Human Histologic Evaluation of Root Coverage Obtained with Connective Tissue Graft Over a Compomer Restoration

Luca Comuzzi, DDS, MS[1]/Fabio Mazzocco, DDS, MS[1]
Riccardo Stefani, DDS[1]/Luca Gobbato, DDS, MS[1]
Edoardo Fornea, DDS[2]/Edoardo Stellini, MD, DDS[3]
Giovanna Iezzi, DDS, PhD[4]/Adriano Piattelli, MD, DDS[5]

This investigation was designed to evaluate the histologic healing pattern of two Miller Class III recession defects associated with noncarious cervical lesions (NCCLs) treated with a connective tissue graft (CTG) and coronally advance flap (CAF). One patient presenting with two teeth predetermined to be surgically extracted was enrolled and consented to treatment. One month after phase I treatment, a full-thickness flap was reflected and the NCCLs treated with a compomer restoration; at the same time, a CTG was harvested from the palate and positioned over the compomer restoration. The flap was then coronally repositioned. After 4 months of healing, an en bloc biopsy extraction of the two teeth was executed. The teeth were analyzed histologically to assess the periodontal wound healing. A long junctional epithelial attachment was noted throughout the major portion of the restored surface. Only minimal signs of connective adhesion and new bone formation could be seen in the apical portion of the restored area, without signs of root resorption or ankylosis. This report provides evidence that the presence of a compomer restoration allowed the formation of a long juctional epithelium after CTG and CAF treatment. (Int J Periodontics Restorative Dent 2014;34:39–45. doi: 10.11607/prd.1921)

[1]Visiting Professor, Department Of Periodontology, University of Padua, Padua, Italy.
[2]Postgraduate Student, Department Of Periodontology, University of Padua, Padua, Italy.
[3]Associate Professor, Department Of Periodontology, University of Padua, Padua, Italy.
[4]Researcher, Department of Medical, Oral and Biotechnological Sciences, University of Chieti-Pescara, Chieti, Italy.
[3]Professor, Department of Medical, Oral and Biotechnological Sciences, University of Chieti-Pescara, Chieti, Italy.

Correspondence to: Dr Fabio Mazzocco, via Cesarotti 31, Padova, Italy; email: fmazzocco@hotmail.com.

Gingival recession, defined as the apical shift of the marginal soft tissues and exposition of the root surface,[1] is often associated with cervical wear. It has been reported that approximately 50% of teeth with gingival recessions are associated with noncarious cervical lesions (NCCLs),[2] which are described as the wear of the tooth substance at the level of the gingival third of the tooth due to reasons other than dental caries.[3] Gingival recessions are ubiquitous within all population groups,[4] and many factors seem to be involved in their development, including plaque-induced inflammation, toothbrush trauma, tooth disalignment, orthodontics, and restorative procedures. It is also generally accepted that the etiology of NCCLs is multifactorial,[3] with a complex interaction of various mechanisms such as corrosion, stress forces, and friction.[5] Main concerns related to this association between gingival recessions and NCCLs are esthetics, dentin hypersensitivity, root caries/demineralization, and bacterial plaque accumulation, which are the main indications for treatment.[6] Equally important, although perhaps more

difficult to obtain, is the regeneration of the lost attachment apparatus common to all recession defects, including the formation of new cementum with inserting connective tissue fibers and supporting alveolar bone.[7] The connective tissue graft (CTG) in combination with a coronally advanced flap (CAF) appears to be predictable and effective for long-term maintenance of root coverage.[8] Some studies seem to suggest that a CTG plus CAF can lead to a limited degree of periodontal regeneration in recession defects.[9–15] Resin-ionomer materials have many properties that allow them to be used successfully in the subgingival region.[16–22] There are three canine histologic studies confirming biocompatibility of glass-ionomer cement and composite resin applied subgingivally.[23–25] The only human histologic evidence demonstrates epithelial and connective tissue adherence to resin-ionomer restorative materials in subgingival lesions.[16] There is no report investigating the periodontal healing pattern over a crown-radicular compomer (hybrid of dental composites and glass-ionomer cement) restoration after treatment with CTG and CAF. The purpose of this study was to histologically evaluate the healing response of a CAF associated with a CTG over a subgingival compomer restoration.

Method and materials

A 50-year-old healthy man requiring periodontal treatment prior to removal of the mandibular premolars for orthodontic reasons presented for consultation. Both mandibular left premolars had a Miller Class 3 recession defect, 3 mm in length and 3.5 mm in width, associated with NCCLs. The patient's first and second premolar recession defects were treated with a CAF plus CTG associated with compomer restorations. Both second premolars were extracted for orthodontic reasons. The one treated with a CAF plus CTG and the compomer restoration was removed with a small part of facial soft tissue and bone. All potential risks, as well as the understanding that no clinical benefit would be gained by recession-related surgeries, were discussed with the patient. The patient agreed to proceed, and an informed consent form was signed based on the Helsinki Declaration of 1975, as revised in 2000.

