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CLINICAL ARTICLE

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The crown lengthening double guide and the digital Perio analysis

Christian Coachman DDS, MDT[1] | Konstantinos Valavanis DDS, MS[1] | Fernanda Camargo Silveira DDS; MS[1] | Sergio Kahn DDS; MS, PhD[1] | Alexandra Dias Tavares DDS; MS, PhD[1] | Eduardo Mahn DDS, DMD, PhD[2] | Hian Parize MS[3] | Felipe Miguel P. Saliba DDS, MS[4]

[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

[2]Universidad de los Andes, Santiago, Chile

[3]Department of Prosthodontics, University of Sao Paulo, Sao Paulo, Brazil

[4]Prosthodontic University of rio Grande do sul, Santa Maria, Rio Grande do Sul, Brazil

Correspondence
Eduardo Mahn, Universidad de los Andes, Santiago, Chile.
Email: emahn@miuandes.cl

Abstract

Objective: This article describes a surgical crown lengthening double guide, which was digitally obtained to improve diagnosis, treatment outcome, and follow-up.

Clinical considerations: The rehabilitation of anterior dental esthetics should involve interdisciplinary and facially driven planning for achieving pleasant long-term outcomes. Surgical crown lengthening is one of the most common periodontal surgery, which can be assisted by digital tools to improve surgical planning and follow-up.

Conclusion: The double guide for surgical crown lengthening allows the proper management of hard and soft tissues for achieving a predefined goal based on biological requirements and facially driven planning. In addition, the digital quality control allows the follow-up compared with the pre-operative condition and planned treatment plan.

Clinical significance: The use of digital tools allow the clinician to develop a facially driven planning with proper communication with the team and patient, leading to a shorter, more predictable, and less invasive surgical technique, reducing postoperative inflammation and increasing patient comfort.

KEYWORDS

CAD-CAM, facially driven planning, periodontics, surgical crown lengthening, surgical guide

1 | INTRODUCTION

The excessive gingival display is a multifactorial condition, often referred as "gummy smile," that requires accurate diagnosis and treatment planning for achieving long-term esthetic outcomes.[1] To improve tooth exposure and reestablish the biological width, a surgical crown lengthening is required, which comprises gingivoplasty and osteotomy.[2]

Due to the increasing digitalization of dentistry in recent years, countless novel concepts have emerged, leading to new ways of diagnosing, planning, communicating, and performing dental treatments. The introduction of digital tools and the creation of a digital workflow facilitates the guidance of dental procedures. In this sense, outcomes can be compared with the initial planning, according to the concepts of Guided Dentistry and Digital Quality Control.[3–5]

Guided dentistry refers to the three-dimensional (3D) virtual simulation of treatment before it is performed, making it possible to visualize the final result even before it is done. In addition, appliances can be developed to help the clinician to achieve surgically the expected result. Digital planning begins with bidimensional (2D)[6,7] virtual simulations (digital smile design). These simulations in turn will guide the 3D virtual designs that are produced in specific

computer-aided design (CAD) software. With the virtual design finalized and approved by both the dentist and the patient, it is possible to produce guides for the execution of the procedures, increasing the predictability and effectiveness of the results through computer-aided manufacturing (CAM).[8]

FIGURE 1 2D facially driven smile frame showing the need for surgical crown lengthening

Digital quality control consists of comparing the final result of the treatment with the initial simulation, allowing the professional to verify the effectiveness of the procedure, or if necessary to make adjustments to achieve the proposed objective. This control is done by scanning the final result and superimposing the 3D file of the virtual simulation of the treatment.[9] For instance, among the main advantages and reasons for the high success of nowadays aligners, is the possibility to examine the outcome before the start of the treatment and the possibility to compare the outcome with the initial proposition presented to the patient.[10]

These are two important concepts of modern digital dentistry because besides improving diagnosis, planning, and execution, they also generate a positive psychological impact on the patient by improving patient education, confidence, and motivation since they demonstrate a commitment by the team to deliver results respecting the preapproved simulations. In addition, they generate

