Treatment of single mandibular recessions with the modified coronally advanced tunnel or laterally closed tunnel, hyaluronic acid, and subepithelial connective tissue graft: a report of 12 cases

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Objectives: To clinically evaluate the healing of mandibular Miller Class I and II isolated gingival recessions treated with the modified coronally advanced tunnel (MCAT) or laterally closed tunnel (LCT) combined with hyaluronic acid (HA) and subepithelial connective tissue graft (SCTG). **Method and materials:** Twelve healthy patients exhibiting one isolated mandibular Miller Class I or II (Cairo Class 1) gingival recession of a depth of ≥ 3 mm, were consecutively treated with the MCAT or LCT in conjunction with HA and SCTG. Treatment outcomes were assessed at baseline and at least 6 months postoperatively. The primary outcome variable was complete root coverage (CRC). **Results:** Postoperative pain and discomfort were low and no complications such as postoperative bleeding, allergic reactions, abscesses, or loss of SCTG occurred. After a mean follow-up of 18.9 ± 10 months, statistically significant ($P < .0001$) root coverage was obtained in all 12 defects. CRC was measured in six out of the 12 cases (50%), four cases showed a root coverage of over 95%, while the remaining two cases reached 80% and 85%. Mean root coverage was 96.09%. Mean keratinized tissue width increased from 1.6 ± 0.8 mm to 4.9 ± 1.3 mm ($P < .0001$) from baseline to follow-up, while mean probing depth showed no statistically significant changes (1.8 ± 0.9 mm vs 1.3 ± 0.5 mm). **Conclusion:** Within their limits, the present results indicate that the described treatment approach may lead to predictable root coverage of isolated mandibular Miller Class I and II (Cairo Class 1) gingival recessions. *(Quintessence Int 2020;51:2–9; doi: 10.3290/j.qi.a44492)*

Key words: connective tissue graft, gingival recession, hyaluronic acid, laterally closed tunnel, modified coronally advanced tunnel

Gingival recessions constitute an increasing problem worldwide. In the USA the prevalence of ≥ 1 mm recession in over 30-year-olds was 58%.[1-4] A recent study in the UK showed that gingival recessions in young adults are highly prevalent, with every participant exhibiting at least one tooth with gingival recession and 42% having a maximal recession of 4 to 8 mm.[5] Gingival recession is frequently associated with esthetic concerns, tooth hypersensitivity, impairment of hygiene, and loss of periodontal support.[3,6-8] Although its etiology is complex, periodontal disease and mechanical trauma are the primary factors in the pathogenesis of gingival recessions.

Additionally, predisposing factors such as areas with minimal or no keratinized tissue,[9] orthodontic movement leading to facial tooth displacement,[10] direct trauma associated with Class II malocclusion, occlusal trauma, or acute infection with herpes simplex virus[11] exacerbate the problem.

From a clinical point of view, the most challenging situations are the recession defects located in the mandibular area. Such defects are frequently observed in conjunction with orthodontic therapy[12,13] and require a more complex treatment, including the use of soft tissue grafting with or without biologic agents aiming to maximize the outcomes.[14-18]

doi: 10.3290/j.qi.a44492

These difficulties are mainly due to a number of anatomical considerations such as vestibulum depth, tooth position, pull of muscles and frenula, and thickness of the hard and soft tissues. All these factors increase the difficulties in preparing a tension-free flap, and the risk of flap perforation and/or necrosis during the healing phase.

More recently, various modifications of the tunnel procedure such as the modified coronally advanced tunnel (MCAT) or the laterally closed tunnel (LCT) in conjunction with soft tissue grafts have been proposed as more realistic options for the treatment of isolated mandibular recession. These surgical techniques consist of the preparation of a full-thickness flap, followed by fiber or muscle release enabling the coronal advancement or lateral closure of the flap, to cover the soft tissue graft and the recessions.[14,15]

The clinical relevance of the proposed concept is supported by findings from two case series including patients with isolated mandibular Miller Class I or II recession, treated with either MCAT or LCT in conjunction with an enamel matrix derivative (EMD) and subepithelial connective tissue graft (SCTG). At 12 months following surgery, the results revealed statistically and clinically significant improvements in terms of root coverage and gain of attached gingiva.[14,15]

