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Aesthetic Management of Destroyed Maxillary Anterior Teeth Treated Through Crown-Lengthing and All-Ceramic Crowns

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Case Report

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Abstract: This case report describes a successful multidisciplinary approach used to preserve the existing tooth structure supporting both hard and soft tissues. The applied approach improved the smile aesthetics of a young female patient with excessively decayed crowns, asymmetric mesio-distal width, and unequal gingival margins of the maxillary anterior teeth. The combined treatment of aesthetic crown lengthening, frenectomy, and restorative dentistry were conducted using zirconia computer-aided design and computer-aided manufacturing (CAD/CAM) crowns. Clinical findings after a 2-year follow-up period confirmed the stability of the gingival margins and absence of adverse effects, such widening of the periodontal ligaments.
Keywords: crown-lengthening, gingival biological width, periodontal-surgery, aesthetic, zirconia, all-ceramic.

INTRODUCTION

When caries are deep or extensive and extended subgingivally, a dentist may opt to use crown-lengthening surgery to expose the solid tooth structure and facilitate restorative therapy given the sufficient amount of clinical crown length gained [1]. Aesthetic crown-lengthening surgery may include a number of surgical techniques, all of which aim to improve the aesthetic appearance, emergence profile, and gingiva of the teeth by creating an adequate clinical crown-length [2]. Similar to other elective surgeries, crown-lengthening surgery may be indicated to increase patient's satisfaction where healthy and sound indicated areas are a prerequisite. Aesthetic crown-lengthening is typically performed to treat elongated teeth caused by periodontal disease, gingival overgrowth, or recessions [2, 3].

Three main scenarios could be corrected by crown-lengthening of sound maxillary anterior teeth: excessive gingival exposure or a "gummy smile" appearance, asymmetry of tooth length with gingival margins, and altered or incomplete passive eruption "short teeth" appearance [2].

Crown-lengthening procedures can be classified as (I) gingival reduction only (bone removal not required by (a) gingivectomy or (b) gingival flap surgery) or (II) Mucoperiosteal flap with ostectomy—bone removal required; (a) One-stage procedures, which require one of the following: 1, Flaps, ostectomy, apical positioning 2, Flaps, ostectomy, gingivectomy, positioning 3, Gingivectomy, flaps, ostectomy, positioning Or (B) Two-stage procedure, which requires: Flaps, ostectomy, and repositioning 4 to 6 weeks later—gingivectomy [4,5].

As dental materials continue to evolve, new all-ceramic materials with superior biocompatibility and mechanical properties, such as high flexural strength and fracture toughness, are continuously being introduced to the market; zirconia-based CAD/CAM systems have also been recently introduced [6-8]. This system has gained popularity in both the anterior and posterior segments for multiple indications. Zirconia is the strongest and toughest ceramic material available thus far. Clinical reports and anecdotal evidence demonstrate that zirconia-based restorations could be used for inlays, inlay-retained bridges, complete crowns, and FDPs [6-9]. This case report discusses a simple technique with basic surgical principles and wound healing associated with crown-lengthening surgery to improve the aesthetic appearance of the maxillary central and lateral anterior teeth. The use of zirconia CAD/CAM restoration for existing teeth in the aesthetic zone is also illustrated.

CASE REPORT

A 19-year-old single female patient was referred to the fixed prosthodontics department from the diagnostic clinic at the College of Dentistry, Jazan University; the patient's main complaint was grossly decayed maxillary frontal teeth, and she sought to

improve her dental aesthetics. The patient was medically fit.

Aesthetic analysis from the dento-facial perspective revealed a competent lip, inadequate maxillary tooth exposure at the rest position of the lip, and an excessive amount of gingival display during a relaxed smile. The smile line did not coincide with the curvature of the mandibular lip (Figure 1A). Intra-oral examination confirmed poor anterior maxillary dentition and a coronally located maxillary frenulum attachment with maxillary median teeth. The clinical crown lengths of the maxillary incisors were short and combined with a wide band of keratinized gingiva (Figure 1A). The mesio-distal width was disproportionate, and crown lengths 2–3 mm above the gingiva were destroyed (Figures 1A, 2A). Molar teeth showed deep caries and remaining roots on the right side, while dental caries was detected in both arches of many teeth. Periodontal findings indicated poor oral hygiene. A pretreatment periapical radiograph showed widening of the periodontal ligaments, which was associated with application of temporary glass ionomer fillings on teeth # 12,22,21,22. A pretreatment panoramic radiograph showed a normal anatomy of the tempro-mandibular joint, finely woven and dense trabecular bone pattern, and remaining roots in relation to teeth # 16, 46, & 47 (Figures 1B, 1C).

