Conservative smile makeover using resin infiltration and microabrasion

Shiraz Khan[1]

Introduction

A patient with severe hypomineralisation defects was offered comprehensive indirect restorative treatment to give a dream smile. This case study demonstrated the advances in minimal intervention dentistry and outlines an ultraconservative approach to improving the patient's smile; but, above all, quality of life.

The dentist's armamentarium has vastly increased in the last decade, with what seems an exponential improvement in technology and materials at dentist's disposal to treat patients.

Use of techniques such as orthodontics, Icon resin infiltration, air abrasion and direct composite restorative techniques, not only provided this patient with an aesthetic result, but also a result that, biologically speaking, cost less, and subsequently will extend the longevity of her teeth. Ultimately, this case fulfils the goals of the 'daughter test', while maximising aesthetics.

As described by Banerjee (2013), minimal intervention dentistry (MID) is a contemporary approach to dentistry that requires ultraconservative operative management of patients. The ethos and philosophy behind this approach aims to keep teeth functional for life (Frencken et al, 2012).

As we are aware the nature of management of caries, broken teeth generally requires some form of loss of tooth tissue. In the example of dental caries, a cavity will present, but the preparation process requires loss of tooth structure to access the lesion, adequately remove bacteria and debris, for a restoration to be placed. Advances in the materials and techniques have made early caries management significantly less intrusive on the tooth's structure.

For instance, the use of air abrasion for cleaning stained fissures, with cavities only just forming in dentine, can be managed in a way without the need for spurious preparation, and the creation of retention and resistance form (Hedge and Khatavkar, 2010).

This has been complemented with parallel advances in adhesive dentistry, which can achieve significant bond strengths to enamel and dentine that has been considered as central to minimally invasive restorative dentistry (Burke et al, 2017).

The process of MID does not only apply to operative management of dental

[1] Dr Shiraz Khan BDS, B(Med) Sc(Hons), MJDFRCS(Eng), PGDip, PG Cert
Private practice, London, UK

Figure 1: Preoperative situation

Figure 2: Pre-restorative orthodontics

Figure 3: Pre-restorative whitening

Figure 4: Split dam isolation due to fixed retainer

Figure 5: Finalisation of isolation with Liquid-Dam

Figure 6: First Icon etch cycle application

Figure 7: Washing and drying of tooth post-etch cycle

caries. The process of being able to improve self-confidence associated with smiling is also a central pillar of any aesthetic dentistry.

Kelleher (2010) summarises the needs to not be driven down cosmetic or aesthetic procedures by patients for improvement in appearance. The subsequent biological cost associated with conventional management strategies for improvement of appearance, such as crowns or veneers, directly opposes the key facet of ensuring teeth remain functional for life.

This does not imply that crown and veneer restorations are not indicated in aesthetic dentistry, but rather, what are the alternative treatment options for improvement in aesthetics for patients.

These should all be presented to the patient in order of biological invasion, relative risks and benefits and appropriate costs. While, as dentists, we are providing a service for patients, as outlined by the 'daughter test', if a provider is unhappy with undertaking a certain treatment modality, refusing treatment should not be considered taboo. Instead, having the patients interest and health should be at the forefront of any treatment plan or proposed treatment options.

Figure 8: Application of Icon Dry (test-drive for infiltration)

Figure 9: Re-etch application for two further cycles with air abrasion

Figure 10: Application of Icon Dry (test-drive for infiltration)

Figure 11: Further etching and air abrasion result

Figure 12: Application of Icon Dry (test-drive for infiltration) showing satisfactory masking

Figure 13: Resin infiltration application

Figure 14: Light curing after three minutes

Figure 15: Re-resin infiltration application, accounting for shrinkage stress

Case Presentation

A 25-year-old female was a self-referring patient who wanted to improve her smile. Having had previous 'smile consultations' the patient was quoted £25,000 for 10 upper ceramic veneers to guise the appearance of these hypoplastic teeth. She was also keen to have such work done; however, the patient had moved job and the practice was difficult to reach.

