Composite-milled "Endo-Overlay" on thermo-viscous composite build-up following deep margin elevation

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Keywords

Deep margin elevation, VisCalor, Thermo-viscous composite, Build-ups, Grandio blocs, Milled composite blocks, Endo-Overlays

Summary

In this clinical case, the author presents a minimally invasive alternative to endocrowns, which he calls "endo-overlay". He relies on the latest advances in nano-hybrid composites for CAD/CAM, particularly on the materials developed by VOCO, which allow for a thin design of indirect restorations.

As a part of a post-endodontic reconstruction for a female patient with subgingival palatal fracture on tooth #16, who was referred by an endodontics specialist, the endo-overlay was successfully applied.

After deep margin elevation with GrandioSO (VOCO), followed by a core build-up with VisCalor bulk (VOCO), an endo-overlay made from Grandio blocs (VOCO) was designed and milled using CAD/CAM technology and finally adhesively luted with a bonded-in resin cement.

Case description

CASE HISTORY

Reason for dental consultation

A 37-year-old female patient came to the practice for a longitudinal mesiopalatal fracture with subgingival extension on her upper right first molar (tooth 16) (Figs. 01 and 02). The endodontics specialist who had performed the prior root canal treatment had referred the patient for a post-endodontic reconstruction.

Dental and medical history

The patient had lost her upper right second molar (tooth 17) two years earlier, again due to a fracture. Her general medical history was unremarkable.

Patient's expectations

The patient hoped that her tooth could be saved and restored with excellent aesthetic and functional results and requested a metal-free solution.

FINDINGS AND DIAGNOSIS

Clinical, radiological and instrumental findings

In addition to the incomplete subgingival fracture on tooth 16, the pre-operative radiograph showed a periapical inflammatory process (Fig. 15a).

Diagnosis

Incomplete longitudinal fracture of tooth 16 with periapical granuloma.

Therapy

Treatment plan

Based on the diagnosis, two possible courses of action were considered:

1. restoration with a fiberglass post and a metal-free crown or
2. a biomimetic approach consisting of deep margin elevation with composite, an adhesive build-up and a metal-free endo-overlay.

As the buccal wall of the tooth was just 2 mm thick, removing an additional 1 mm for a crown preparation would have significantly weakened the remaining wall. Due to the low wall thickness, the biomimetic approach was chosen.

Another essential decision was which material to use for the prosthetic restoration: ceramic or a CAD/CAM composite. It was decided to use a state-of-the-art nano-ceramic hybrid material for high-quality CAD/CAM restorations (Grandio blocs, VOCO) because of its excellent mechanical stability, easy handling, and fast milling process.

Timeline of treatment steps

The incomplete fracture on tooth 16 was clinically visualised (Figs. 01 and 02).

The fracture was unremarkable when using Caries Marker (VOCO), so that a nano-hybrid composite was used to directly seal it while performing the deep margin elevation.

A rubber dam was placed and the tooth was etched (Fig. 03). After application of Futurabond U (VOCO) (Fig. 04), a deep margin elevation was performed (Fig. 05) using Grandioso (VOCO; shade A2), which was chosen for its favourable mechanical behaviour. The tooth was built up with the thermally controllable bulk-fill composite VisCalor bulk (VOCO) (Fig. 06), which was shaped, cured and grinded in the form of a retention cavity (Figs. 7b and c). As perfectly smooth preparations can present difficulties during luting, it is preferable to provide them with an indentation to prevent incorrect seating of the restoration. Therefore, a slight ring-shaped central depression was created (visible on Figs. 7b and c as a 0.5 mm deep occlusal box) to facilitate the positioning of the endo-overlay and its adhesive cementation (Figs. 11 and 12).

The residual cusps were prepared geometrically with bevelled margins using diamond instruments (820 und 859EF, JOTA; s. bur 820 in Fig. 07a).

