

"Crown-then-Graft": A Novel Approach to Optimize Teeth for Crown Placement and Root Coverage Procedures. A 5-year Case Report

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Cobi Landsberg, DMD Periodontology, Private Practice, Tel Aviv, Israel

Nitzan Fuhrer, DMD General Practitioner, Private Practice, Tel Aviv, Israel



Correspondence to: Dr Cobi Landsberg 53 Gordon Street, Tel Aviv, Israel; e-mail: Cobi@landsberg.co.il; fax: +972 3 523 5665

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Purpose: The presence of a treatable gingival recession in teeth ready for crown preparation requires a combined restorative-periodontal effort to achieve all biologic and esthetic goals. This needs an ideal artificial crown proportion and a harmonious gingival architecture. Traditionally, a root coverage procedure is initially performed followed by final crown preparation and cementation. However, during the prosthetic phase, irritation to the grafted delicate tissue may be followed by recession and exposed crown margins. To minimize prosthetic irritations, the "crown-then-graft approach" (CTGA) is suggested in which the root coverage procedure is performed after final crown preparation.

Methods: After definitive crown preparation and impression taking of the left maxillary incisor, an acrylic crown with flat marginal profiles was temporarily cemented into the patient's mouth. Root coverage procedures were implemented using a combined connective tissue graft and a coronally advanced flap. No additional tooth preparation and impression taking were performed. After 6 months, a final crown, fabricated from the previous impressions, was cemented.

Results: Initially, the grafted tissue margins completely covered the root and 1–2 mm of the temporary crown margins. At 12 months post-surgery and 6 months post-definitive crown cementation, the gingival margins slowly receded, reaching the ideal position. Complete root coverage was maintained for the next 5 years.

Conclusions: The CTGA may minimize tissue irritation after root coverage in teeth designed for combined crown preparation and root coverage procedure, and may account for long-term marginal tissue stabilization.

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Introduction

An important concern in dentistry is esthetics. Harmonious and symmetric tooth alignment with a consistent shape, size, and color is essential, and the importance of harmonious gingival morphology has been emphasized.¹ A problem faced by dentists and patients is gingival recession of the soft tissue,^{2,3} which can result in unfavorable esthetics,⁴ increased root caries susceptibility⁵ and dentin hypersensitivity.⁶

Numerous surgical techniques have been introduced to correct labial and gingival recession defects, including surgical flap procedures, such as the coronally positioned flap,⁷⁻⁹ and the laterally sliding flap¹⁰. This also includes procedures that use graft materials in combination with flap operations, such as subepithelial connective tissue graft,¹¹⁻¹³ enamel matrix derivatives,^{12,14} bio-absorbable, or nonresorbable membrane¹⁵ and acellular dermal matrix.^{13,16}

These techniques have been evaluated in clinical studies.17,18 The depth of the defect has been measured preoperatively and after 6 months, or at a later follow-up examination. The results, in terms of mid-facial root coverage, have been expressed as the percentage of the original covered defect, or as the percentage of defects with complete coverage. Mean root coverage of 70-80% is the most common. Up until the early 2000s, complete root coverage was achieved in about 50% of the treated defects.¹⁸ However, with the development of advanced techniques and regenerative materials, a higher predictability (close to 95%) has been shown.17,19-21

Attempts have been made to identify factors that influence the outcome of root coverage procedures.²²⁻²⁵ A scoring system, used to evaluate the esthetic outcome, depends on final color and tissue blend.²⁶ However, information relating to the selection of the best procedure for each individual is still unavailable. The choice may become more confusing when the recession is combined with a cervical lesion that disrupts the cementoenamel junction. This necessitates creating a less favorable surface (of restorative material) for gingival adaptation. Different approaches that demonstrate various amounts of root coverage have been proposed, such as only the coronally advanced flap (CAF), CAF plus resin-modified glass ionomer or resin composite, or only the subepithelial connective tissue graft (SCTG) or combined with CAF or resinmodified glass ionomer. The advantage of restoring the cervical lesion before implementing the root coverage procedure has been emphasized. A cervical restoration, if correctly planed and performed, does not have a negative effect on the degree of root coverage, but significantly improves the esthetic outcome and reduces dental hypersensitivity.23,24,27-32

In the esthetic zone, interplay between the surgical and prosthetic steps may become even more critical when a tooth is designed for both root coverage and crown preparation. The conventional approach is to first implement the root coverage procedure, and only after marginal tissue stabilization, prepare the tooth, take impressions, and cement the final crown. However, during tooth preparation and impression taking, irritation

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to the marginal gingiva can occur.³³ This in turn could be responsible for marginal tissue recession and for the intracrevicularly placed crown margins to become visible within time.³⁴⁻³⁶

In this article, a different approach is proposed to minimize tissue irritation and recession. The final crown margins are prepared first, followed by the final impression for the fixed crown, placement of the provisional crown, and then implementation of the root coverage procedure. After tissue maturation, the provisional crown is replaced with the final crown, without any additional tooth preparation and impression taking. A clinical case report is presented that demonstrates implementation of this "crown-then-graft approach" (CTGA).