Surgical procedure

After local anesthesia (Mepivacaine with epinephrine 1:100000, Pierrel Pharma), an intrasulcular incision was made at the buccal aspect of the involved teeth. An envelope flap without vertical releasing incisions was then made (Fig 1a). Full-thickness dissection extended to the mucogingival junction, followed by partial-thickness dissection apically, eliminating muscle tension and facilitating coronal repositioning of the flap.[26] The exposed root surfaces were thoroughly planed with curettes and finishing burs up to the marginal level of the crestal bone to reduce root convexities. Restoration of the NCCLs was performed using resin ionomer (Geristore Syringeable, DenMat) following the manufacturer's instructions (Fig 1b). The restoration was performed to reestablish the entire defect caused by the cervical wear. The buccal portions of the interdental papillae were then de-epithelialized to create a connective tissue bed for subsequent suturing of the CAF.

The CTG was harvested from the premolar region of the palate and positioned to cover the exposed roots and then sutured (Novosyn 5-0, Braun Aesculap) to the interdental papillae (Fig 1c). The fully mobile flap was then advanced coronally to cover the major portion of both restorations and securely sutured to the de-epithelialized surfaces of the interdental papillae. Great care was exercised in avoiding compression of the CTG. Appropriate corticosteroid (betamethasone disodium phosphate: 4 mg/2.5 mL), antibiotics (amoxicillin: 875 mg plus clavulanate 125 mg, twice daily for 6 days), analgesics (ketoprofen lysine salt: 80 mg, twice daily for 3 to 4 days), and mouthwash (0.12% chlorexidine digluconate: two times daily for 2 weeks) were prescribed. Sutures were removed 2 weeks postsurgery. The patient began to brush and floss after the second week. The patient was seen weekly for the first month and twice a month thereafter (Fig 1d).

En bloc resections

Four months following correction of the recession defects, en bloc resection of the mandibular premolar was accomplished as follows. Two proximal vertical incisions extended approximately 5 to 6 mm apically from the gingival margin and were connected at their apical end by a horizontal incision made through the bone and the root. The tooth was then atraumatically extracted along with the facial tissues, with great care to preserve soft and hard tissues (Fig 2), and placed into a container of 10% neutral buffered formalin. The harvest site was then sutured with a laterally positioned flap. Three months later, orthodontic treatment was initiated. No postoperative complications occurred.

Fig 1 (a) *Full-thickness envelope flap was reflected without releasing incisions. The two crown-radicular NCCLs on the mandibular right first and second premolars were prepared for the restorative treatment.* (b) *The NCCLs were filled with compomer restoration.* (c) *CTG was applied on the treated root.* (d) *Clinical result after 3 months of healing.*

Histologic procedure

The specimen was processed to obtain thin ground sections using the Precise 1 Automated System (Assing). They were dehydrated in a graded series of ethanol rinses and embedded in a glycolmethacrylate resin (Technovit 7200 VLC, Kulzer). After polymerization, the specimens were sectioned along their longitudinal axis with a high-precision diamond disk at approximately 150 µm and ground down to about 30 µm with a specially designed grinding machine (Precise 1 Automated System).[27] Three slides were obtained from the specimen, stained with acid fuchsin and toluidine blue, and examined with transmitted light under a Leitz Laborlux microscope under polarized light (Leitz). Histomorphometry was carried out using a light microscope (Laborlux S, Leitz) connected to a high-resolution video camera (3CCD, JVC KY-F55B, JVC) and interfaced to a monitor and personal computer. This optical system was associated with a digitizing pad (Matrix Vision) and a histometry software package with image-capturing capabilities (Image-Pro Plus 4.5, Media Cybernetics, Immagini & Computer).

Results

Patient-centered results

The color, texture, and tissue thickness at 4 months surrounding the right mandibular premolars appeared indistinguishable from the adjacent anatomical areas to both the clinicians and patient (Fig 1d). Postoperative swelling, inflammation, and discomfort were minimal.