Recently, hyaluronic acid (HA), an anionic, nonsulfated glycosaminoglycan, distributed widely throughout connective, epithelial, and neural tissues in the whole body, has been proposed as a biologic agent for reconstructive periodontal surgery. HA is also present in body fluids like serum, saliva, and gingival crevicular fluids.[19] In in vitro and animal studies, HA has shown promising effects on wound healing. It was shown that HA significantly increases the tensile strength of granulation tissue,[20] stimulates clot formation,[21] induces angiogenesis,[22] and increases osteogenesis. A recent in vitro study has demonstrated that HA is biocompatible and enhances the proliferative, migratory, and wound healing properties of cell types involved in soft tissue wound healing following regenerative periodontal surgery.[23] In human skin wounds and ulcers, the use of HA resulted in faster reduction of the wound size when compared with controls.[24,25]

Taken together, the available evidence indicates that HA appears to be a promising biologic material for periodontal wound healing. It could thus be hypothesized that the use of HA may positively influence wound healing after periodontal plastic surgery. This hypothesis is in line with the findings of a recent randomized controlled clinical trial (RCT) comparing treatment of gingival recession with either coronally advanced flap (CAF) alone or combined with HA, which demonstrated that the adjunctive application of HA resulted in higher reduction of recession depth and increased probability of complete root coverage (CRC) in Miller Class I recessions compared with the use of CAF alone.[26]

However, to the authors' knowledge, at present there are no clinical reports evaluating the treatment of mandibular recession defects following by means of MCAT or LCT in conjunction with HA and SCTG.

Therefore, the aim of this consecutive case series was to clinically evaluate the healing of recessions following treatment with MCAT or LCT with HA and SCTG.

Method and materials

Subject selection

A total of 12 adult patients presenting one isolated Miller Class I or II (Cairo Class 1) mandibular gingival recession were included in the present case series, after having completed preliminary professional tooth cleaning and having received individual oral hygiene instructions (Figs 1a and 2a). None of the patients were smokers and all were systemically healthy without any signs of periodontal disease. Each patient had to display one isolated Miller Class I or II mandibular gingival recession of a depth of ≥ 3 mm. Patients exhibited an adequate level of oral hygiene evidenced by a full-mouth plaque score (FMPS) < 25%[27] and full-mouth bleeding score (FMBS) < 25%.[28] Written informed consent was obtained from all patients. Ethical approval was obtained from the ethical committee of Bern, Switzerland (2018-01877).

Surgical approach

All 12 patients were consecutively treated as follows using the MCAT[15,29] or LCT[14] technique by the same experienced clinician (AS): Following local anesthesia, root planing of the exposed root surface was performed with Gracey curettes (Stoma). Intrasulcular incisions around the involved tooth were performed using microsurgical blades (Key Dent, Micro Blades, American Dental Systems) and specially designed tunneling instruments (Stoma). A mucoperiosteal flap was raised by means of differently designed tunneling knives beyond the level of the mucogingival junction leaving the interdental papillae intact (Fig 1b). Subsequently, the mucoperiosteal tunnel was extended by full thickness preparation laterally from the recession utilizing the same tunneling knives. Attaching muscles and inserting collagen fibers were separated and released from the inner aspect of the tunneled flap by means of microsurgical blades (Key Dent, Micro Blades) and Gracey curettes (Stoma). As a result of this

Fig 1a Preoperative situation depicting a deep Miller Class I recession located vestibularly at the mandibular left central incisor.

Fig 1b Tunnel preparation.

Fig 1c Application of hyaluronic acid.

Fig 1d Subepithelial connective tissue graft (SCTG) placed in the tunnel and fixed with mattress sutures, application of hyaluronic acid.

Fig 1e The tunneled flap was closed laterally by sling sutures and single sutures.

Fig 1f The clinical evaluation at 26 months demonstrates complete root coverage.

doi: 10.3290/j.qi.a44492

procedure, the tunneled flap could be mobilized and advanced coronally without tension. Finally, to achieve complete mobilization of the flap, the interdental papillae were gently undermined using the specially designed tunneling knife (Sculean-Aroca N°1, Stoma). Special attention was paid not to disrupt the interdental papillary tissues and to avoid flap perforation.

After tunnel preparation, a palatal SCTG of a thickness of 1.0 to 1.5 mm was harvested by using the single incision technique.[30,31] Immediately after harvesting, the SCTG was soaked in NaCl, while the donor site was closed with a modified mattress suture (5-0 Seralon, Serag-Wiessner).