Case report

A 35-year-old woman came to the dental practice with a complaint of gingival recession and dark appearance of the associated exposed root of the left maxillary incisor. She wished to reverse the recession and to regain esthetic contour and gingiva color. Clinical examination revealed an ill-fitted crown with bulgy contours and a v-shaped recession 3 mm deep and 5 mm wide (Fig 1). The periodontal condition was healthy in the neighboring teeth and other parts of the mouth.

Radiographic examination showed physiological crestal profiles on the left maxillary incisor and neighboring teeth (Fig 2). The patient was advised to replace the old crown with a new one and to have a root coverage procedure using the CTGA.



Fig 1 At presentation. Note ill-fitting crown margins and cleft development associated with the left maxillary incisor.

Fig 2 At presentation. The periapical radiograph demonstrates normal crestal profiles.



Prosthetic procedure

The objective was to achieve definitive ideal tooth preparation. The buccal finishing line was prepared ½ to 1 mm apical to the gingival line at the adjacent intact central incisor. Interproximally, the finishing line was placed ½ to 1 mm in the intracrevicular region, since this area would not be modified during surgery. A minor correction was made to the axial walls to provide the necessary restorative space that was consumed by the



CASE REPORT







Fig 3 (a to c) The old crown is removed and the tooth re-prepared with its labial margins located approximately ½–1 mm apical to the planned gingival marginal line. Thereafter, the interproximal margins are further prepared apically, and a double cord retraction technique is used, followed by a polyvinyl-siloxane (PVS) (Elite HD, Zhermack, Badia Polesine, Italy) impression.



Fig 4 Provisional crown with its margins flat at the labial aspect. Note the location of the crown margins, which respects the symmetry of the desired gingival line.

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buccal abrasion of the root. A double cord (SIL Trax AS No. 7, Pascal International, Bellevue, WA, USA and Ultrapak #000, Ultradent Products, South Jordan, UT, USA) impression technique was implemented (Figs 3a to 3c).

On completion of the prosthetic procedure, a temporary crown with a flat marginal profile was made in the laboratory. The crown was then relined with acrylic (Unifast Trad, Kasugai, Aichi, Japan), polished and temporarily cemented (Fig 4).

Root coverage procedure

It was decided to limit the surgical field to the involved central incisor to avoid potential damage to the almost ideal gingival contours on the neighboring teeth. Vertical oblique incisions were made at the mesial and distal line angles of the crown, extending up to a distance of approximately 3 mm apical to the mucogingival junction line. New surgical papillae were elevated by splitting the anatomical papillae, followed by full thickness flap elevation up to the mucogingival line, exposing the full extent of the exposed root. Horizontal splitting incisions of the flap were then performed to completely free the flap from muscle attachments and the underlying periosteum and to allow flap coronal advancement without tension.

The root was planed and smoothed with a periodontal curette and rotatory diamond finishing burs up to the recorded presurgical level of attachment. A thin connective tissue graft was harvested from the palate, then placed and fixed to cover the exposed root surface. After de-epithelialization of the adjacent papillae, the flap was coronally advanced







Fig 5 (a to c) A triagonal flap is elevated, the root planed, a connective tissue graft is placed and covered by the "over" coronally advanced flap.

over 1 to 2 mm of the acrylic crown margins, and was stabilized by 7-0 polyvinyl simple sutures at the vertical line incisions. A 6-0 polyamide (Ethilon, Ethicon,







Fig 6 At 1 week post-surgery. The advanced flap seems to incorporate well with the neighboring tissues. Sutures were removed the following week.



Fig 7 At 3 weeks post-surgery, the flap margins have migrated slightly apically.



Fig 8 (a to d) At 6 months post-surgery, the final crown was cemented.



Fig 9 The cemented final crown at 12-months follow-up.

Somerville, NJ, USA) sling suture around the tooth achieved further graft anchorage. No periodontal dressing was used (Figs 5a to 5c).

Postoperative treatment

Analgesics (Naproxen Sodium 275 mg (Teva, Petach-Tivka, Israel), four times daily) were prescribed for 3 days. The patient was instructed to abstain from brushing and flossing around the surgical area until suture removal (14 days), and to consume only soft food during the first week. She was also instructed to avoid any other mechanical trauma to the treated site. At 2 weeks, the patient was instructed to floss and use the coronally directed roll technique with an extra soft brush (Jordan, Norway). During the first 4 weeks, the patient used 0.2% chlorhexidine solution rinse (Tarodent, Taro, Haita, Israel) for 1 min twice daily. She was also recalled for professional supragingival biofilm control, weekly for the first 4 weeks, then monthly for the first 6 months. At 2 months post-surgery,

the patient was instructed to change to a stronger (still soft) brush (Elmex, GABA, Switzerland) for the coronally directed roll technique, and to complement plaque control with a single tufted brush (Paro 1003, Esro, Kilchberg, Switzerland), splayed and used to sweep along the gingival line of the crowned tooth.