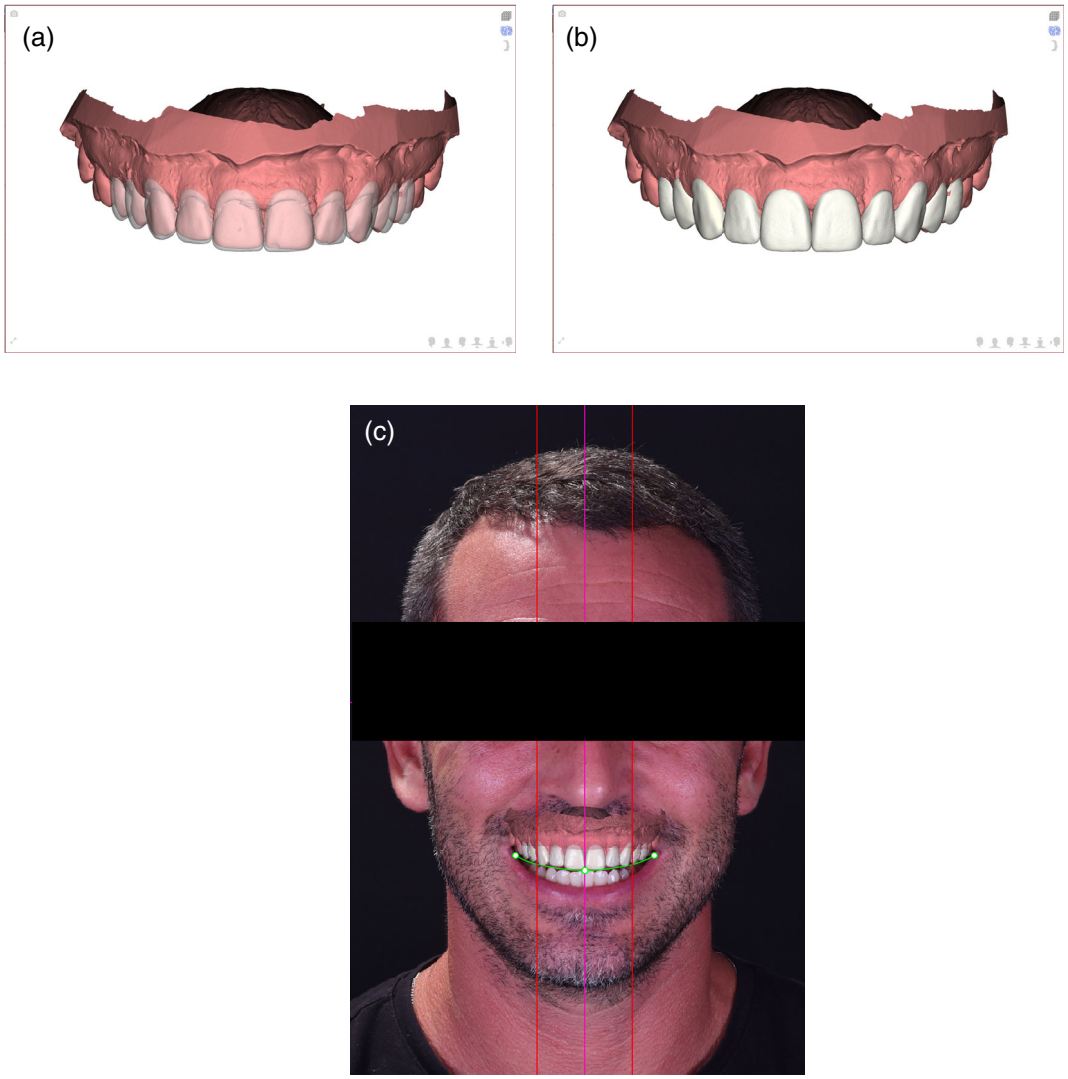

FIGURE 2 3D diagnostic wax-up performed and presented for the patient. (A) transparent diagnostic wax-up showing the amount of gingivoplasty required. (B) opaque diagnostic wax-up showing the planned teeth surface. (C) facially driven planning.

more efficiency and confidence for the professional, since the use of guides speeds up the process and makes the procedure less dependent on the operator's manual and artistic skills.