Medically, the patient was fit and well, not taking any regular medication, with no known allergies. The patient was also a regular dental attendee and would see the hygienist at routine, six-monthly intervals. The patient would rarely eat sugary snacks, and would mainly consume water.

Extraoral examination was unremarkable with no deviations, clicks or crepitus on opening. The intraoral soft-tissue was unremarkable with no ulcerations/patches or discolourations to note. And the hard-tissue was free from dental caries, mild wear and no fractured teeth.

Diagnosis

The patient was diagnosed with the following:

- Chronic marginal gingivitis
- Retained lower Es with poor prognosis
- Severe generalised enamel hypoplasia
- Orthodontic crowding.

The patient was generally caries free; however, the discussion regarding the lower Es was queried about the long-term prognosis. A decision-making process would be made between the orthodontist and patient regarding space creation, and longevity of these retained lower Es.

Figure 16: Light curing after two minutes

Figure 17: Immediate post-infiltration picture

Figure 18: Application to achromatic composite to restore vestibular defect

Figure 19: Polishing

Figure 20: Immediate postoperative result

Figure 21: Preoperative smile

Figure 22: Postoperative smile

Figure 23: Preoperative (post-orthodontic) retracted anterior uppers

An initial phase of supra and subgingival scaling and prophylaxis would be undertaken prior to any aesthetic-restorative dentistry.

Discussions with the patient

In the patient's words, they were keen to 'improve the appearance of her teeth, mainly the white spots'. The case was presented to the patient with a large screen and discussions of what the 'aesthetic concerns' were. The patient had not previously considered orthodontics; however, would consider pre-restorative orthodontics. Furthermore, the patient was also advised that although veneers are an aggressive treatment strategy, this would be the only method of disguising the white spots.

The discussion then opened up regarding more minimally invasive methods for white spot lesion removal. The patient had never heard of Icon, and initially did not believe this would work. The patient was advised this is a severe case of enamel hypoplasia and the subtle preparation to the enamel surface would likely be required, in the form of air abrasion; however, this would be the most conservative way to manage this case.

Subsequent bonding would also likely be required to fill the defects where the Icon/air abrasion had taken place; however, the patient would be able to mask the lesions without the need for drilling/shaping the teeth for full/part coverage indirect restorations.

Treatment options for the patient

As discussed in the earlier introduction, all of the treatment options are required to be discussed with the patient, including their relative merits and downfalls, in order to

Figure 24: Postoperative retracted anterior upper

Figure 25: Postoperative retracted upper lateral views

ascertain adequate consent (GDC standards). In this case, we discussed the restorative options in ascending order of level of invasion:

1. Do nothing – although this negates the reason for the patient's appointment
2. Whitening – this will lead to the whitening of the white spots in addition to the natural tooth; therefore, this may worsen the scenario
3. Microabrasion – the is a minimally invasive manner to reduce white spot appearance; however, usually requires very superficial white lesions
4. Icon resin infiltration – this will require fine enamel preparation and several cycles, but would be the least invasive way to get complete blending of the white spot lesions
5. Direct composite restoration – this will require enamel and dentine removal of the white spots for these to be subsequently restored
6. Direct composite veneers – this may still require enamel preparation, but either an application of a base opaque layer to mask the white areas or subtle enamel preparation, or opaque composite application; losing the vitality of the teeth
7. Indirect veneer restorations – although flexibility with material choice, due to longevity, and ability to hold lustre and polish for extended periods of time, porcelain would likely have been the restorative material of choice. This is the most invasive option, and will likely cost the most.

Icon resin infiltration

Enamel hypoplasia and other traumatic dental injuries can appear on teeth as white, yellow or brown discolourations. Hypoplasia is characterised by reduced enamel thickness, pits and opacities, as well as other irregularities. Although the hardness remains intact, there is a large variation in size and severity (Andreasen et al, 1971).

The appearance of white spots occurs due to variation of refractive indices between enamel crystals and the medium inside the porosities (opacities) (Andreasen et al, 1971). The difference between water and air is 1.33 and 1.0, which is sufficient to see a difference in dispersion of light.

