such as digital photography, intraoral and facial scanning, and CBCT imaging, which allow for the assessment of ideal relationships between hard and soft tissues in the context of surgical planning for GS correction using surgical guides (8, 9).

Clinical crown lengthening is a periodontal surgical procedure designed to expose a greater portion of the tooth surface, either for aesthetic or functional purposes. This intervention involves the removal of excess gingival tissue, and if necessary, alveolar bone, in order to reveal more of the clinical crown (10).

The goals of crown lengthening include achieving optimal biological width, preserving periodontal health, and ensuring both the functional and aesthetic stability of future prosthetic restorations (11). The procedure may be performed using traditional surgical methods, lasers, or piezoelectric devices,

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and often depends on the visual assessment and manual precision of the clinician—factors that can lead to unpredictable results and prolonged recovery (12).

With the application of modern digital technologies—including CBCT imaging, CAD/CAM planning, and the fabrication of surgical guides—greater accuracy and predictability in clinical outcomes can be achieved (13, 14).

Aim

The aim of this article is to present a clinical case of guided periodontal surgery for the correction of excessive gingival display using a digitally planned intervention.

Case report

A 24-year-old female patient presented to the dental clinic dissatisfied with the aesthetics of her smile due to excessive gingival display. Clinical examination revealed short maxillary anterior teeth with an excess of gingival tissue (Figure 1). Periodontal examination revealed probing depths of 3–5 mm with adequate periodontal health (no plaque, bleeding, or periodontal pockets). Extraoral and intraoral photographs were taken, along with intraoral scans. Cone-beam computed tomography (CBCT) was requested, and the patient signed an informed consent form.

Figure 1a. Initial smile (extraoral)

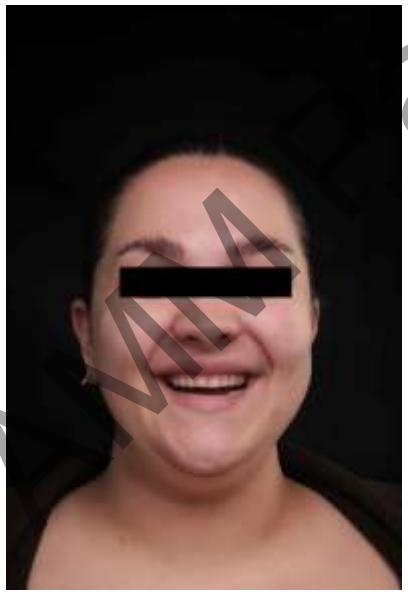

Figure 1b. Initial smile (intraoral)

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Digital treatment planning was initiated with the analysis of digital photographs and intraoral scans using the 3Shape system (Copenhagen, Denmark). A proposal for the future appearance of the teeth was created within the software (virtual diagnostic wax-up). The design considered the visibility of the anterior teeth, as well as the ideal height-to-width ratio of the central incisors (approximately 80%). The virtual design (Figure 2) was then translated into a physical model using 3D printing technology (Figure 3), followed by the fabrication of a diagnostic mock-up using silicone impression material (Virtual, Ivoclar Vivadent, Liechtenstein) and dual-cure composite resin (Protemp 4, 3M, Germany) (Figure 4).