Nearly all specialties of modern dentistry can take advantage of this benefit, with these two concepts, as a rule, to achieve effective and predictable results.[11,12] This article aims to describe how these

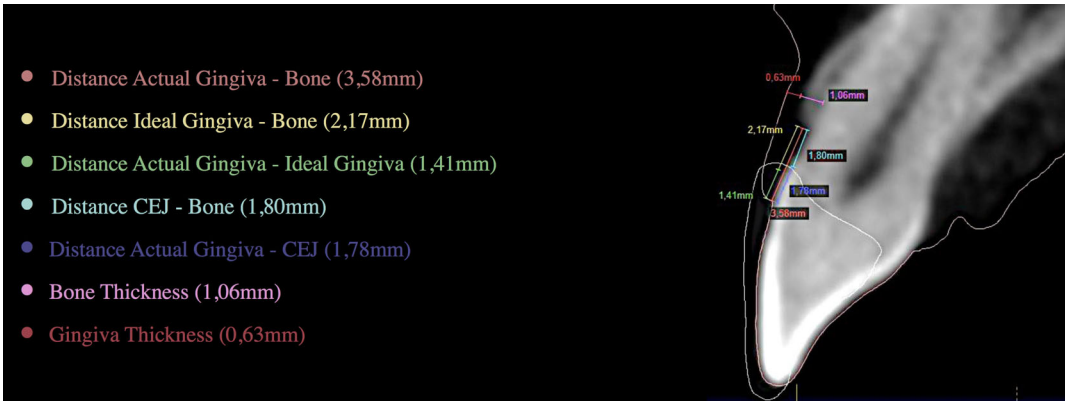

FIGURE 3 Perio Analysis showing the measurements performed for surgical procedure

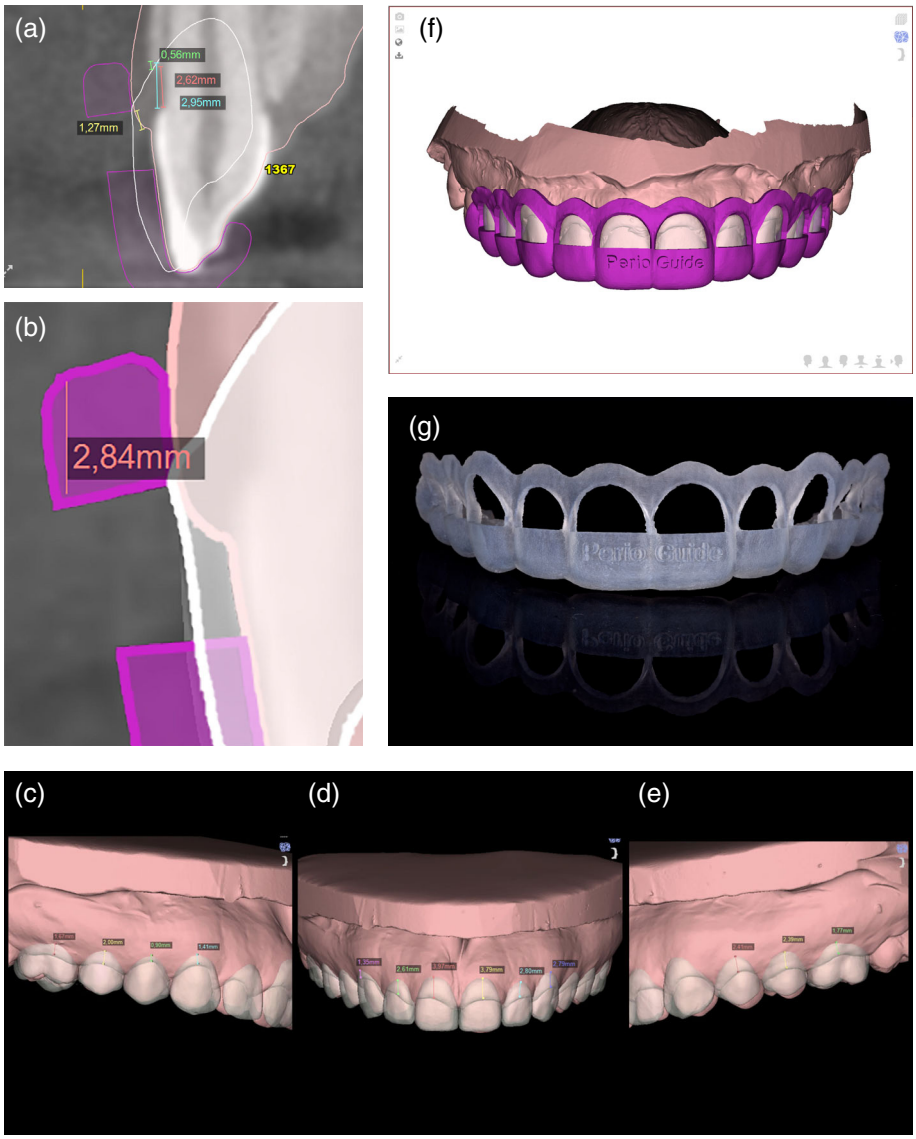

FIGURE 4 Double guide design and manufacturing. (A, B) Perio Analysis measurements determine the guide design. (C–E) Amount of gingivoplasty required. (F) The final design of the double guide. (G) Double guide printed and postprocessed