The amount of vertical reduction on the cusps was 1 mm (Figs. 09b and c) (1.5 mm on the supporting cusps) (Fig. 07). The resulting preparation was scanned (CEREC Omnicam, Dentsply Sirona), while the restoration was designed using exocad (Align Technology) (Fig. 08a) and then milled on a CEREC MC XL (Dentsply Sirona) from Grandio blocs (VOCO) (Figs. 08b and 09). FinalTouch (VOCO) in brown and orange shades was applied for the chromatic characterisation of enamel fissures (Fig. 10).

Conditioning of the indirect restoration: Since the milled endo-overlay was made

Fig. 01 Initial situation: longitudinal mesiopalatal fracture.

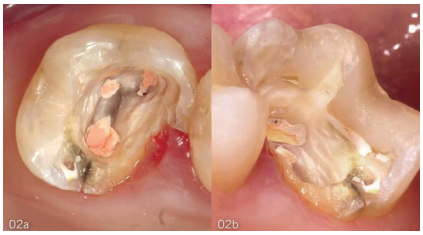

Fig. 02 Occlusal (a) and mesial (b) of theinitial situation.

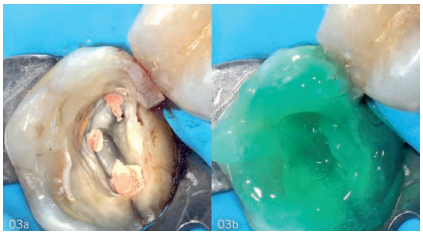

Fig. 03 Absolute isolation with rubber dam (a) followed by phosphoric acid etching step (b)

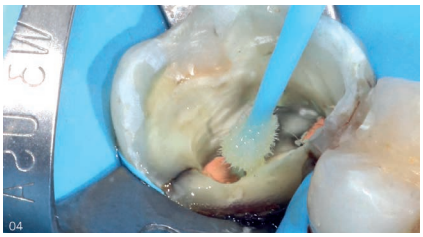

Fig. 04 Application of Futurabond U.

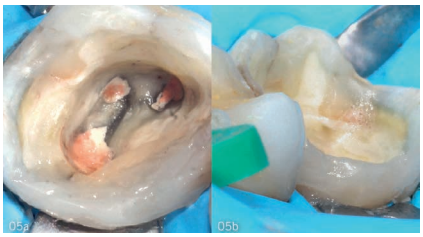

Fig. 05 Deep Margin Elevation (DME) from the occlusal (a) and mesial (b) views.

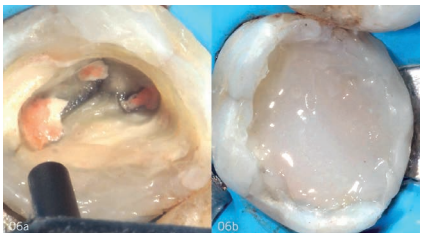

Fig. 06 VisCalor bulk (VOCO) enables the build-up, volume reduction of the pulp chamber and shaping in one step.

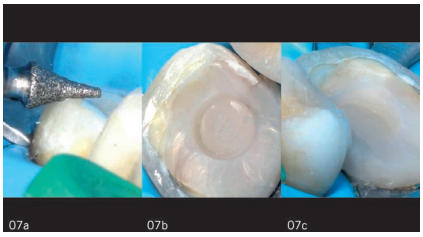

Fig. 07 Creation of a marginal bevel (a) and finished prepared cavity from occlusal (b) and mesial (c).

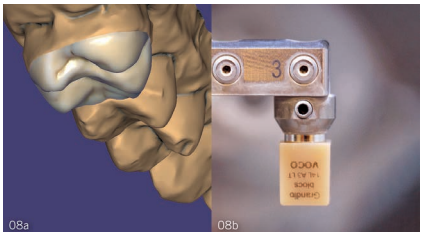

Fig. 08 Virtual construction of the endo overlay (a) and Grandio blocs mounted for milling (b).

