CLINICAL

Biomimetic restorations

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Introduction

A 57-year-old male made an emergency appointment because his upper left central had snapped off the previous day while eating bread (Figure 1).

The patient's main concerns were his appearance and that he wanted as minimally invasive treatment as possible. He was also willing to consider having additional smile enhancement treatment in the future.

Despite the patient's last dental visit being three years ago, other than the sharp edges rubbing against his tongue, the patient was otherwise pain-free and was not experiencing any extreme sensitivity.

Upon examination, the presence of a non-complicated oblique fracture on his upper left central incisor involving both enamel and dentine was obvious (Figure 2).

Vitality testing using ethyl chloride elicited a positive response. Periapical radiography suggested there was no pathology either, so no endodontic intervention was required at this stage.

The patient had not kept the fractured piece of tooth, which meant we could not consider reattaching it using heated composite. Therefore, the most appropriate alternative at this stage was a stress-reduced direct composite resin class IV restoration utilising a biomimetic minimally invasive approach.

There was also the presence of a class III composite restoration on the UR1 that was exhibiting microleakage and untidy margins. This would be replaced at the same time.

The patient presented a class III malocclusion, with heavy occlusal contacts in the anterior region. Heavy attrition was detected on both the upper and lower incisors. Prosthetic space was limited, which would create an additional challenge.

Treatment planning

Various options were discussed including a ceramic restoration, but this would require more tooth reduction, which was something the patient was keen to avoid.

Consequently, because UL1 was vital, a biomimetic minimally invasive approach

Figure 1: Initial presentation extraoral view

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Figure 2: Initial presentation with black background for contrast

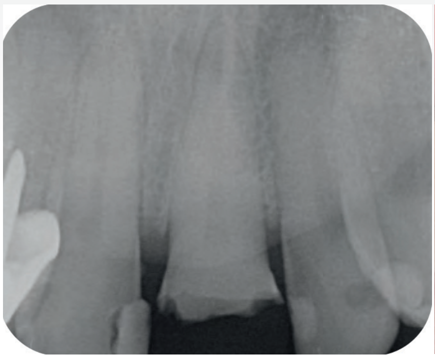

Figure 3: Periapical radiography showing fractured UL1 and UR1 with leaking class III

Figure 4: Shade selection using uncured composite buttons

Figure 5: Digital mock-up of final restoration using a mirror image of UR1

Figure 6: A mirror image during treatment planning

Figure 7: Primary anatomy, shape of mock-up with silicone matrix in situ

was recommended in order to preserve pulp vitality and maximise the longevity of the restorative work.

A stress reduced biomimetic approach was recommended because it is the gold standard and the least invasive option. This would be

a free-hand layered, class IV stress-reduced composite resin restoration on UL1. The faulty class III restoration on UR1 would be replaced at the same time.

A visit to the hygienist for a scale and polish was arranged, as well as a full case assessment consultation and follow up appointment.

As part of the treatment planning for the restoration of his fractured central incisor, a discussion was carried out to emphasise the importance of treating the existing malocclusion. This is in order to resolve the existing traumatic anterior relationship to protect and prolong the longevity of the other teeth and planned restorative work, and to improve function.

The patient agreed to proceed with a stress-reduced layered composite class IV restoration on UL1 and a replacement class III on UR1.

An Essix night guard would also be prescribed, pending a decision on corrective treatment for the malocclusion, which the patient accepted could put the anterior teeth and restorations at risk.

Biomimetic treatment protocol

Treatment began by taking appropriate extraoral and intraoral photographs (Figure 3).

Next, shade assessment was made by creating a button try-in (Figure 4) and a composite mock-up for the patient to approve (Figures 5 and 6).

I used Clearfil AP-X (Kuraray) shade A3D for the deepest layer of the dentine replacement, following a more superficial dentine replacement layer with Estelite Sigma Quick, shade OA3 (Tokuyama). I prefer to use the PLT version because it makes placement on the tooth quicker, easier and with reduced risk of waste. The enamel layer was added using Estelite Asteria (Tokuyama), shade NE, again using the PLT version.

The occlusion of the patient was checked and assessed in maximum intercuspation as well as during excursive movements. Adjustments were made on the palatal aspect as well as on the incisal edge of the mock-up.

