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Crown lengthening procedure based on cone beam computed tomography measurements

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Abstract

This case report describes about a patient's desire and visualization of a pleasant smile for whom esthetic crown lengthening is indicated due to excessive gingival display. The Cone Beam Computed Tomography (CBCT) scan was used as a measurement using smile design principle which provided a reference for flap surgery and osteotomy procedure. A 6 months post-surgery follow up was obtained.

Keywords: Crown Lengthening Procedure, CBCT

Introduction

Esthetic is an essential part of contemporary dental practice, and a pleasing smile depends on gingival tissue architecture and dental characteristics. The smile esthetic is subjective, but the evaluation remains objective. Smile line is an imaginary line that follows the lower margin of the upper lip and usually has a convex appearance.

Excessive display of the gingival surface characterizes the gingival or gummy smile. Gummy smile has been defined as a non-pathological condition causing esthetic disharmony in which more than 3 mm of gingival tissue is exposed when smiling^[1]. Thus, a continuous gingival margin display of 3 mm during natural smile is often considered desirable.

Establishing correct diagnosis taking into consideration variables such as gender, age and periodontal health is important. Once the abnormality in the smile level is determined, the establishment of the gummy smile etiology is essential.

The possible causes are excessive maxillary growth, short upper lip, or abnormal eruption of maxillary anterior teeth. Subsequently, short tooth syndrome (STS) has been defined as a condition caused either by excessive gingival display or lack of incisal tooth display during smiling or a low smile line^[3], which is a cause of common esthetic concern for many patients^[2].

Some of the causes of gummy smile includes deep bite and overeruption and compensatory eruption (wear/erosion) in teeth, as well as gingival hyperplasia and altered active/passive eruption in gingiva. The condition may be due to a discrepancy in at least one of the following anatomic entities: maxilla^[3], lip^[4], gingiva^[1], or teeth^[2], though more than one of these entities is often involved.

Differentiating between entities is necessary to define the treatment and to enable the involvement of the various techniques required. The treatment plan is even more critical when the etiology is of mixed origin. Clinicians often encounter the need for crown lengthening and have to make treatment decisions taking into consideration how to best address the biological, functional and esthetic requirements of each particular case.

Clinical crown lengthening refers to procedures designed to increase the extent of supragingival tooth structure for restorative or esthetic purposes^[5].

Esthetics-related crown lengthening surgery aims to provide adequate clinical crown length and diminish gingival display^[6].

Gingivectomy or esthetic crown lengthening with bone resection is often required to increase the clinical crown length and achieve acceptable esthetic outcomes^[6].

The decision whether to perform bone resection is largely dependent on the location of the alveolar bone crest in relation to the cemento-enamel junction.

Moreover, a 3-mm distance from the alveolar crest to the gingival margin on the facial aspect is necessary for periodontal health, allowing for 2 mm of biological width and 1 mm for sulcus depth [7].

The appropriate amount of alveolar bone to be removed needs to be visualized by a clinician. However, the lack of a guide for bone resection may result in unpredictable post treatment esthetics. Some authors suggest the use of digital workflow to fabricate surgical guide based on a digital wax-up [6-10]. However, these devices are often imprecise [10].

The use of CAD-CAM techniques has helped surgeons perform more precise and predictable surgery. However, this technique requires additional time before surgery and increases the patient's cost.

In this report, the CBCT scan was used to locate the cementoenamel junction, in which this technique eliminates the need for diagnostic waxing when restorative treatment is not indicated

This clinical report discusses about a patient with gummy smile due to short upper lip and passive eruption. Regardless of the various techniques that have evolved and are available today, the present technique provided a simplified method of designing smile relying on the existing tooth morphology and anatomy using CBCT scan measurement to locate the cementoenamel junction and to locate the correct osseous topography for a more predictable outcome. The photographs of the smile were recorded for the standardization of the smile

design.