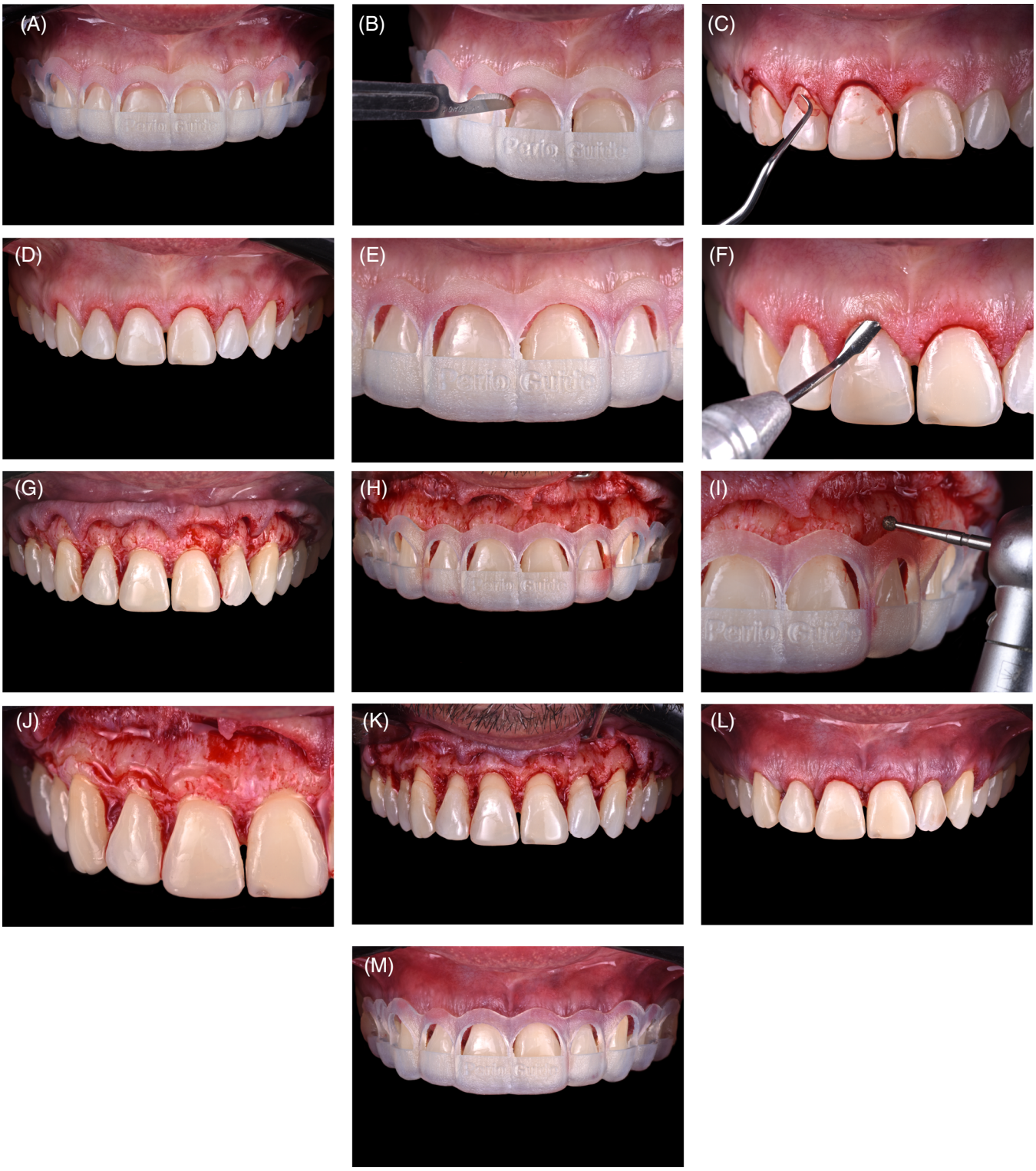

FIGURE 5 Surgical procedure with the double guide. (A) Evaluating the double guide fit on teeth and soft tissue. (B) Internal bevel incision performed with scalpel blade 15C perpendicular to the inner edge of the window of the guide, outlying the new gingival margin. (C) Soft tissue removal with a periodontal curette. (D, E) Upper arch after gingivectomy and confirmation through the guide. (F) Intrasulcular incision with an ophthalmologic scalpel blade. (G) Full-thickness mucoperiosteal flap elevated, note that the bone crest is mostly at the level of the CEJ. (H) Repositioning of the guide to perform the osteotomy. (I) Marking the osteotomy limit with spherical diamond bur according to the outer edge of the window of the guide. (J) Vertical bone level established. (K, L) osteotomy and osteoplasty finished and flap sutured. (M) Repositioning the guide and the comparison of planned and achieved gingival margin (quality control)