Icon resin infiltration is a process that allows alteration of the refractive index of opaque white spots to RI 1.62, which appears similarly to enamel RI 1.65; thereby leading to masking of white spots (Torres et al, 2011). This does not require removal of the white spot, but instead access to the white lesion and use of a low-viscosity resin, which infiltrates the lesion driven by capillary forces (Meyer-Lueckel and Paris, 2008) and subsequently blends the RI of the white spot to the surrounding enamel. As Kim et al (2011) also found resin-infiltration is a more than suitable treatment approach and modality in masking white spot lesions.

Treatment rationale

As listed, the options vary greatly in cost, both financially and biologically. The patient was thrilled about having natural looking teeth; however, as part of education, the patient was debating whether veneer restoration would be the treatment modality of choice.

The fundamental core aspect in the decision-making process was not financial, more biological. Adopting the 'daughter test' (Kelleher, 2010) mentality, most practitioners would be happy to minimise intervention on the patient if a suitable aesthetic outcome was achievable.

The patient was advised that likely a combined approach may solve this case in the most conservative method as possible. If the patient was interested in having her teeth aligned, this would provide an optimally aesthetic result without having to over-prepare certain teeth to make the indirect restorations all aligned.

Final treatment plan

1. Full mouth supra and subgingival scaling and prophylaxis
2. Orthodontic alignment (carried out by orthodontist with fixed labial)

Figure 26: Before and after standard, monochrome and hyper-contrasted views

Figure 27: Before and after result

3. Whitening
4. Icon resin infiltration and labial bonding UR3-UL3 (to correct concavities post-Icon etch).

Composite bonding

As outlined by Dietschi et al (1995), any restoration from class III to V can adequately satisfy many aesthetic concerns when restored with composite resin. These articles outline the use of varying opacities of composite, dentine and enamel, to recreate natural-looking effects and restorations. Focusing more on this case, the likelihood of requiring such advanced layer techniques may be completely omitted.

There will be sufficient underlying dentine, and enamel, with the exception of the UL1 incisal edge, which may require dentine. Composite bonding can be completed in isolation, without resin-infiltration; however, as outlined above, Icon uses hydrochloric acid to enable subtle, but minimal, enamel erosion that will lead to a defect being created.

This defect will then be covered by composite resin. Therefore, the function of the composite is not to mask the 'remaining' white spot, if any, but rather to create a smooth homogenous surface that fills the void created by the Icon etching (and/or air abrasion).

This is so much the case that the composite chosen will often be achromatic in nature, which subsequently allows the natural tooth colour to shine through the resin material. Although the material has undergone significant advancements in the past two decades, the material, and indeed the bonding, does degrade over time. As outlined by Drummond (2008), the main mode of failure of composite is either degradation of the resin matrix, or the interface between the filler and resin matrix.

Evidence also seems to suggest that failures in less than five years tend to be more technique associated, while those after five years tend to be due to secondary caries, rather than failure of the composite itself. Concomitantly, this reflects the requirement for adequate isolation (Cajazeira et al, 2014) during all adhesive procedures, and effective oral hygiene prior to commencing any restorative dentistry.

This case the composite of choice was Tokuyama Asteria Estillite Composite restorative material. This is a nano-hybrid composite material that not only has excellent filler proportion (82% b/w), but, in the author's experience, has great handling characteristics, and excellent final polish.

By contrast, a study by Moraes et al (2009) describes nano-hybrid composites as having inferior properties to nano-filled composites; however, in a non-load bearing

situation such as this case, it is extremely unlikely that the physical properties will play a significant role in long-term success.

Furthermore, using various forms of surface treatments will ensure the composite repair provides, predictable, effective bonding and repair, should there be any fractures (Margareta et al, 2010). This, ultimately, leads to composite being the restorative of choice.

Treatment sequence

The patient undertook supra and subgingival scaling and prophylaxis prior to commencement of treatment. The orthodontic treatment included 14 months of labial (ceramic) fixed braces to improve alignment, relieve crowding and improve gingival level symmetry.