Fig 2 *En bloc resections were performed 4 months following combined restorative-surgical treatment. Block specimen included the mandibular right premolars with buccal tissues.*

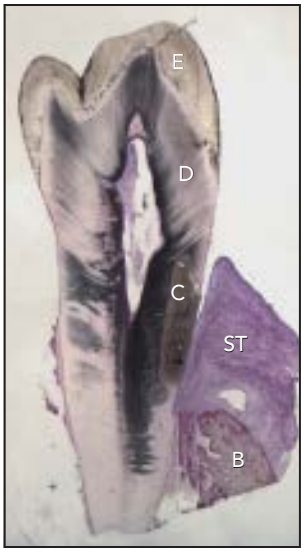

Fig 3 *Low-magnifica tion view of second and first premolars. Teeth and surrounding tissues can be seen (acid fuchsin–toluidine blue; original magnification ×6). E = enamel; D = dentin; ST = soft tissue; B = bone; C = compomer.*

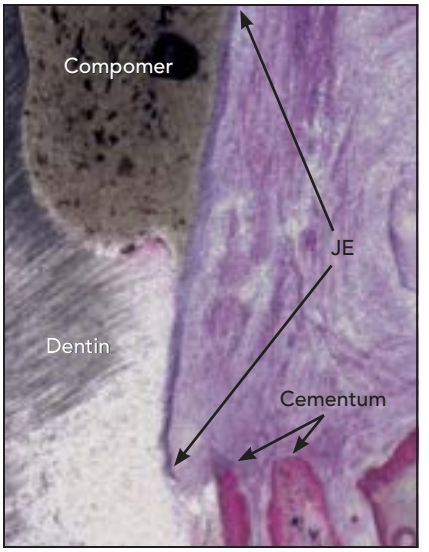

Fig 4 *The junctional epithelium* (JE) *appeared highly adherent to the entire root surface, both at the level of the compomer restoration and more apically at the level of the dentin (acid fuchsin–toluidine blue; original magnification ×18).*

Objective clinical results

Root coverage was 85% for the first premolar and approximately 80% for the second premolar 4 months postsurgery. There was a 2-mm gain in keratinized tissue for the first and second premolars.

Histologic and histomorphometric results

At low magnification, the premolar can be seen with the surrounding tissue (Fig 3). No root resorption or ankylosis was detected in any of the serial sections, and the inflammatory cell infiltrate was minimal. The root surface previously treated was clearly identifiable by the presence of the restoration and, apically, by the absence of cementum due to root instrumentation. The junctional epithelium was limited to 2 to 5 cells in thickness and ended just coronally to the bone crest, appearing highly adherent to the entire root surfaces, at the level of the compomer restoration and apically at the level of the dentin (Fig 4). Old cementum of the root appeared to be covered by new cementum apically of the end of the junctional epithelium. Sharpey fibers were attached to the newly formed cementum under polarized light (Fig 5a). In the intervening root area, the compomer restorations and the dentin surfaces were covered by parallel connective tissue fibers coronal to the bone crest, suggesting connective tissue adhesion.

A long junctional epithelial attachment (LJE) and connective tissue adhesion along the restoration and root surface, without gaps in the outline between soft tissues and root surfaces, can be detected (Fig 5b). Histomorphometric analysis of the second premolar showed sulcular epithelium (2.55 mm) and junctional epithelium (3.82 mm) (Fig 6). In the same sample, two findings due to artifacts were noted: a separation between the coronal portion of junctional epithelium and compomer restoration and a void within the connective tissues.

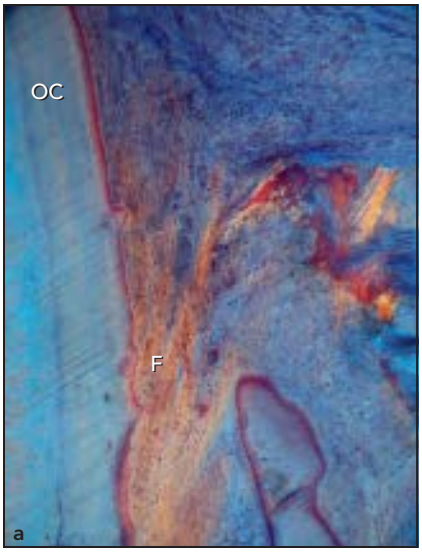

Fig 5 (a) *Apically, it is possible to observe the junctional epithelium* (asterisk) *and the old cement* (OC) *of the root, which appears to be covered by new cement with attached Sharpey fibers* (F) *(acid fuchsin–toluidine blue; original magnification ×40).* (b) *Sulcular epithelium* (SE) *and a long junctional epithelial* (JE) *attachment can be detected (acid fuchsin–toluidine blue; original magnification ×18).*

Fig 6 *Histomorphometric measurement of the second premolar showing 2.55 mm of sulcular epithelium and 3.82 mm of junctional epithelium (acid fuchsin–toluidine blue; original magnification ×18).*

