Space redistribution: a full mouth closure

Sahil Patel, additional to be added??

When presented with a case of diastemata across upper and lower teeth, the clinician must balance aesthetics within functional parameters. Disproportional and asymmetric spaces have ultimately led the author to believe these cases are destined to an aesthetic compromise. This case report outlines the journey and struggle in redistributing space across multiple teeth (*Figure 1*).

Data Collection

The patient, a 32-year-old male attended with a long standing desire to close the spaces between his teeth. He was not exposed to orthodontic correction as an adolescent, and serves within the United States Air Force, which requires him to frequently relocate. His dental state was analysed via a data collection chart, customised by the author, based on occlusal, periodontal, orthodontic indices commonly in use, combined with aesthetic parameters.[1-3]

The pre-operative occlusion showed no anterior guidance, and bilateral group function across canines, premolars and first permanent molars (*Figures 2-15*).

Figure 1

Space re-distribution

Excess space may be managed in multiple methods, depending on the aetiology. In this case, a combination of genetics, diminutive lateral incisors and anterior-posterior maxillary excess contributed to the clinical appearance. Whilst orthodontics could retract the anterior segments and translate teeth efficiently along pre-adjusted edgewise appliances, the potential for relapse is relatively high.[4,5] In addition, the diminutive lateral incisors would require treatment in combination with orthodontics, which excludes any options that do not commit the individual to the restorative cycle. A purely restorative approach is complicated by there being an asymmetric spread of space and the midline diastema potentially limiting ideal proportions.[6] An indirect workflow was chosen, as the advantages of composite resin in this case were negligible, due to the preparation necessary being approximately equal to that of ceramic. The space closure required

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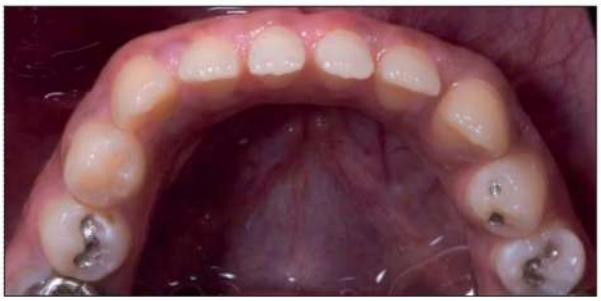

Figure 14

Figure 15

a significant thickness and tissue pressure of ceramic onto the gingivae in the form of overhangs from the abutment margins. The ability of developing a high lustre extra-orally via ceramic processing is a major advantage in optimising the gingival response and cleansability long-term. In order to ascertain the achievable aesthetics, a diagnostic wax-up was developed with an aim to distalise the excess space, whilst minimising restorative intervention. This was presented to the patient in the form of a direct transfer intra-orally via bisacrylic resin in a silicone transfer matrix. Preservation of a minimal mid-line diastema was included for the patient to determine if full closure was his desired course (*Figures 16-21*).

Treatment options were to employ a joint orthodontic-restorative approach, or purely restorative. The patient showed adequate competence and capacity to consent and felt that due to his Armed Forces commitments, a restorative route was his preference. The consent process for elective dentistry included the patient's decision based on material risks pertinent to the situation, and within the constraints of what is considered evidence based and safe within the clinician's ability[7-9] (*Figures 22-24*).

Figures 16-21

Occlusal management and intervention

It is recognised in orthodontics that closure of anterior open bites is high risk for relapse.[10] Similarly, restorative procedures used to close anterior open bites have anecdotally been reported to heighten the risk of restoration fracture. The causes for this are likely owing to adult patients having a larger adapted envelope of function, which is often constricted by elective treatment. If this breaches the adaptive capacity, breakage, fremitus, pain and pocket formation are common signs of overloading.[11] On assessment within a semi-adjustable articulator, the pre-operative occlusion was primarily distributing occlusal forces on the premolars and first molars. There was little sign of destructive patterns developing, and the wear was within physiological parameters. The decision was made to partially close the anterior open bite, with a shallow anterior guidance. The guiding surfaces of the canines and premolars were designed to not steepen the existing pattern and ensure that full freedom of movement was still possible. Treatment included upper right second premolar- left second premolar (15-25), and lower left first premolar- right first premolar (34-44).