Figure 2. Virtual design of the proposed final restorations

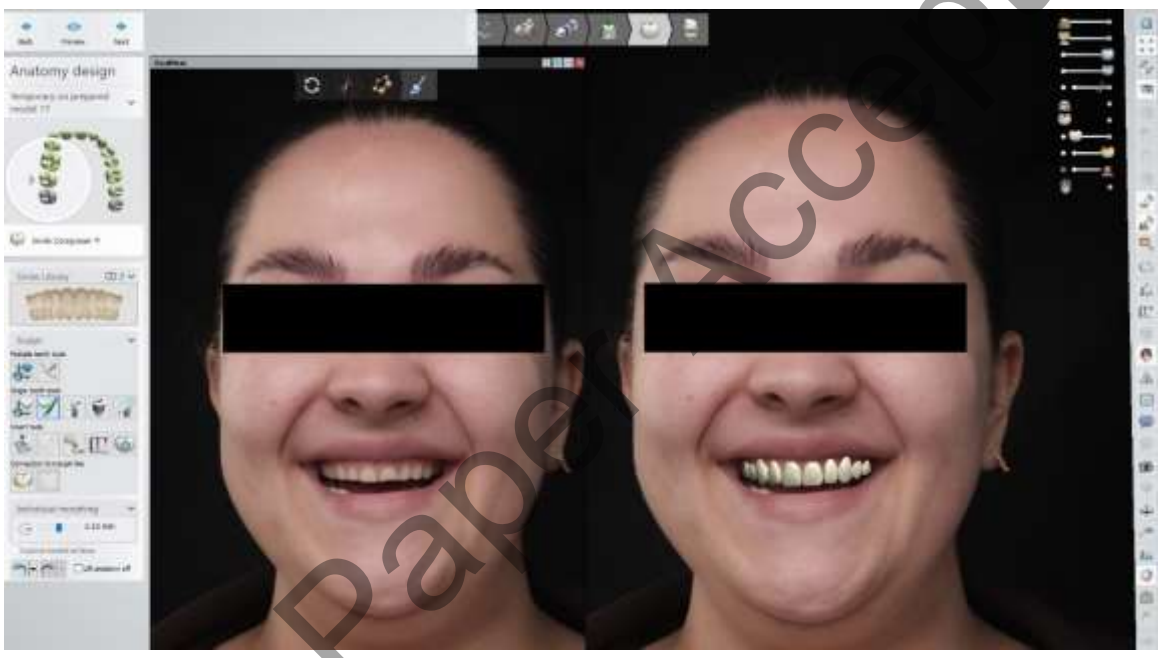

Figure 3. 3D printed model of the proposed final restorations

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Figure 4a. Mockup (extraoral)

Figure 4a. Mockup (intraoral)

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The diagnostic mock-up provides the patient with a preliminary visual preview of the future restoration.

Additional diagnostics were performed using cone-beam computed tomography (CBCT) to assess all dental surfaces as well as the soft and hard tissues. The CBCT scans were imported into the Planmeca Romexis software (Helsinki, Finland), where the STL model was aligned. Lines defining the smile's zenith curve were then drawn to determine the amount of soft and bone tissue to be removed (Figure 5). The surgical guide was subsequently designed and fabricated using 3D printing (Sprint Ray Inc., USA) in surgical guide resin with a thickness of 1 mm (Figure 6).

Figure 5. Design of surgical guide

Figure 6. Printet surgical guide

48h prior to surgical intervention, patient was instructed to rinse the mouth with 0,12% chlor-hexidine-dicluconate for 1min three times a day and additionaly 5 minutes before intervention. Concurrently, printed surgical guide was submerged in 2% chlor-hexidine-digluconate solution.

Subsequently to setting up the surgical field with sterile surgical drapes, local anesthesia - articaine 40 mg/ml; epinephrine 10 µg/ml -was administered by local infiltration at the the bottom of maxillary vestibule and the bases of interdental papillas.

Using millimeter probe (Carl Martin GmbH, Germany), measuring of supracrestal tissue attachment vertical dimension, from the free gingival rim to the depth of bone crest was done and compared with the delimitation of the surgical guide positioned in the mouth (Figure 7). Afterwards the internal bevel incision was done using 15c surgical blade (Swann-Norton, England) (Figure 8 and 9).

Figure 7. Surgical guide in the mouth

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Figure 8. Gingival collar removal

Figure 9. Gingival collar removed

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After the stent was removed, intrasulcular incision was done one distal tooth beyond surgical field perimeter bilaterally and the full thickness flap was raised apicaly beyond mucogingival junction.

