EDELWEISS PUBLICATIONS
OPEN ACCESS

https://doi.org/10.33805/2572-6978.140
Volume 4 Issue 1 | PDF 140 | Pages 4

Dental Research and Management

Case Report ISSN: 2572-6978

Digital Workflow for Periodontal Crown Lengthening in Treatment of Altered Passive Eruption: Case Report

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Citation: Umanzor VA, Romero HH, Kafati Z, Rodriguez A, Guifarro J, et al. Digital workflow for periodontal crown lengthening in treatment of altered passive eruption: case report (2020) Dental Res Manag 4: 27-30.

Received: Mar 13, 2020
Accepted: Jul 10, 2020
Published: Jul 17, 2020

Abstract

This paper describes the treatment of a patient diagnosed clinically and based on cone beam computed tomography images with excessive gingival display caused by altered passive eruption Type 1B. A digitally computer designed and 3-D printed surgical guide was fabricated for crown lengthening to provide periodontal esthetics. The combination of intraoral scanners and cone-beam computerized tomography images, and use of planning software, provides a very precise representation of the real conditions of the hard and soft tissues.

The design and fabrication of computer surgical guides can improve precision and predictability for surgical procedures and can be superior to conventional free-handed surgery in terms of efficiency and treatment outcomes. Surgical experience and general understanding of computer assisted systems and thorough knowledge of conventional protocols is mandatory to make routine use of these systems.

To select a treatment modality, the etiology must be clearly identified and the patient has to be informed of his options for treatment which for this condition are a gingivectomy or an apically positioned flap with or without osseous reduction determined by the type of altered passive eruption.

Keywords: Altered passive Eruption, Surgical stent, Digital workflow, Gingivectomy

Introduction

Excessive Gingival Display (EGD) can be considered one of the main concerns for patients regarding esthetics and its etiology has to be identified in order to define the ideal treatment plan. The gummy smile has been defined as a smile showing more than 1.5-2 mm of the gingiva and affects 7% of men and 14% of women world-wide [1]. Etiology varies, including gingival enlargement, Altered Passive Eruption (APE), vertical maxillary excess, anterior dentoalveolar extrusion, short upper lip, hyperactive upper lip, or a combination of the before mentioned factors [2].

In altered passive eruption, the Free Gingival Margin (FGM) is located more incisally or coronally over the enamel, resulting in short clinical crown length. The excessive gingival coverage of the anatomical crown is caused by retardation of the passive eruption phase of tooth eruption [3].

The distinguishing feature of Type 1 is a wide band of keratinized attached gingiva with an apical location of the mucogingival junction in relation to the alveolar crest. In subtype 1A, the distance from the Cemento-Enamel Junction (CEJ) to the bone crest is within the norm of 1.5-2mm, while in subtype 1B the CEJ is almost coincident with the alveolar crest [4]. In Type 2, the keratinized gingiva is narrower and the mucogingival junction closer to the CEJ, which could be attributed to a failure of active or passive eruption. Type 1B is the most commonly encountered, and has been termed altered active eruption, which is a failure in the active eruption phase [4].

Crown lengthening is a periodontal procedure used to expose the tooth structure for the purpose of reestablishing the appropriate supracrestal tissue attachment space [5].

The most recent development in digital production of surgical guides is based on the superimposition of Cone Bean Computed Tomography (CBCT) data and intra-oral scanning data. These guides are designed and fabricated using computer-aided design/computer-aided manufacturing technology with the use of printing or milling devices. These novel approaches improve positioning and accuracy of the surgical procedures [6].

Clinical Report

The patient presented to a private dental clinic for a crown lengthening procedure to treat her excessive gingival display from tooth 1.3 to 2.3 **(Figure 1).** Her diagnoses of gingival excess was established after the following examinations; periodontal probing, periapical radiographs, phenotype evaluation, cone-beam computed tomography scan for precise assessment of the osseous crest and its relation with the CEJ, for this purpose, radiographic markers were placed on each clinical crown and intraoral scans to obtain digital impressions of the maxilla, mandible and their occlusal relation for guide processing **(Figure 2).**

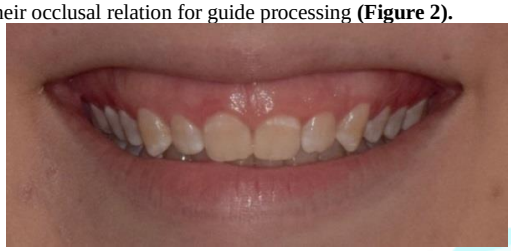

Figure 1A: Smile view.