Case Presentation

A 28 year old male patient presented to the Department of Periodontics at Nair Hospital Dental College, Mumbai, Maharashtra with a chief complain of "gummy smile" (Figure 1) and desire of its correction. On clinical examination, it was found that more than 4 mm of gingival band was exposed from the gingival margin to the lower border of the upper lip from upper right premolar to upper left premolar. There was no significant medical history whereas there was a history of tooth restoration in 37 done three months earlier.



Fig 1: Pre-operative smile showing excessive gingival display



Fig 2: Pre-operative smile view

There were no significant findings on the extraoral examination. A lateral cephalometric analysis confirmed absence of vertical maxillary excess.

The maxillary lip length was 20 mm, the gingival display at rest was 4 mm. The clinical crown lengths of central incisors was 8 mm, lateral incisors was 7 mm and canines was 7 mm. The gingival phenotype was assessed and determined to be thick.

The CBCT scan was used to analyze the level of the alveolar bone crest in relation to the cementoenamel junction. Based on sagittal cross section of the maxillary anterior sextant, the distance between the bone crest and the CEJ was at maximum 1.5mm (Figure 3). The CBCT scan also showed that the patient had a thin buccal cortex. The clinical presentation of the shape of the teeth had a squarish appearance as a result of altered passive eruption with low bone crest level. Optimal tooth proportions "golden proportion" was kept as an objective means to determine the correct position of the osseous topography clinically. Clinical measurements are performed directly on the teeth with the periodontal probe

(UNC 15) to confirm and verify the amount of osseous tissue to be removed.



Fig 3: Distance from the Cementoenamel junction to facial bone crest as measured

Bone Sounding

The level of the alveolar crest was determined prior to esthetic crown lengthening by bone sounding following the administration of a local anaesthesia. The bone sounding is done to determine the level of the alveolar crest and to assess

the need for osseous contouring prior to flap reflection. The periodontal probe (UNC 15) was utilized to penetrate the mucosa until contact was made with the underlying bone (Figure 4).



Fig 4: Transgingival probing to determine the location of alveolar crest.

Surgical Procedures:

Local anaesthesia 1:200000 lignocaine was administered via local infiltration. Bleeding points were marked at the point of incision line with the periodontal probe. Clinically, the CEJs were identified by tactile feel using periodontal probe. An internal bevel incision was made from right to left first canine teeth with a #15 blade to remove the excess gingiva to the level of the anticipated CEJ. The gingival tissue was removed using a Gracey curette while visualizing the new crown lengths (Figure 5). The second incision sulcular was made (Figure 6). A full thickness mucoperiosteal flap was raised by blunt dissection to fully expose the osseous crest. The flap was then raised and all granulation tissue and tissue tags were removed and any exposed root surfaces were debrided (Figure 7). There was minimal manipulation of interproximal papillary tissues. After debridement, sling suture was given using resorbable braided (polyglactin 3-0) suture material and hemostasis was ensured (Figure 8). The periodontal dressing of coe-pack was placed (Figure 9).



Fig 7: Mucoperiosteal flap reflection



Fig 8: Sling Sutures



Fig 9: Periodontal Dressing with Coe-pack



Fig 5: Appearance of incision outlining the gingival collars prior to internal bevel incision



Fig 6: Exposed crown margins and root surfaces after the internal bevel incision

After surgery, antibiotics Amoxicillin (500 mg) and an analgesic (Paracetamol 500 mg and 50 mg Diclofenac Sodium) was advised to take for 3 times/day for the 3 days and to rinse with 0.12% Chlorhexidine Gluconate twice daily for 10 days. On the 10th post-operative day, sutures were

removed. Healing was uneventful (Figure 10). The patient then presented for recall at 4 weeks, 3 months and 6 months. After three months (Figures 11 and 12) there was a reduction in the amount of gingival display on smiling when compared with the pre-operative levels and showed satisfactory outcomes at the 6 months follow-up (Figures 13 and 14)