The principles of an occlusal compass are excellent ideals to strive for, however, cannot fully be realised for all cases.[12] Increasingly complex diagnostic and execution methods exist,[13-15] which may be reserved for cases where the maximum intercuspation position and vertical dimension are

Figure 22

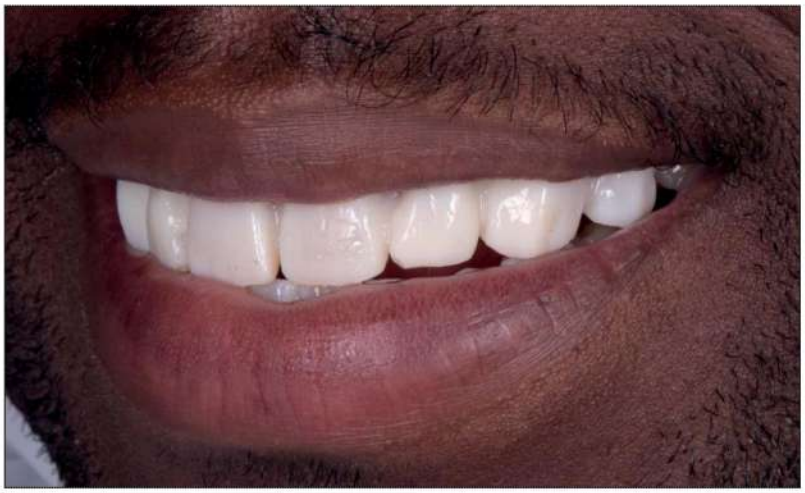

Figure 23

Figure 24

unsatisfactory and destructive. It is acknowledged that in order to provide elective treatment, a broad understanding of material properties and biological parameters is paramount. In the current climate of reducing intervention, it is the author's aim to solve aesthetic issues in a preservative manner that mitigates long-term risk. To this end, restorative preparation was initiated by revalidating consent for treatment by replacing the bisacrylic resin transfer directly onto the unprepared teeth. This functioned as a second opportunity to note aesthetic improvements, and occlusal accuracy. A short video clip was recorded to establish the effect the treatment progression had on 'F', 'V', 'E' and 'S' sounds. Local anaesthesia was administered and depth cuts made according to the wax-up up ensured maximum preservation. Mesialisation of the upper abutments was the chosen strategy to allow closure of the midline diastema without creating disproportionate height-width ratios. Non-osseous crown lengthening was carried out in selected areas to assist with tooth proportions: 13, 11, 21, 22, 23, 33, 32, 31, 41, 42 and 43. The alveolar crests were measured prior to gingivectomy via a fully rectified electrosurgery unit.[16] The connective tissue was ensured to be adequate for healing and maintenance of biologic width. In using an established method to preserve tooth structure,[17,18] in many cases it is possible to retain the bonding area to 90% within enamel. The presented case was prepared with feather-edge apical margins, which are critical to retaining the cervical enamel, which is often only 0.3mm. The final feature of the preparation was undercut removal, which allows the technician to conceal the margins within deflective areas, as well as maximise bonding area. The 22 was minimally prepared to accept a full coverage restoration (*Figures 25-33*).