Figure 1B: Frontal view.

Figure 1C: Upper close-up view.
Figure 1: Preoperative photograph.

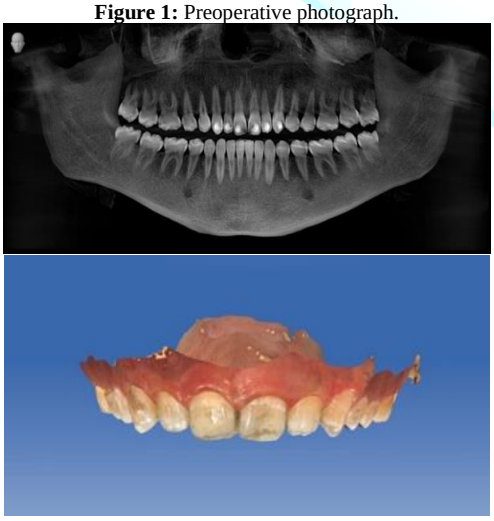

Figure 2A: CBCT initial exam.

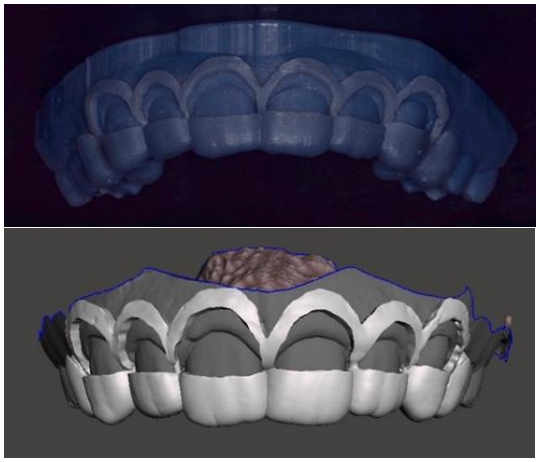

Figure 2B: 3D scanned diagnostic model.
Figure 2

The guide was fabricated using a 3-D printer through the polymerization of an ultraviolet- sensitive liquid resin and was designed defining the desired gingival margin and osseous crest position according to the registration of the digitalized models onto the CBCT scans. Using reference points CEJ to the crest leaving a 3mm distance between these two reference points. **(Figure 3)**. Surgical guide was fabricated using BlueSkyBio and Meshmixer software.

An hour prior to surgery, the patient was prescribed a dose of 875mg of amoxicillin and 125mg of clavulanate acid as a prophylactic antibiotic. Patient was also instructed to rinse for 1 minute using oral chlorhexidine 0.12% to minimize oral bacterial load.

Local anesthesia was administered with 4% articaine with adrenaline 1:100,000 to anesthetize the infraorbitary and nasopalatine nerves as well as local infiltration.

The tooth supported 3D printed surgical stent was delivered to verify adjustment and stability. And an internal bevel incision according to the gingivectomy guide was designed and followed Intrasulcular incisions at the papilla area and in the buccal aspect with the subsequent removal of the collar tissue **(Figure 4).**

A full-thickness mucoperiosteal flap was elevated on the buccal side to access the alveolar bone crest without compromising the papilla from 1.3 to 2.3. The osteotomy was performed to reposition the buccal crest 3mm apically from the CEJ, using a low speed bur #701 with copious irtigation using abundant saline solution. Evaluation of every tooth was assessed to assure 3mm of supracrestal attachment space using a dental probe. The flap was repositioned apically and suspensory continuous suture was placed **(Figure 5).**

The patient was evaluated for suture removal 14 days after the surgery **(Figure 6)** and follow-up examinations were performed at 2 weeks, 1, 3, 6 months and 1-year recall. Oral hygiene instructions and plaque removal were performed at each visit accordingly. Post surgical measures included ibuprofen 600mg every 8 hours for 7 days, 875mg of amoxicillin and 125mg of clavulanate acid for 7 days, chlorhexidine mouth rinse 0.12% 3 times a day for 21 days.