The treatment plan described by Rosenstiel *et al*. [3] was explained to the patient and implemented in phases. As an emergency treatment, multidisciplinary consultation was conducted, and RCTs were carried out on teeth #12, 11, 21, and 22 (Figure 2A). During these appointments, deep scaling with root planning was performed, and the patient was given oral hygiene instructions after measurements of the pocket depth and plaque indices of the maxillary anterior teeth using the William periodontal probe (Figure 2B). Then, a composite build-up of the RCT teeth was performed (Figure 2C), the roots of the teeth were prepared for fiber posts, and the cores were done (Figure 2D). Finally, the results of emergency and phase I treatment were evaluated. A post-operative radiograph obtained after RCTs of teeth #12, 11, 21, and 22 showed widening of the periodontal ligament space and incomplete fusion of the per-maxilla due to the high frenulum attachment (Figure 2D).

In phase II, periodontal surgery was conducted through frenectomy. Local anesthesia was administered, and the frenulum was engaged with a hemostat inserted to the depth of the vestibule (Figures 1A, 1B). An incision was made along the upper surface of the hemostat extending beyond the tip (Figure 3C). Then, a similar incision was made along the undersurface of the hemostat. The triangular resected portion of the frenulum was removed with the hemostat, resulting in exposure of the underlying fibrous attachment to the bone. The fibers were separated from the fiber origin with the periosteal elevator (Figure 3D). The surgical field was irrigated with saline solution and cleaned with sponge gauze until bleeding ceased. Finally, the labial mucosa was sutured to the apical periosteum (Figures 3E, 3F).

For crown-lengthening, the pockets were initially probed to check their depth and ensure that they did not extend beyond the muco-gingival junction. Then, an adequate amount of local anesthesia was injected. A pocket marker or periodontal probe was used to outline the base of the pockets with a small bleeding point. These marks delineated the pocket wall to be removed. The pocket marker was placed into the pocket and held parallel to the tooth. When the base of the pocket was reached, the tissue was marked (Figures 4A, 4B). Once the bleeding points had been established, they formed a dotted line to serve as outlines of our incisions, which were made and begun on the most terminal tooth to be continued until completion (Figures 4B, 4C). Incisions were made using a scalpel or gingivectomy knife (Figure 4D). The heel of the knife was used for the primary incision, which began just apical to the bleeding points. The blade was held in such a manner that the incision was as close to the bone as possible for total pocket removal and a tissue bevel was produced at 45°. The blade must pass fully through the tissue to the tooth (Figure 4D).Orban knife was used to free the tissue interproximally. It was placed interdentally and buccally at a 45° angle until the tissue was freed. The knife was also engaged to the tooth to free the tissue at the line angle. Thereafter, the tissue was removed using heavy scalars (Figures 4E, 4F). A curette was used for scaling and root-planning to remove residual granulation tissue, calculus, and soft cementum (Figure 4G). After controlling bleeding and achieving hemostasis (Figure 4H), the periodontal pack material was mixed, prepared according to the manufacturer's instructions, and applied to cover the gingivectomy wound (Figures 4I, 4J). The patient returned for follow-up after 1 week for dressing and suture removal and did not report any complications from the past week. Upon examination, the tissue showed good healing without inflammation. Finally, the sutures were removed (Figure 4K).

In phase III, composite build-ups were prepared until the proper contours were reached (Figure 5A). Preparation of teeth #12, 11, 21, and 22 were done, and a maxillary final impression was made with additional silicon (Virtual, Ivoclar Vivadent, Lichtenstein) using the double-mixing technique. Shade selection was performed using the digital shade guide of VITA System 3D-Master (Vita Easyshade(R) Compact, Vita, Germany) (Figure 5B). Provisional crowns were constructed from Success SD (PROMEDICA NEUMUNSTER, Germany) and cemented with temporary cement (Temp-BondNT, Italy). Pouring the final impression with CAD/CAM special improved stone, die preparation, ditching, and finish line exposure

were performed. The master maxillary cast was mounted manually using a Di-Lok tray (Di-Equi Dental Products, Wappingers Falls N.Y). Zirconia cores were constructed, and then tried-in on the prepared teeth. Porcelain build-up was done using VITA VM(R) 9 (VitaZahnfabric /Germany). All laboratory procedures were performed according to the manufacturer's instruction. The final contours of the porcelain build-up over the zirconia cores were of the proper shape, contour, and colors. The fits of individual crowns, occlusal adjustments, lateral movements, and protrusive movements were checked before glazing of the crowns. Glazed crowns were cemented with Rely X, TM, Unicem AppliCap Resin Cement (3M ESPE, Germany). Final treatment outcomes in terms of function and aesthetics satisfied the patient and the interdisciplinary team. To date, the restorations have been in function for 2 years without any complications (Figure 5D).

In phase IV, the patient was scheduled for continuous and regular follow-ups. During these visits, the team noted excellent gingival conditions and crown contours. Post-operative radiographs obtained after 2 years showed a good relationship between soft and hard tissues when smiling (Figures 6A&B), while periapical, and panoramic are presented in (Figures 6C &D). The patient showed excellent physical and mental health with noticeable improvements in self-esteem.