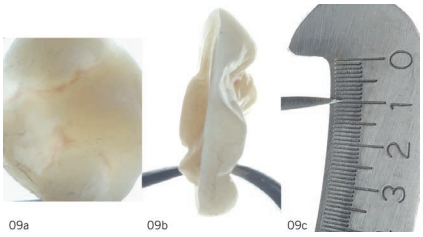

Fig. 09 Milled endo-overlay with a thickness of 1 to 1.5 mm, measured using an Iwanson caliper.

of the nano-hybrid CAD/CAM composite Grandio blocs, according to the VOCO instructions for use, its surface did not need to be further conditioned with any etching agent. It was sufficient to sandblast it with Al_2O_3 (Rocatec, 50 µm, pressure of 2 bar, 3M), condition it with the silane coupling agent Ceramic Bond (VOCO) for 60 seconds, and then dry it using a gentle air stream for 5 seconds (not shown).

Conditioning of the build-up and the hard tissue: Also the composite build-up surface on tooth 16 was sandblasted (Rocatec, 50 µm, pressure of 2 bar, 3M) to increase its retention potential and then rinsed with water. The effect of the teflon tape isolation used to prevent damage to the adjacent teeth was visible (Fig. 11a). With the self-etching dual-curing universal adhesive Futurabond U (VOCO) (Fig. 11c), a preliminary etching of the tooth hard tissue using phosphoric acid gel is merely optional. In fact, Futurabond U alone achieves high levels of adhesive strength on enamel and dentine, so that prior etching of the hard tissue – and possibly of composite surfaces – may be carried out as in this case (Fig. 11b), though it is not required. Only enamel which is unprepared must be etched and rinsed at the beginning of the bonding process. The generated microretentions help the dual-curing cement system Bifix QM (VOCO) to properly lute with the hard tissue (Fig. 12). At the beginning of the chemical curing time of 3 minutes, 30 s were initially waited for Bifix QM to set in the marginal area (Fig. 12a). This 30 second pause is intended to prevent shrinkage and gap formation, which can occur if the adhesive material is levelled too early. Only then a foam pellet (Pele Tim, VOCO) held by tweezers was used to level the luting material in the marginal zone so that all soft excesses were removed. (Fig. 12b).

After careful cleaning (not shown), light-curing was carried out from vestibular to palatal (Celalux 3, VOCO) to ensure complete polymerisation of the cement material in the marginal area. The rubber dam was removed, the occlusion was adjusted (Fig. 13) and the endo-overlay was polished (Fig. 14).

Discussion

The reported case presented several challenges, each of which required appropriate approaches.

An incomplete longitudinal fracture can be a challenging decision because if the fracture is accidentally increased using instruments, it can result in damage to the floor of the pulp chamber, symptoms and lead to tooth loss (Gill et al., 2021).

The incomplete longitudinal fracture described here could have provided a portal of entry for microorganisms or the mechanical basis for cracked-tooth syndrome. Therefore, it had to be closed directly with a composite (GrandioSO, VOCO).

A further difficulty was achieving good absolute isolation, which is a prerequisite for deep margin elevation (Dietschi und Spreafico, 1998) with predictable long-term results (Van Meerbeek et al., 2005; Dietschi und Spreafico, 2019). Mechanical gingival retraction prepared the site for easier rubber dam placement and ensured proper moisture control on the adhesive interface. The coronal margin relocation does not negatively affect the periodontal health status of patients, provided that the connective compartment of the supracrestal tissue attachment is not injured (Ghezzi et al., 2019).

The situation at this point was consistent with a large class 1 cavity. In order to fill it without having to worry about the problems resulting from the stress-related shrinkage associated with composites, it was decided to use a bulk-fill composite. The development of state-of-the-art bonding agents and bulk-fill materials for usage inside the pulp chamber has expanded their application range and reduced technique sensitivity (Hayashi et al., 2019; Mannocci et al.,

Fig. 10 Colour characterisation of the overlay with FinalTouch (brown and orange shades, VOCO).