The patient was placed in fixed and removable retention indefinitely. The patient was requested to remove the fixed retainer prior to any bonding/Icon, however, the patient was very anxious during the composite removal of the brackets during the debond procedure, and subsequently requested if this could be left.

The patient then undertook two weeks of home-whitening using 10% carbamide peroxide for seven days, and 16% carbamide peroxide for a subsequent week. The system used in this case was Enlighten. There is importance in ensuring a minimum period of 14 days from cessation of whitening to start of bonding. Not only does the improved value of tooth substrate begin to stabilise but also a statistically significant reduction in bond-strength (Garcia-Godoy et al, 1993).

After two weeks of whitening, followed by two weeks for stabilisation, the patient was booked in for the restorative appointment. A preoperative shade assessment was undertaken with white enamel (WE) from Tokuyama Asteria Estillite composite being a mutually agreed shade match, by patient, dentist and nurse.

The upper premolar-premolar were isolated using Unodent heavy rubber dam. There was a modified split dam approach as the patient kept their bonded retainer on. This was modified using Liquidam. The pellicle of was subsequently removed 4-4 using a slow handpiece and a prophylaxis brush.

The process of resin infiltration occurs as follows. Icon etch contains, 15% hydrochloric acid, which is applied for two-minute intervals. This translates to approximately 50µm enamel removal. The etch is washed for 30 seconds, then Icon Dry an 99% ethanol-based liquid, is placed over the teeth.

This is the most significant aspect of any Icon treatment as it gives the opportunity to review whether the lesion will be adequately masked or not, a test-drive if you will of what the tooth will appear like after resin-infiltration.

In this case, as can be seen by the severe hypoplasia, there will likely be a requirement for subtle enamel preparation to access the white spot. This is repeated for three to four cycles.

If sufficient improvement is not noted, then you would consider adjunctive measures. In this case, the UL1 specifically was treated with air abrasion. This was using 27µm aluminium oxide particles for 30s at pressure of two bar. Then a reapplication of Icon etch was used. After two further cycles of etching and air abrasion, the Icon dry showed satisfactory masking of the white spot lesion.

Therefore, it was time to infiltrate with resin. Resin infiltration requires a two-minute application and agitation on the teeth, followed by a one minute for the resin to remain undisrupted on the teeth. This is followed by excess removal and teeth separation (using floss) and curing for 30 seconds on each tooth. A second application is repeated for two minutes and cured to account for contraction shrinkage.

We are then able to restore the void with composite resin. Here, it is important to stage that the use of composite is not to mask the white spot, rather to fill the void; therefore, the use of an achromatic enamel is sufficient.

In this case Asteria Estillite was used, using WE to fill the voids. This was applied generally 2-2. As research suggests (Wiegand et al, 2011), using adhesive with Icon increases the bond strength. In the authors experience, bottle 2 from Optibond FL is used routinely.

This is subsequently cured for 30 seconds and the labial composite increment is placed. The final increment is cured under an oxygen barrier medium to remove the oxygen inhibition layers and optimised stability and hardness (Strnad et al, 2015). In this case, liquid strip (Ivoclar Vivadent) was used. Finally, a combination of Soflex discs (3M ESPE) and Astropol were used (Ivoclar Vivadent) as these have also proven to have the smoothest topography under SEM (Marghalani, 2010).

Conclusion and reflection

MID is proving to provide dentists alternative skills under their armamentarium. However, the most significant point, is these additional techniques are proving to allow the teeth incur less biological cost, while maximising their longevity.

While this case demonstrates a fair result, the treatment had surpassed all patient expectations. The key in this case is long-term evaluation, and to consider how this case will fair in 12 months, five years and 10 years.

However, a significant advantage is that composite can be stably repaired, added and subtracted; therefore, rendering this the treatment of choice in this 25-year old female patient. Although this was not an absolutely perfect result, the patient was delighted with the treatment, as she was managed in an ultraconservative manner.

The patient undertook supra- and subgingival scaling and prophylaxis prior to commencement of treatment.