Patient was recommended to avoid brushing and rinsing during the first 24 hours, only consume soft foods for 1 week and avoid oral hygiene in the treated areas for 7 days. 1 year after surgery we can observe the stability, maturity and health of the periodontal tissues **(Figure 7).**

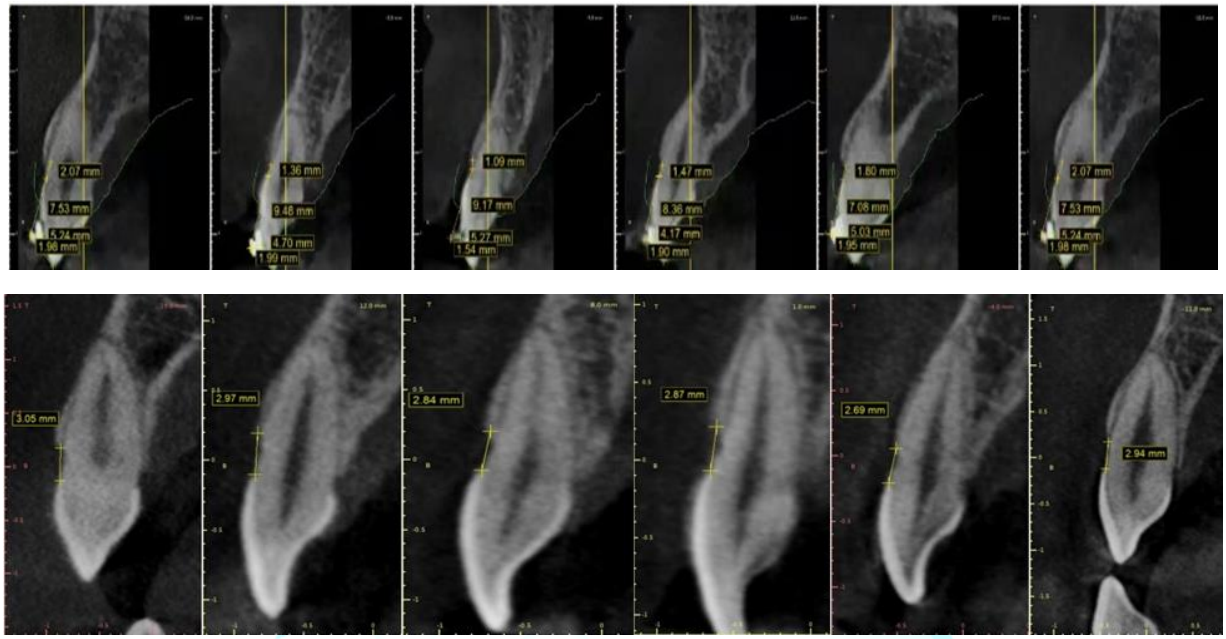

Figure 3: 3D printed model, surgical guide and CT measurements.

Figure 4A: Surgical guide positioned intraorally

Figure 4B: Gingivectomy and gingivoplasty.

Figure 4

A

B

A: Full-thickness flap elevated B: Osteotomy and osteoplasty C: Flap repositioned.

Figure 5

Figure 6: Postoperative two weeks follow-up.

Figure 7A: Smile view.

Figure 7B: Frontal view.

Figure 7C: Upper close-up view.
Figure 7: 1-year Postoperative photograph.

Discussion

The combination of intraoral scanners and cone-beam computerized tomography images, and use of planning software, provides a very precise representation of the real conditions of the hard and soft tissues. The design and fabrication of computer surgical guides can improve precision and predictability for surgical procedures and can be superior to conventional free-handed surgery in terms of efficiency and treatment outcomes. Surgical experience and general understanding of computer assisted systems and thorough knowledge of conventional protocols is mandatory to make routine use of these systems.

Although, additional in vivo studies are necessary to justify the increase in costs of computer guided techniques in comparison to conventional protocols verified in final treatment outcomes, these virtually planned and manufactured surgical guides seem promising for periodontal plastic surgery.

To select a treatment modality, the etiology must be clearly identified and the patient has to be informed of his options for treatment which for this condition are a gingivectomy or an apically positioned flap with or without osseous reduction determined by the type of APE [7].

Periodontal plastic surgery is used to achieve gingival symmetry and harmony and therefore obtain esthetic outcome that meets the patient´s demands. Esthetics-related crown lengthening surgery aims to provide adequate clinical crown length, reduce gingival display, as well as meet the patients esthetic demands [8].

The introduction of Computer-Aided Design and Computer-Aided Manufacturing (CAD-CAM) techniques has helped surgeons perform more precise and predictable surgeries that contribute to improved esthetics, lover operative times and reduce morbidity [9].

Summary

This article describes the treatment of a patient diagnosed with excessive gingival display caused by altered passive eruption type 1B with the use of a digitally designed and 3-D printed surgical guide for crown lengthening periodontal plastic surgery.

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