Once the patient had approved the mock-up, I created a silicone index using Imprep AC Impression Material Putty Soft Rapid (Fast Set) dark blue from Unodent (Figure 7).

Local anaesthetic was administered before complete

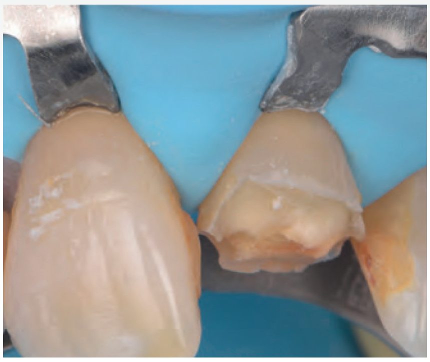

Figure 8: Rubber dam in situ

Figure 9: Initial reduction of enamel margins to create bevel. Class III in UR1 removed

Figure 10: Bevel refined for smoother transition and enhanced aesthetic result

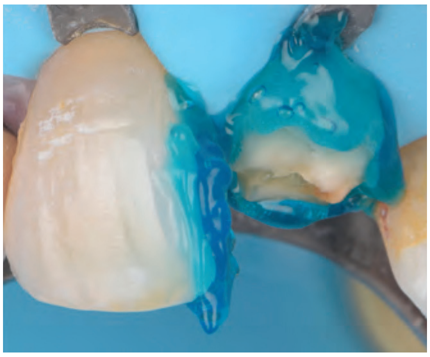

Figure 11: Selective enamel etching of enamel on UL1 and UR1

Figure 12: Frosted appearance after enamel etching completed

Figure 13: Immediate dentine sealing using SE Bond & Protect and Optibond FL adhesive and resin coating with 0.5mm Clearfil Majesty Flow in place

isolation was achieved using Isodam heavy blue rubber dam and modified B6 and B5 Brinker rubber dam clamps (Coltene) (Figure 8).

The interproximal surfaces of UR1 and UL1 were cleaned using an ultrasonic scaler before the existing failing class III composite restoration in UR1 was removed.

Restoration of UL1 began by preparing the tooth. This involved creating a minimal rounded bevel margin, removing any irregular and non-supported enamel prisms, and extending the fine bevel 2-3mm cervically using a diamond bur FG Medium Grit 556 (25) from Perfection Plus.

The bevel should be extended as long as the fracture extension (Figure 9). Afterwards, finishing of the preparation with a coarse abrasive disc (Optidiscs, Kerr) was performed to acquire a feathered limitless margin and allow seamless integration of the restoration into the environment. This facilitates a gentle shade transition to ensure an optimised aesthetic result (Figure 10). The surface of both the enamel and dentine was then conditioned by air particle abrasion using Aquacare 28µm aluminium oxide particles and an Aquacare air abrasion unit (Veloplex).

Selective enamel etching was performed with 37% phosphoric acid for 20 seconds, then rinsed and dried (Figures 11 and 12). The first stage of the restoration build-up was to provide immediate dentine sealing (IDS) to reduce postoperative sensitivity by sealing the dentine tubules and to increase the bond-strength.

A fourth generation self-etching two bottle adhesive system, SE Bond Seal and Protect (Kuraray), was used. The primer (bottle one) was gently rubbed onto the dentine only, air-dried to remove the solvent, before a second application of the primer was applied to the dentine only and again air-dried to remove the solvent. The bond (bottle two) was then rubbed onto the dentine only, and the excess was removed with a clean/dry microbrush. This was light-cured for 20 seconds.

Optibond FL (Kerr) (bottle two) adhesive was then applied to the sealed dentine surface and the excess was removed using clean Microbrushes (Centrix) before being light-cured for 20 seconds (Figure 13).

The second stage was to build a resin coat over the IDS by applying a 0.5mm layer of Clearfil Majesty Flow (Kuraray), shade A2, to the dentine area (Figure 14).