Thereafter, HA (Hyadent, Regedent) was applied onto the root surface and under the surrounding soft tissues by means of a sterile syringe (Fig 1c). Immediately after HA application, the SCTG was pulled in the tunnel by means of single or mattress sutures and fixed at the inner side of the tunnel flap (Fig 1d). Subsequently, the graft was fixed at the cemento-enamel junction or 1 mm below by a sling suture (6-0 Seralon, Serag-Wiessner) in order to obtain complete immobilization of the graft. Finally, the tunneled flap was either moved coronally or laterally to completely cover the graft and the recession by means of a sling suture or single interrupted sutures, followed by HA application on the entire external surface of the soft tissues at the treated site (Fig 1e). Postsurgically, patients were given analgesics (2 × 500 mg/day mefenamic acid, Mephadolor, Mepha Pharma) for 2 to 3 days and antibiotics (2 × 1,000 mg amoxicillin and clavulanic acid, Augmentin, GlaxoSmithKline) for 7 days to prevent infection. Patients were not allowed to brush the surgical sites for 14 days postoperatively. Patients were advised to use a 0.1% chlorhexidine gluconate mouthrinse solution (Chlorhexamed, GlaxoSmithKline) twice a day for 1 minute during the first 21 days postsurgically. The palatal sutures were removed at 7 days after surgery, whereas those from the area of the recession were removed at 14 to 21 days postoperatively. Patients resumed toothbrushing at the surgical sites after suture removal using an ultrasoft manual toothbrush (Paro surgical mega soft, Paro), employing the roll technique, and gradually returned to regular oral hygiene habits at 1 month postsurgery. Recall appointments including professional supragingival tooth cleaning and individually tailored oral hygiene instructions were scheduled postoperatively.

Clinical assessments

The following clinical parameters were assessed at baseline and at follow-up examinations (Figs 1a and 1f, Fig 2): probing depth (PD), clinical attachment level (CAL), complete root coverage (CRC), mean root coverage (MRC), and keratinized tissue width (KTW). The primary outcome variable was CRC (ie, 100% root coverage).

Table 1 Basic demographic data (n = 12)

Variable		Result
Age, mean ± SD (y)		26.8 ± 9.2
Gender, n (%)	Women	10 (83.4%)
	Men	2 (16.6%)
Smoker, n (%)	No	12 (100.0%)
	Yes	0 (0.0%)
Orthodontic treatment, n (%)	No	2 (16.6.%)
	Yes	10 (83.4%)
Retainer, n (%)	No	2 (16.6.%)
	Yes	10 (83.4%)

SD, standard deviation.

Statistical analysis

Statistical analysis was performed using Prism v7 (GraphPad Software). The primary outcome variable was CRC. Statistical analysis was based on Wilcoxon signed rank test. Significance was set at $P < .05$.

Results

This case series comprised a total of 12 healthy nonsmoking patients with single Miller Class I or II (Cairo Class 1) gingival recessions (Table 1). In one patient the recession was localized at a mandibular canine, and in the other 11 patients the recessions were localized at mandibular central incisors. Nine cases were treated with LCT and three cases with MCAT.

The postoperative pain and discomfort were low and no postoperative bleeding, allergic reactions, abscesses, or loss of SCTG occurred.

After a mean observation time of 18.9 ± 10.0 months (range 6 to 33 months), a statistically significant root coverage ($P < .0001$) was obtained in all defects. CRC was achieved in 6 out of the 12 cases (50%). In four cases, root coverage measured > 95%, whereas in the remaining two cases the root coverage amounted to 80% and 85%, respectively. Overall, the MRC was 96.09%. Mean KTW increased from 1.6 ± 0.8 mm to 4.9 ± 1.3 mm yielding a mean gain of KT of 3.3. ± 1.6 mm ($P < .0001$) (Table 2,

Fig 2a Preoperative situation depicting deep Miller Class I recession located vestibularly at the mandibular left canine.

Fig 2b The clinical evaluation at 14 months demonstrates a root coverage of almost 100%.

Fig 2b), while mean PD did not show any statistically significant changes ($P = .269$) (ie, 1.8 ± 0.9 mm at baseline vs 1.3 ± 0.5 mm after follow-up examination).

Discussion

The findings of the present case series show that treatment of isolated mandibular recessions can be successfully treated by means of a tunneling approach in conjunction with HA and SCTG. In all cases, the postoperative healing was uneventful and no adverse reactions were observed. After a mean follow-up of 18.9 ± 10 months, statistically significant root coverage was obtained in all 12 defects (ie, MRC was 96.09% with a CRC of 50%). In four out of 12 cases root coverage measured > 95%, while in the remaining two cases root coverage amounted to 80% and 85%, respectively. The observed root coverage was accompanied by a statistically significant ($P < .0001$) increase in mean KTW (ie, from 1.6 ± 0.8 mm at baseline to 4.9 ± 1.3 mm at follow-up), but without any statistically significant change in probing depth (ie, 1.8 ± 0.9 mm at baseline vs 1.3 ± 0.5 mm after follow-up examination).