Although composite bonding was undertaken, what is shown by this case is the relevance of the infiltration of the white lesions, and not removal, which led to masking of all the white spots. The composite was merely adjunctive to reduce the concavities created by HCl etching. Therefore, this case demonstrates the power of Icon Resin infiltration.

Advances in adhesion, composite technology and resin infiltration approaches, not only make this a feasible treatment option, but rather, the treatment option of choice in such cases; and, ultimately, would be what we would consider as suitable treatment if this patient was any clinician's daughter.

References

Andreasen JO, Sundstrom B, Ravn JJ (1971) The effect of traumatic injuries to primary teeth on their permanent successors. I. A clinical and histologic study of 117 injured permanent teeth. Scandinavian Journal of Dental Research 79: 219-83

Bannerjee A (2013) Minimal intervention dentistry: part 7. Minimally invasive operative caries management: rationale and techniques. British Dental Journal (214): 107-111

Burke FJT, Lawson A, Green DJB, Mackenzie L (2017) What's New in Dentine Bonding?: Universal Adhesives. Dental Update 44: 328-340

Cajazeira MR, De Saboia TM, Maia LC (2014) Influence of the operatory field isolation technique on tooth-coloured direct dental restorations. American Dental Journal 27: 155-159

Dietschi D (1995) Free-hand composite resin restorations: a key to anterior aesthetics. Practical periodontics and aesthetic dentistry. PPAD 7(7): 15-25; quiz 27

Dietschi, D (2001) Layering concepts in anterior composite restorations. Journal of Adhesive Dentistry 3(1): 71-80 Drummond JL (2008) Degradation, fatigue, and failure of resin dental composite materials. Journal of Dental Research 87(8): 710-719

Frencken JE, Mathilde PC, Manton DJ, Leal SC, Gordan VV, Eden E (2012) Minimal Intervention Dentistry (MID) for managing dental caries – a review: report of a FDI task group. International Dental Journal 62(5): 223-243

Garcia-Godoy F, Dodge WW, Donohue M, O'quinn JA (1993) Composite resin bond strength after enamel bleaching. Operative Dentistry 18: 144-144

Hegde VS, Khatavkar RA (2010) A new dimension to conservative dentistry: Air abrasion. Journal of conservative dentistry JCD 13(1): 4

Kelleher MGD (2010) The 'Daughter Test' in Aesthetic ('Esthetic') or Cosmetic Dentistry. Dental Update 37(1): 5-11 Kim S, Kim EY, Jeong TS, Kim JW (2011) The evaluation of resin infiltration for masking labial enamel white spot lesions. International journal of paediatric dentistry 21(4): 241-248

Marghalani HY (2015) Effect of finishing/ polishing systems on the surface roughness of novel posterior composites. J Esthet Restor Dent 22(2): 127-138

Meyer-Lueckel H, Paris S (2008) Improved resin infiltration of natural caries lesions. Journal of Dental Research 87: 1112–1116 Moraes RR, Goncalves LS, Lancellotti AC, Consani S, Correrr-Spbrinho L, Sinhoreti MA (2009) Nanohybrid Resin Composites: Nanofiller Loaded Materials or Traditional Micohybrid Resins? Operative Dentistry 34-5: 551-557.

Rinastiti M, Özcan M, Siswomihardjo W, Busscher HJ (2010) Immediate repair bond strengths of microhybrid, nanohybrid and nanofilled composites after different surface treatments. Journal of Dentistry 38(1): 29-38

Strnad G, Kovacs M, Andras E, Beresescu L (2015) Effect of curing, finishing and polishing techniques on microhardness of composite restorative materials. Procedia Technology 19: 233-238

Torres CRG, Borges AB, Torres LMS, Gomes IS, Simões de Oliveira R (2011) Effect of caries infiltration technique and fluoride therapy on the colour masking of white spot lesions. Journal of Dentistry 39(3): 202-207

Wiegand A, Stawarczyk B, Kolakovic M, Hämmerle CHF, Attin T, Schmidlin PR (2011) Adhesive performance of a caries infiltrant on sound and demineralised enamel. Journal of Dentistry 39(2): 117-121

Reprinted with permission from Aesthetic Dentistry Today August 2019