This will secure the hybrid layer and increase the bond

Figure 14: Biobase created with EvereX Posterior

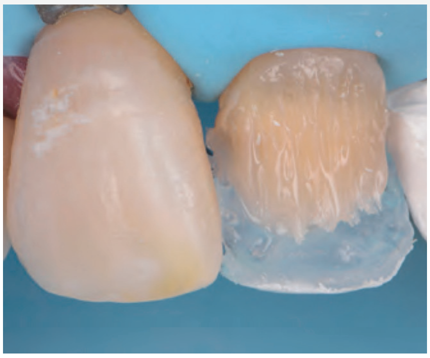

Figure 15: Initial build-up of palatal shell using Estelite Universal Flow Medium CE

Figure 16: Initial build-up after the clamp was replaced

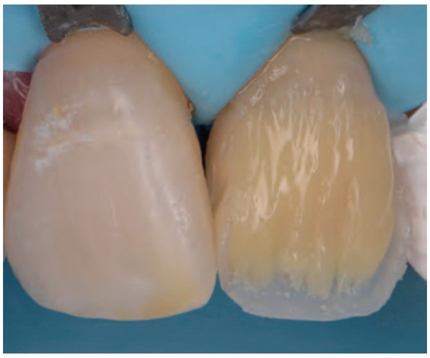

Figure 17: Initial build-up after the clamp was replaced

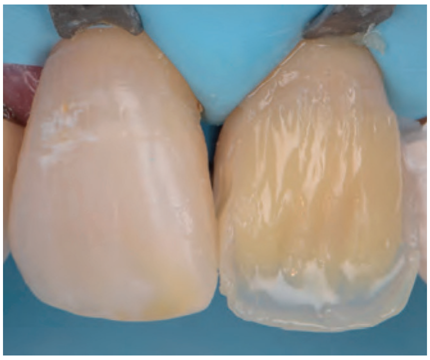

Figure 18: Adding intrinsic characterisation using white and ochre Estelite Color

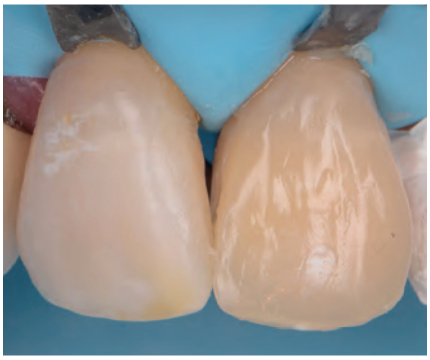

Figure 19: The enamel layer completed using Estelite Asteria NE. The restoration is really taking shape.

strength of the restoration to the tooth.

This was overlaid with Everex Flow (GC), shade A3, and finally Estelite Sigma Quick (Tokuyama), shade OA3, to complete the build-up of the deep dentine replacement area or biobase.

To begin the enamel layer build-up, more Optibond FL was applied to the etched enamel surfaces and any excess removed using clean Microbrushes. This was light-cured for 20 seconds.

The palatal shell was built-up using Estelite Universal Flow Medium CE (Tokuyama) and the silicone index created during the mock-up stage (Figure 15).

Once the palatal shell was in place, the clamp was repositioned (Figure 16) and the dentine mamelon replacements were built-up using Estelite Sigma Quick AO3 (Figure 17).

Characterisation was created using white and ochre Estelite Color (Tokuyama) (Figure 18) and Transopal Flow (Ivoclar).

The final composite layer, Enamel replacement on the labial aspect, was created using Estelite Asteria (Tokuyama), shade NE (Figure 19).

Because of their patented rapid amplified polymerisation technology, Tokuyama composite resins can be completely cured to a greater depth in just 10 seconds, but do not require such a high level of camphorquinone. This means that they have a longer working time in ambient light and don't experience the post-curing 'yellowing' associated with conventional composite resins with a higher camphorquinone content, as they 'age'.

A layer of glycerine gel was applied to allow full polymerization of the oxygen inhibition layer before a second light-cure for 10 seconds was applied.

Once cured, we finished working on

the tooth's primary anatomy, shaping the morphology using Optidiscs (Kerr) (Figure 20). The secondary anatomy was achieved with various shaped medium grit diamond burs.

We used H48LQ flame shaped tungsten finishing bur (Komet) for a more controlled and smooth finishing of our primary and secondary anatomy (Figure 21). Then Enhance (Dentsply) points and cups were employed to complete the finishing stage.