To the best of the authors' knowledge this is the first report evaluating the treatment of isolated Miller Class I or II recessions using MCAT or LCT in conjunction with HA and SCTG.

In agreement with the present results, a recently published RCT evaluating the effectiveness of adjunctive HA application in CAF in Miller Class I single gingival recession sites reported a MRC of 93.8% for defects treated with CAF and HA compared to 73.1% for CAF alone. The authors reported no changes in the KTW (2 mm) in the test and control group at baseline and the 18-month follow-up.[26] In the present patients, MCAT or LCT with HA and SCTG resulted in a similar MRC (96.09% vs 93.8%), but a significant increase in KT (1.6 ± 0.8 mm to 4.9 ± 1.3 mm) was observed. This may be due to the additional use of a SCTG.[32,33] In another case series, 16 mandibular Miller Class I or II defects were treated with MCAT combined with EMD and SCTG.[15] After an observation period of 12 months, a statistically significant MRC (96.25%) was observed, which is in agreement

Table 2 Descriptive results and significance at reexamination compared to baseline

Parameter	Mean ± SD (mm)	Min (mm)	Max (mm)	*P* value
RH baseline	4.6 ± 0.9	3	5	< .0001
RH follow-up	0.5 ± 0.6	0	2	
RW baseline	2.6 ± 0.6	2	4	.0005
RW follow-up	0.4 ± 0.5	0	2	
AG baseline	0.5 ± 0.5	0	1	.0005
AG follow-up	3.5 ± 1.3	2	7	
KT baseline	1.6 ± 0.9	0	3	< .0001
KT follow-up	4.9 ± 1.3	4	8	

AG, attached gingiva; KT, keratinized tissue; RC, root coverage; RH, recession height; RW, recession width.