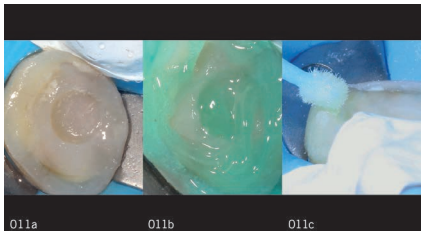

Fig. 11 Prepared cavity after sandblasting (a), etch-and-rinse (b) and application of universal adhesive (c) (Futurabond U VOCO).

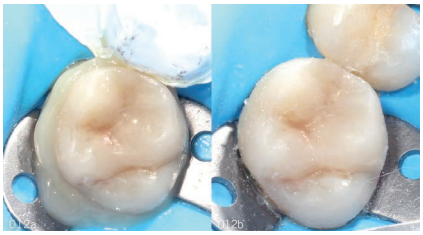

Fig. 12 Cementation with Bifix QM (VOCO) before (a) and after removal (b) of the excess material.

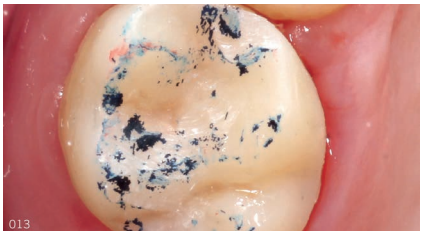

Fig. 13 Occlusion is checked using articulation paper.

Fig. 14 Completed restoration before (a) and after polishing (b).

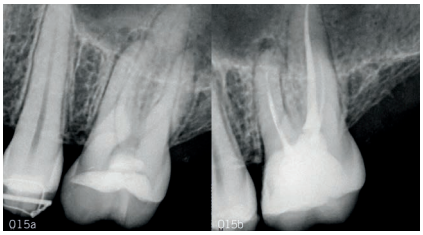

Fig. 15 Pre- and postoperative radiographs.

2022). Generally, bulk-fill composites can be applied and cured in 4 mm deep layers (Lima et al., 2018). The thermally induced flowability of VisCalor bulk (VOCO) allows a packable bulk-fill composite to be applied in the same way as a flowable composite, thereby achieving optimal adaptation to cavity floor and walls. Within seconds, as VisCalor bulk cools, it returns to a packable composite, which is easy to shape (Demirel et al., 2021).

Bevelled margins were prepared using diamond instruments (Ferraris et al., 2021), thereby achieving biomechanical advantages for the endo-overlay and providing better protection for the underlying tooth structure. Recent finite element analyses (Zheng et al., 2022) show that flat butt joint minimally invasive preparations are not as optimal as blunt butt joint preps with 20° bevel. This applies also to the nanoceramic hybrid material Grandio blocs (VOCO). As a result, in order to maintain the integrity of the remaining walls it was possible here to avoid any axial reduction.

To facilitate the placement of the endo-overlay, a ring-shaped central depression was prepared (visible in Fig. 07b and c as an occlusal box with a depth of only 0.5 mm). As described previously, the endo-overlay was fabricated with an ultrathin thickness of 1 mm (1.5 mm on the supporting cusps) (Valenzuela et al., 2021).

It is worth noting that very few occlusal adjustments were required due to the correct design and the precision of the system (Rocca et al., 2021).

Conclusion

Patient satisfaction

The patient was completely satisfied with the aesthetic and functional results of her treatment. ◆

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For the full list of references, contact Australasian Dentist on: gapmagazines@gmail.com

Prof. Dr. Lucas Echandia, DDS, is an accomplished prosthodontist and academic based in Córdoba, Argentina. He graduated from the National University of Córdoba in 2009 and has since held various positions in academia, including as Assistant Professor of Prosthodontics I "A" at the National University of Córdoba. Additionally, he is since 2020 an Associate Professor of Clinical Prosthodontics II as well as in Endodontics at the Catholic University of Córdoba, where he has been the Director of the Department of Oral Rehabilitation since 2017.

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