Final polishing was achieved using a combination of Optishine (Kerr), Flexicups and Flexipoints (Cosmedent) and – for the ultimate shine and finish – Diacomp Twist (Eve)

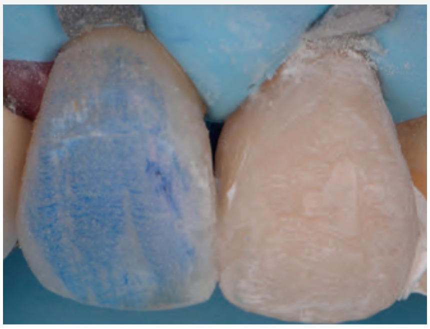
Figure 20: Creating the primary anatomy. Note the blue on UL1 to help highlight its morphology

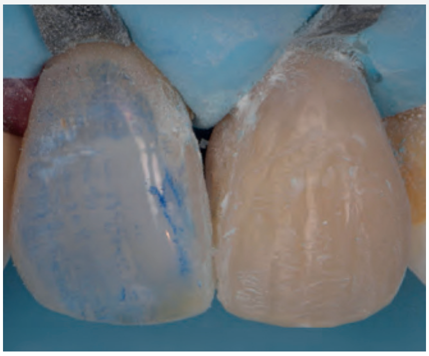
Figure 21: Creating the secondary anatomy including striations

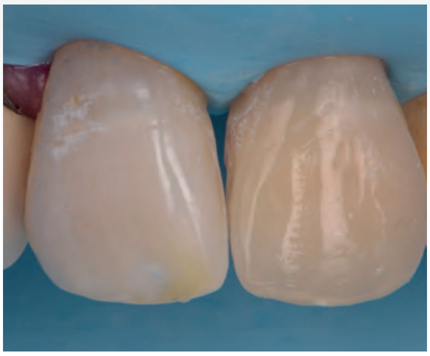
Figure 22: The final restoration after polishing


Figure 23: The final restoration

silicone polishers and Flexibuffs with Enamalize (Cosmedent) (Figure 22).

Because all Tokuyama composite resins are manufactured using patented spherical filler particles, I find it is possible to produce a significantly higher degree of shine in a significantly lower amount of time than is possible with any alternative brand of composite resin material. This saves me a lot of time and effort and the lustre is retained for a longer period of time (Figure 23).

Occlusal protection

TAs mentioned previously, the patient had a class III malocclusion, with heavy occlusal contacts in the anterior region.

There was evidence of heavy attrition on both the upper and lower incisors. Therefore, in order to protect the new


Figure 24: The final restoration after rubber dam removed


Figure 25: Intraoral view before and after


Figure 26: Extraoral view before and after

Figure 1: Initial presentation extraoral view

restorations and the rest of the dentition, an upper night Essix splint was prescribed along with appropriate occlusal adjustment to ensure proper function. An intraoral 3shape (Trios) scan was taken and the upper night guard splint was fabricated.

At the control appointment, and following complete rehydration of the teeth, optimal integration of the restorations on UR1 and UL1 was observed (Figures 24 to 27) – or rather not observed, as they were undetectable from the surrounding natural dentition.

The occlusion was assessed and stable bilateral contacts were established during maximum intercuspation and during excursive movements. However, there was a traumatic anterior bite still present that put the teeth and restorative work at risk.

We discussed the need for correction of the malocclusion and an extensive full examination appointment was offered to the patient, so that we could discuss this further.

We stressed the importance for a healthy mouth, free of disease and the need to replace the missing posterior teeth to improve function and prolong longevity of the dentition and restorative work. However, until this is delivered the patient will continue to wear the night guard.

The patient was extremely happy with the appearance of his new restorations and will be recalled for future appointments for a comprehensive examination and scale and polish with the hygienist.

Conclusion

This was quite a challenging case involving a seriously broken down central incisor. However, by utilising biomimetic principles and state-of-the-art restorative materials, it was possible to deliver a predictable, stress-reduced, hyper-realistic, direct composite restoration that blended with the environment.

We achieved a satisfying result for the patient that was relatively quick and easy. An outcome the patient was extremely pleased with.

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