doi: 10.3290/j.qi.a44492

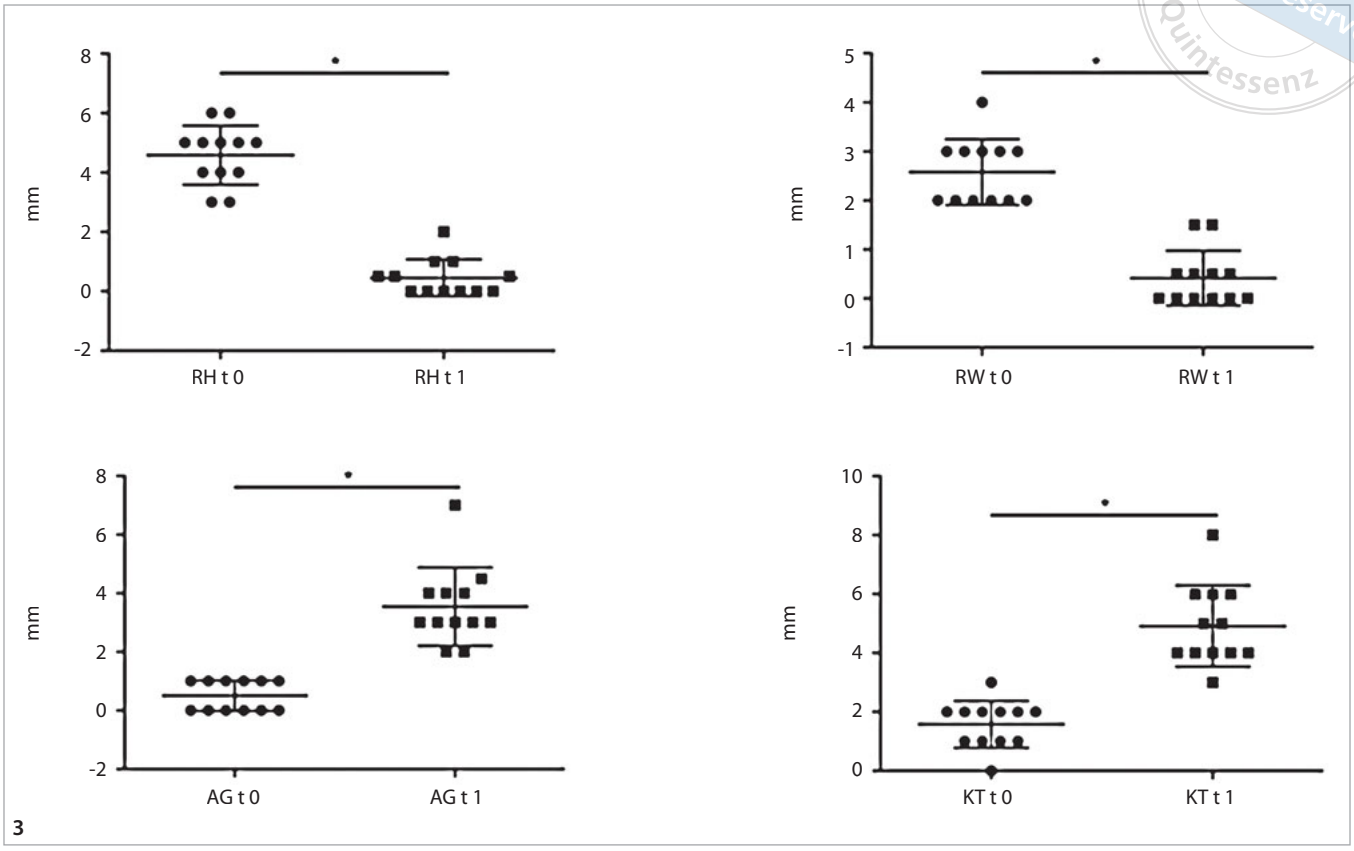

Fig 3 Distribution of data for the two time points at baseline (t0) and > 6 months postoperatively (t1). *$P < .01$, by two-tailed Wilcoxon signed rank test. AG, attached gingiva; KT, keratinized tissue; RH, recession height; RW, recession width.

with the present findings (96.06%). In contrast to the current findings, the KTW only increased from 1.98 ± 0.8 mm to 2.5 ± 0.9 mm at 12 months, as compared to 1.6 ± 0.8 mm to 4.9 ± 1.3 mm. These differences may be related to the surgical technique. In the present study, nine defects were closed using the LCT. Applying the same technique in a case series on isolated Miller Class I, II, and III gingival recessions, Sculean and Allen[14] reported a mean increase in the KTW from 1.41 ± 1.0 mm at baseline to 4.14 ± 1.67 mm at 12 months, yielding a mean gain of KT of 2.75 ± 1.52, which is comparable to the present results. When using HA combined with a membrane for the treatment of multiple recessions, KTW was increased by 2.53 ± 0.50 mm.[34]

Current research has shown positive effects of HA on wound healing. In a systematic review by Casale et al,[35] it was concluded that the topical application of HA could lead to faster healing after implant placement and sinus grafting procedures, leading to a reduction in patients' discomfort. Additionally, the topical application of HA has been reported to have a beneficial effect in the treatment of gingivitis and chronic periodontitis.[36,37] In a recent meta-analysis including only two RCTs, HA showed additional clinical benefits when used in conjunction with periodontal surgery.[38]

In vitro studies have demonstrated the positive effects on wound healing such as stimulation of clot formation,[21] induction of angiogenesis,[22] improvement of periodontal ligament cell viability,[39] bacteriostatic effects,[40] and anti-inflammatory activity.[41]

Supporting these results, a recent in vitro investigation on two HA formulations with human fibroblasts showed both HA formulations being biocompatible and enhancing the proliferative, migratory, and wound healing properties of cell types involved in soft tissue wound healing.[23] Thus far, no histologic investigations are available on the regenerative potential of HA in periodontal surgery.

In addition to the reported positive effects of HA on wound healing in clinical and laboratory research, there are further explanations for the good results in the present case series, ie all patients were nonsmokers, and had a good level of oral hygiene (FMPS < 25%). Furthermore, special attention was given to avoid flap tension, complete graft coverage, and the postoperative coronal position of the flap.

When interpreting the results, it needs to be pointed out that the present case series provides only data of 12 consecutively treated patients without a control group (ie, without HA) and, therefore, it is impossible to draw any conclusions on the clinical benefit of using HA additionally to SCTG. However, despite these drawbacks, the uneventful healing and the excellent clinical outcomes (ie, MRC of 96.09%) coupled with an observation time of more than 1 year in eight cases indicating clinical stability, seem to suggest that the described treatment represents a valuable approach for the treatment of isolated mandibular Miller Class I or II gingival recessions.

Conclusion

Within their limits, the present results indicate that the described treatment approach may lead to predictable root coverage of isolated mandibular Miller Class I and II (Cairo Class 1) gingival recessions.

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doi: 10.3290/j.qi.a44492

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