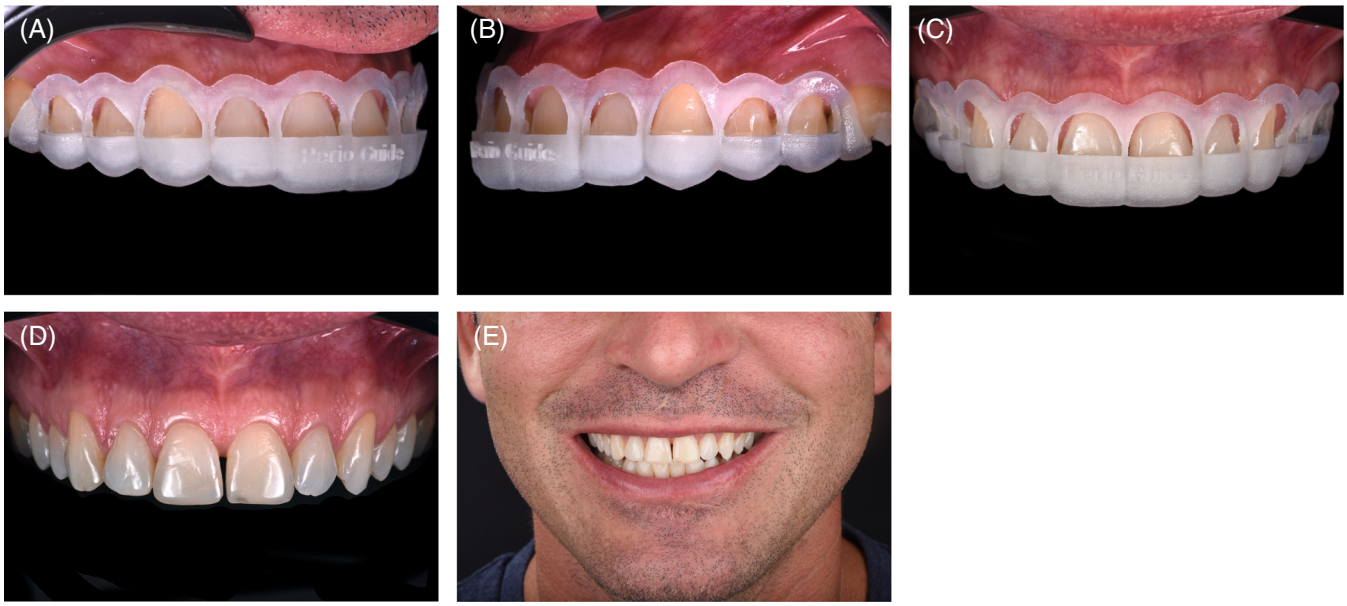

FIGURE 6 One-year follow-up. (A–C) Lateral and frontal view with repositioning of the guide confirming outcome obtained as planned (quality control). (D, E) Intraoral and extraoral view of the achieved gingival margin

concepts can assist treatments involving clinical crown lengthening in esthetic regions, promoting a digitally guided treatment, its integration with the face, with other interdisciplinary procedures, and leading the result closer to the initial planning.

2 | CASE REPORT

A 35-years old male patient was referred to the private dental office unsatisfied with the size of his teeth during smiling. After clinical and radiological examinations, photographs and intraoral scans were taken for data collection. A facially driven smile frame was designed using DSDApp (DSDApp LLC), which revealed the need for surgical crown lengthening to improve the smile appearance (Figure 1). Therefore, a cone-beam computed tomography (CBCT) exam with lip retractor was required for the Perio Analysis and surgical planning.[13] By superimposing the clinical data, a digital patient was created and a crown lengthening double guide was planned using the NemoStudio software (Nemotec, Madrid, Spain). The 3D simulations were presented to the patient, which accepted the treatment planning (Figure 2).