In order not to encroach the biologic width afterwards, the bone crest was judiciously trimmed the exact amount the gingivectomy was done, using fine grain flat top tappered 014 diamond bur (Komet Dental, Germany) in slow speed handpiece with copious saline irrigation. Newly positioned osseous rim was rounded using ball shaped fine grain 023 diamond bur (Komet Dental, Germany) and the same bur was used to give juxtaradicular bone a physiological contour. Exposed radicular surfaces

were polished using multifluted surgical length football shaped No 14 carbide polisher (Komet Dental, Germany).

Surgical field was rinsed with copious amounts of saline and 1% povidone - iodine solution, flap repositioned and sutured with vertically matress sutures using 5-0 polydioxanone (Ethicon, USA).

Patient released and advised for edemaand pain control using coldpacks and 600 mg ibuprofen three times a day for consecutive 48 hours and instructed for 14 day TID regimen of 0,12% chlor-hexidine digluconate mouth rinses (untill suture removal).

Discussion

Gummy smile presents both aesthetic and functional challenges. Accurate diagnosis of the underlying etiology is essential to formulate an appropriate treatment plan—whether the cause is hyperactive upper lip musculature, short clinical crowns, altered passive eruption, or gingival hypertrophy (15, 16). In the present case, a digital workflow was employed for the planning and execution of conventional scalpel-based gingivoplasty using a CAD/CAM-generated surgical guide. This approach underscores the strong interdependence between periodontology and aesthetic dentistry, particularly in patients with excessive gingival display.

Digital planning enables precise determination of the resection line and evaluation of the supracrestal tissue attachment using CBCT analysis, thus preserving the biological width and minimizing the risk of postoperative complications (17, 18). A pre-approved reverse planning protocol combined with a diagnostic mock-up provided the patient with a clear visualization of the expected outcome, enhancing confidence in the treatment (19).

Although piezoelectric devices offer selective and safe access to hard tissues, a traditional scalpel technique was utilized in this case. When performed by an experienced clinician and combined with contemporary digital planning, conventional surgery continues to offer a high degree of control and predictable aesthetic outcomes (20).

The use of CAD/CAM technology allows for the fabrication of customized surgical guides that define the exact amount of gingival tissue to be removed, thereby improving both the predictability and safety of the procedure (21, 22). Digital guides significantly contribute to surgical efficiency by reducing operative time, minimizing postoperative discomfort, enhancing tissue healing (23), and facilitating improved communication among the dentist, surgeon, and dental laboratory (24).

To correct a gingival smile, clinical crown lengthening remains an effective method to reduce gingival exposure relative to the upper lip while maintaining natural interproximal relationships (25, 26). Among various therapeutic options, periodontal plastic surgery—particularly gingivoplasty—remains the gold standard in addressing this aesthetic concern (19, 27).

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Modern periodontology operates within a digital environment. Technological tools such as CBCT imaging, intraoral and facial scanning, stereolithography, and surgical guides substantially improve the quality of treatment planning and procedural predictability (18). While clinical probing has traditionally been used to locate the cementoenamel junction (CEJ), contemporary protocols incorporate the merging of CBCT scans with intraoral scans and the use of retractors, resulting in a highly precise three-dimensional visualization with minimal invasiveness (28).

In conclusion, this case demonstrates that conventional surgery, when supported by digital technologies, can yield excellent aesthetic outcomes with high precision and patient satisfaction (29).

Conclusion

The integration of digital planning with conventional surgical techniques facilitates the achievement of high precision and favorable aesthetic outcomes in gummy smile correction, while enhancing procedural efficiency, accuracy, and safety. This approach underscores that digital technology serves as a valuable adjunct to, rather than a replacement for, traditional methodologies—augmenting clinical control and increasing patient confidence. The synergy between advanced technological tools and clinical expertise is essential for optimizing treatment success in contemporary periodontal and aesthetic dentistry.

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