Fig-1: Pre-operative clinical and periapical and panoramic views

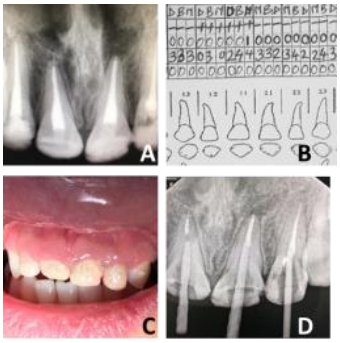

Fig-2: Radiographical view, periodontal charting, intra-oral view after RCT and with fiber post

Fig-3: During and after frenctomy

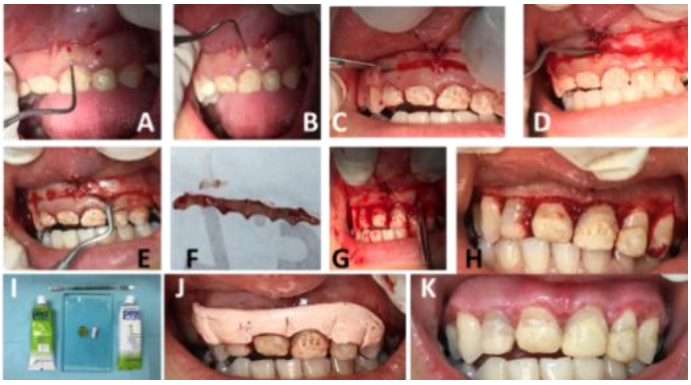

Fig-4: During and after crown-lengthening procedures

Fig-5: After proper composite build-up and teeth preparation, shade selection, laboratory constructions and intra oral cementation

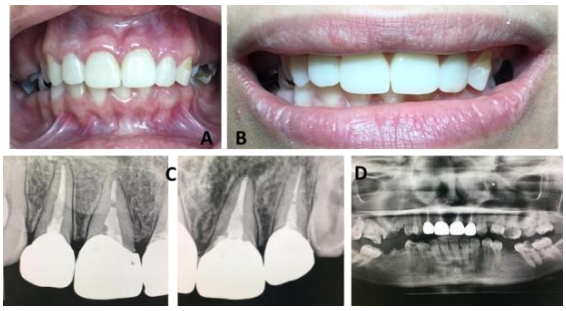

Fig-6: Intra-oral and radiographical views after two-year follow-up

DISCUSSION

Lengthening the crown of a tooth with minimal supragingival tooth structures may involve additional surgical removal of tissues for many indications and advantages, such as aesthetic (emergence profile) and functional concerns, gingival biological width (biological membrane, dento-gingival attachment), and ferrule length [10,11].

One of the main disadvantages of surgical crown-lengthening in maxillary anterior teeth is the potential of recession of the gingiva and trauma to the surrounding tissues [3]. The margins of any restoration or crown are located with-in the gingival biological width area, which may induce gingival inflammation, loss of connective tissue attachment, and unpredictable bone loss. Clinically, these issues could manifest as gingival bleeding, periodontal pocket formation, and gingival recession [12]. The tissue must retain a state of health and the proper clinical conditions of teeth during follow-up appointments. This state can be established by combining crown-lengthening with frenectomy surgery because the presence of an abnormal frenulum could result in gingival rescission, diastema formation and accumulation of debris by reflection, and opening of the sulcus [3, 5]. In the current case, from the time of crown-lengthening surgery, to the preparation appointment, and final impression, the maxillary teeth remained healthy without any sign of disease after frenectomy surgery (Figures 5A, 5B). At the 2-year follow-up, the periodontium around the individual crowns remained healthy without pocket formation or recession (Figures 6A, 6B).

Different approaches in the restorative dentistry field have recently been developed to treat difficult cases associated with the asymmetry, shape, position, width/length proportion, alignment, and color

of anterior teeth [6]. CAD/CAM ceramic materials show excellent biological, clinical, physical, and mechanical performance. Aesthetic dentistry frequently entails balancing aesthetic and functional requirements [13]. Patient requests for more aesthetic and biologically safer materials have led to increased demands for all-ceramic restorations [14].

The clinical significance of the treatment in this case is preservation of the decayed teeth by crown-lengthening, which means reduced costs associated with other treatment options. Good relationships among the size, contour, length, and mesio-distal width of the maxillary frontal teeth are also created. Finally, durable biocompatible zirconia CAD/CAM separated crowns can exist in harmony with existing occlusions.

CONCLUSIONS

Complicated clinical crown lengths and widths, especially in the maxillary aesthetic zone, can be treated by an interdisciplinary approach involving RCTs of short teeth followed by surgical crown-lengthening. This approach can provide the desired emergence profile, ferrule effect, and required biological width. Periodontal surgery, such as frenectomy of the gingival tissue, can also aid in healing, improve dental aesthetics, and minimize recurrence [15]. The advantages of all-ceramic zirconia are multifold: they create a maintainable healthy periodontal environment, improve the facial appearance, and restore the normal size of teeth in harmony with the existing occlusion. Such an approach can be considered to save both the natural tooth and its supporting tissues. It can also relieve the patient of the mental stress of tooth extraction, especially at a young age.

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