2.1 | Perio analysis and surgical planning

Taking the 2D facially driven smile frame as a reference, a 3D digital diagnostic wax-up was designed. The following distances were measured on CBCT images: bone crest to the gingival margin (pretreatment biological width); cement-enamel junction (CEJ) to the gingival margin; CEJ to the bone crest; gingival and bone thickness. When superimposing the digital diagnostic wax-up with the CBCT scan, the following measurements were obtained: the distance from the cervical margin of the wax-up to the gingival margin (determining the amount of soft tissue to be removed) and the distance from the cervical margin of the wax-up to the CEJ (determining if bone removal is required). Thus, this analysis allowed to determine the need for gingivoplasty associated with osteotomy and whether the osteotomy could be performed with a flapless approach, or would require flap elevation (Figure 3).

2.2 | Crown lengthening guide design and manufacturing

Based on esthetic and biological parameters, the double guide was designed to orientate the posttreatment position of bone and soft tissue (Figure 4). Therefore, a window was placed contouring the cervical margin of the waxed-up teeth, in which the inner edge guided the gingivoplasty and the outer edge guided the height of the bone crest. The distance between the inner and outer edge was determined by the periodontal phenotype. For cases of thin-scalloped periodontium (type A1), the distance from the bone crest to the gingival margin should be about 2.0 mm. For thick-scalloped periodontium (type A2) a distance of 3.0 mm should be observed. For a rather flat-thick periodontium (type B), this distance increases to 4.0 mm, which should be respected so that there is no relapse of the gingival margin.[14] After the guide was digitally designed, a motivational mock-up was tested intraorally and the guide was printed with a biocompatible resin, postprocessed, and sterilized (Figure 4).

2.3 | Crown lengthening surgical procedure

The surgical procedure is shown in Figure 5. According to the patient phenotype, a 3 mm biological width was determined by the Perio

Analysis measurements. After evaluating the double guide fit on teeth and soft tissue, the inner edge of the guide delimited the new gingival margin. Once the gingivectomy was performed and the flap elevated, the outer edge of the guide delimited the osteotomy limit. During every step, the repositioning of the guide was used to evaluate the soft and hard tissues limit, according to the planning.

2.4 | Digital quality control

After the healing period, the quality control was obtained by adapting the double guide to the teeth, revealing the planned and achieved gingival margin (Figure 6). In addition, after 1-year, intraoral scans were taken and the preand posttreatment exams were compared and stored in cloud data for future comparisons (Digital Quality Control).

3 | DISCUSSION

The main factors for the success in esthetic crown lengthening procedures include the achievement and maintenance of ideal gingival margin levels and architecture, which are influenced by biologic requirements.[15] The digitally obtained double guide provides proper soft and hard tissues management and, therefore, reduces the chances of under-or overcontouring of these tissues, facilitating predictability, reproducibility, and long-term pleasant outcomes.[1] In addition, optimal fit, ease fabrication, and time-efficient procedure have been reported among the advantages of the technique.[1]

The facially driven and biologically oriented planning associated with the 2D simulation and 3D guide design allows the clinician to propose and perform a less operator-dependent procedure because the decision of how much and which tissues should be removed is oriented by the Perio Analysis measurements. Hence, the digital visualization of the patient gingival phenotype and biological width is mandatory, which can be obtained with CBCT exam with lip retractor and intraoral scan.

Once the procedure is performed, the comparison between the planned and achieved outcomes is essential for the follow-up. Therefore, the Digital Quality Control is proposed to assess the maintenance of the gingival level and relapse of soft tissue.

The use of a digitally designed double guide for crown lengthening has been successfully reported elsewhere.[1,16–21] However, further studies should evaluate the accuracy of surgical guides for crown lengthening procedures and the influence of several factors such as scanner protocol and systems, guide errors or misfits, different resins, 3D printers, and software systems.[17,18] In addition, clinical trials are needed to validate and confirm the reliability and repeatability of this technique.[18,19]

4 | CONCLUSION

The double guide for surgical crown lengthening allows the proper management of hard and soft tissues for achieving a predefined goal based on biological requirements and facially driven planning. In addition, the digital quality control allows the follow-up compared with the preoperative condition and planned treatment plan.

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DATA AVAILABILITY STATEMENT

No research data available

ORCID

Eduardo Mahn https://orcid.org/0000-0003-1950-3081
Hian Parize https://orcid.org/0000-0003-0205-5892

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