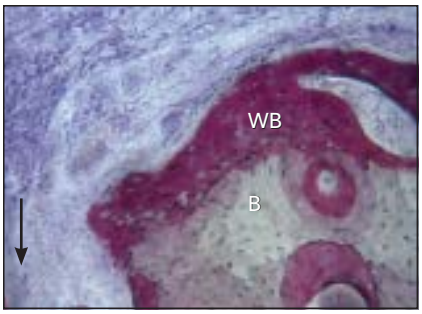

Fig 7 *In the cortical area, it is possible to observe preexisting mature bone* (B) *and woven bone* (WB)*, easily distinguishable by the difference in staining (acid fuchsin–toluidine blue; original magnification ×100).*

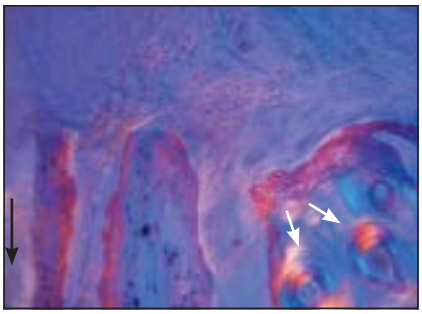

Fig 8 *Haversian systems are present in the cortical compact bone* (white arrows)*. Collagen fibers with a parallel orientation, as occurs in lamellar bone, can be observed (acid fuchsin–toluidine blue; original magnification ×40).*

Fig 9 *Between the newly formed cement and the alveolar bone* (B) *it is possible to note an interposed thick band of cement* (C)*. The black arrow indicates the apex of the root (acid fuchsin–toluidine blue; original magnification ×18).*

The alveolar crest presented minimal signs of coronal growth (Fig 7) in the second premolar specimen, with an area of bone remodeling in which it was possible to note the presence of some osteons (Fig 8). Between the alveolar bone and intensely stained cementum, it was possible to note an interposed thick band of cementum (Fig 9).

Discussion

Many reports have verified the effectiveness of a CTG plus CAF for the treatment of localized recession-type defects to restore the functional and esthetic morphology of the mucogingival complex.[8] It is considered the gold standard of treatment for recession defects. Although some investigations have suggested that CTGs seem to be capable of leading to limited regeneration,[9–12,28] most suggest that healing occurred through either an LJE or connective tissue adhesion to the root surface.[13–15,29,30] This case report was characterized by the presence of crown-radicular compomer restorations and, histologically, it indicated healing with mainly an LJE, demonstrating that the compomer restoration did not interfere with the normal healing that usually occurs after CTG plus CAF treatment.

Saldanha et al[23] concluded that in dogs with periodontitis, subgingival resin-modified glass-ionomer restorations provided better clinical and histologic responses of the periodontal tissues than amalgam restorations. The only human histologic evaluation demonstrated clinical and histologic (3 months postsurgery) evidence of epithelial and connective tissue adherence to resin-ionomer restorative materials in subgingival lesions and a lack of inflammatory cells adjacent to the resin-ionomer material.[16] The choice of resin ionomer as a restorative material was based on physical characteristics: biocompatibility, such as dual-cure set fluoride release and lower levels of microleakage. The results of the present case report are similar to those obtained by Dragoo,[16] in particular, for the close adhesion of the periodontal tissues to the resin-ionomer restorative material and the lack of inflammatory cells.

Recent clinical trials and case reports evaluated CTG efficacy, combined with cervical restorations, for obtaining root coverage in teeth affected by gingival recession and NCCLs.[17–22] The clinical outcome of these studies revealed that the combined restorative-periodontal treatment produced significant gains in clinical attachment level and gingival recession reduction. The presence of restorations did not interfere with the coverage achieved by the CTG, and the treated sites presented no signs of inflammation or bleeding on probing. There were improvements in the final esthetics and resolution of dentin hypersensitivity. The present report is in line with those studies; in fact, despite the subgingival localization of the apical margins of the restoration, the site presented no clinical sign of inflammation such as redness, suppuration, or bleeding on probing. With the data from the histomorphometric analysis, it is interesting to note the comparison of the clinical and histologic measurements: the combined histologic measurement of sulcus depth and epithelial attachment was 6.37 mm, while the clinical probing depth was 2.0 mm. These findings may be explained by the high adherence of the junctional epithelium to the restoration and root surface.

This type of healing could be attributed to the proper adhesion, polishing, and refinement of the compomer restoration performed during surgery after reflection of the flap, which allowed for the correct access to the NCCL. Furthermore, the biocompatibility of the restorative material, frequent patient maintenance, and adequate plaque control may have contributed significantly to the healthy condition of the gingival tissue observed during the present study.

Conclusion

Within the limitations of this case report, it could be concluded that the use of a compomer material to treat transgingival NCCLs did not interfere with the normal healing of a CTG combined with a CAF, allowing epithelial adhesion over the restoration material with minimal signs of clinical and histologic inflammation.

Acknowledgment

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