Fig 10: Ten days post-operative



Fig 11: Intraoral view 3 months post operative



Fig 12: Smile view 3 months post operative



Fig 13: Intraoral view 6 months post operative

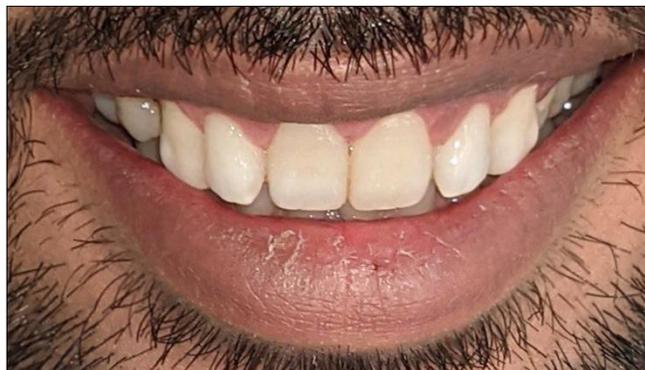


Fig 14: Smile view 6 months post operative

Discussion

Several authors have described surgical techniques developed to overcome the challenges that are present when attempting to perform aesthetic crown lengthening on multiple maxillary teeth.

The treatment for gummy smile due to altered passive eruption aim to achieve reduction in the excess gingival tissue, full exposure of the anatomical crowns, balance of the gingival contours, re-establishment of the appropriate biological width^[5, 6], and improvement of the possibly associated excessive gingival display^[11].

In this report, the CBCT scan was used to locate the cemento-enamel junction. The technique eliminates the need for diagnostic waxing when restorative treatment is not indicated.

In some patients, when maxillary anterior teeth have incisal wear followed by compensatory eruption, the cemento-enamel junction is more coronal than expected. Performing esthetic crown lengthening in such patients based on a diagnostic wax-up can cause excessive removal of soft tissues, which may in turn result in root exposure, mandating a restorative treatment that was otherwise not indicated^[10].

The use of a surgical template designed to be temporarily adapted to the maxillary anterior teeth can vary in fit and position, become unstable, and dislodge during treatment, resulting in a loss of critical referencing measurements. The template technique requires additional cost and office visits toward its fabrication prior to performing the aesthetic crown lengthening procedure^[12].

Several studies have confirmed that an ideal tooth proportion of approximately 80% (width/length) within maxillary anterior dentition exists^[13, 14]. Sterret, Spear, Kokich, Chiche, and others have previously reported the concept of utilizing individual tooth proportion in lieu of the “golden proportion” as an objective means when achieving ideal aesthetics^[14, 15-17]. This 80% tooth proportion value allows one to mathematically determine objective measurements when re-establishing the tooth width and length relative to the gingival architecture of the supporting periodontal tissues.

The pre requisite to determining the proper tooth proportion is an intact incisal edge of the tooth. If the incisal edge is worn or altered, it needs to be restored prior to proceeding with measurement.

Using a precise outline of the anatomical cemento-enamel junction location of the patient can compensate for the variability among patients and reduce the chance of under- or over-contouring of hard and soft tissues. Also, CBCT analysis provide reference for both gingival and bone resection during crown lengthening surgery, which facilitates the surgical procedure and increases treatment predictability.

This case report suggest that gingival display in altered

passive eruption patient can be significantly reduced by performing routine esthetic crown lengthening procedure, with concomitant reduction in gummy smile resulting in high patient's satisfaction. However, additional clinical studies are needed to confirm the reliability and repeatability of this technique.

Conclusion

The primary objective of aesthetic crown lengthening surgery is to enhance the gingival contour, form, and position of the attachment apparatus relative to individual tooth proportion within the oral region known as the aesthetic zone. Aesthetic crown lengthening surgery results in high levels of patient satisfaction and predictable and stable outcomes in the short term. This clinical report describes a method for esthetic crown lengthening based on the cemento-enamel junction level, which was outlined using CBCT which allowed the surgeon to perform aesthetic crown lengthening procedure in a successful and more predictable manner in terms of clinical outcomes and maintaining it for 6 months.

Conflict of interest: There are no conflicts of interest.

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