Initial healing phase

At 1 week, healing appeared to be uneventful (Fig 6). However, to ensure a mature union between the flap and neighboring tissues, suture removal was delayed to the following week.

At 3 weeks, the flap margins migrated slightly apically. Scar tissue at the vertical incision lines and some overlapping of the flap margins on the adjacent distal papilla were noted (Fig 7).

Final crown placement

At 6 months, the provisional crown was replaced with the final zirconia crown (Lava Zirconia, 3M ESPE, Seefeld, Ger-







Fig 10 At 18-months follow-up, the marginal gingiva have regained a normal anatomic position.



Fig 11 At 2½-years follow-up, note the importance of esthetic crown-gingival contours in a high smile line situation.



Fig 12 At 4½-years post-surgery, a profile view demonstrating thinned gingival margins of the left maxillary incisor. An incisal fracture can be noted.



Fig 13 Radiographic view demonstrating physiological crestal profiles and a stable crown structure at $4\frac{1}{2}$ years post-surgery.

many), which was fabricated based on the pre-surgery impression. Final crown cementation (Panavia F 2.0, Kurary Medical, Okayama, Japan) of the crown was done 1 month later (Figs 8a–8d).

Follow-up

At 12 months, the gingival margins appeared uneven (Fig 9), and only at 18 months were the esthetic anatomic con-

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tours finally recaptured, as the gingival margins had migrated further apically (Fig 10). At 2½ years, the gingival topography at both central incisors appeared almost identical, with the nearly complete disappearance of the incision lines (Fig 11).

At 41/2 years, the patient had visited the office to repair a fractured incisal corner of the maxillary right incisor, at which time healthy, nicely contoured, but somewhat thinned gingival margins were noticeable on the left maxillary incisor (Figs 12 and 13). After 5 years, slight gingival marginal recession with exposition of the crown margins was noted. There was also some shadowing of the gingiva, reflecting the dark root surface underneath (Fig 14).

Discussion

In the presence of a normal periodontium, most of the intracrevicularly placed crown margins may become visible due to gingival recession, between 1 to 10 years after crown cementation.^{34,35} In many clinical situations this undesired outcome is related to overt violation of the biological width,37,38 ill-fitted crown margins,³⁹ plaque-induced gingivitis,40 or self-inflicted injuries, such as toothbrush abuse.^{41,42} However, even in the hands of an expert clinician, there are "silent" mechanical^{33,43} and chemical⁴⁴⁻⁴⁶ irritations that may be introduced to the most coronal part of the attachment apparatus during crown preparation, impression taking and crown cementation, which could result in immediate or late gingival marginal recession.



Fig 14 At 5-years follow-up, note the shadowing and minor recession of gingival margins with visible crown margins.

Grafted gingival tissue on a previously exposed root surface may be more sensitive to these irritations, because it is not as protected by well-organized and attached fibers as the native gingiva. Therefore, an attempt should be made to improve the quality of the grafted tissue and to minimize tissue trauma during crown preparation by using the most biocompatible restorative materials, and composing the most suitable oral hygiene program for the patient.

A coronally advanced flap combined with sub-epithelial connective tissue graft is the preferred procedure to improve the quality of the gingival tissue. This so-called "bilaminar technique," which proved effective in the mean reduction of recession and frequently with complete root coverage, also demonstrated a gain in both buccolingual and apico-coronal width of the keratinized gingiva. A wide and thick gingiva may have the capacity to mask darkened non-vital roots and become less prone to recession due to mechanical, chemical, or bacterial irritations.^{19,21,32,47-50} In this respect, it may be assumed that if a more dense fibrotic grafted tissue been used in the presented case, the less likelihood that thinning of the graft with gingival shadowing and recession would occur. According to the authors' observations in this case, it may be assumed that the delay in the root coverage procedure, to after final crown preparation and impression taking, was beneficial in decreasing the potential irritations to the grafted tissue.

It could be further speculated that an additional postponement of the root coverage procedure to a point where the final crown had already been cemented, would prove even more effective in eliminating potential irritations to the grafted gingiva, and perhaps in achieving improved, long-lasting esthetic results. To date, and to the best of the authors' knowledge, no long-term studies or case reports on complete root coverage in crown restored teeth can be found in the literature. This is in contrast to the numerous studies that demonstrate high predictability of complete root coverage in non-restored teeth or in teeth with cervical lesions. This disparity may be explained by the unavoidable prosthetic originated interferences to the healed grafted gingiva, and the difficulty with establishing a biologically stable, irritation-free gingivo-crown interface.

The CTGA was designed to downgrade this difficulty by choosing an "outof-the-box" sequence of the involved procedures when treating such cases. Undoubtedly, further investigation is needed to validate the CTGA as a predictable and efficient approach, especially in cases in which predetermination of the maximum root coverage level may be difficult.

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