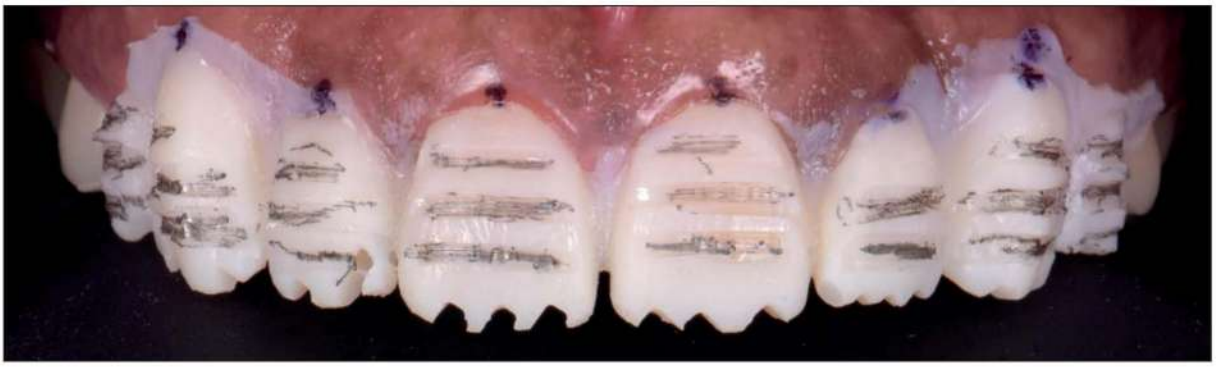

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Figure 33

Prior to impression making, the gingival tissues were displaced with a 15% aluminium chloride and kaolin based retraction paste. Various techniques exist to reliably capture abutments, such as single stage, two stage, copper-band technique, as described by Mizrahi 2011,[19] or intra-oral scanners. A single stage vinylpolysiloxane was used for the working impression for its proven simplicity and accuracy in impressing multiple abutments. Provisional restorations were placed with a spot-etch, adhesive resin and shrink-fit bisacryl resin approach.

Cleansability was ensured by opening interproximal spaces with fine diamonds, such that rigid dental floss may be passed through. Modifications were made with flowable composite resin until the aesthetics requirements had been met. An upper impression via an irreversible hydrocolloid was taken to provide a basis for fabrication of the definitive laminate veneers and crown. The patient was instructed to maintain rigorous oral hygiene and evaluate the temporary veneers over the appointment interval[6] (*Figures 34,35*).

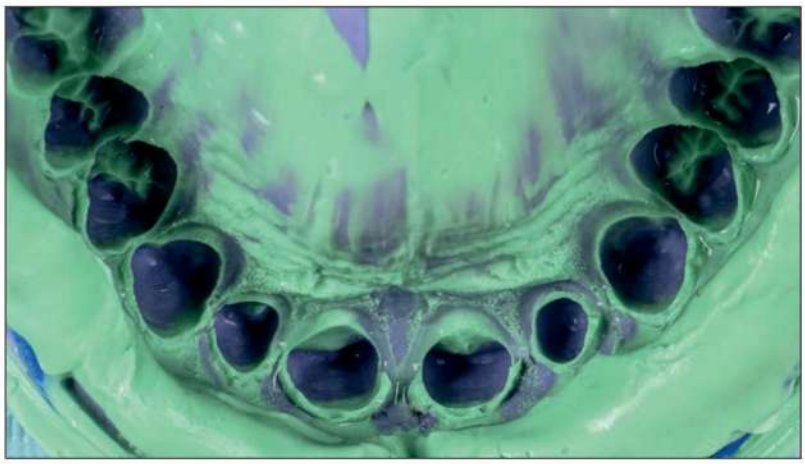

Figure 34

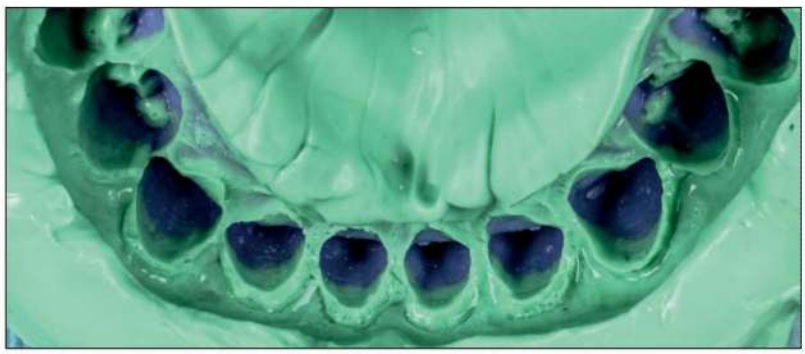

Figure 35

Ceramic processing

Firstly, it is the belief of the author that technical steps alone are not sufficient, as pro-dentals, maintaining passion and compassion are significant factors in creating the work depicted. The impressions were initially verified to not be distorted, as the patient approved provisionals were the guide for the ceramic restorations. The first cast was used for single dies, followed by a second cast full model, which is the technician's preference to work with. The dies were ditched preserving sub-gingival margins and in the case of infinity margins, a false margin created slightly below the depth of the impression.

The single dies, solid model, and provisional model were digitally scanned and overlaid to ensure space parameters were respected, and once designed, the frames were milled in wax and pressed in a low translucency BL2 zirconia reinforced lithium disilicate. Following divestment, the reaction layer was removed, and frameworks fitted down in a controlled stepwise manner, to avoid marginal fracture. The fit of the frames were finally confirmed on the solid model prior to ceramic layering:

1 **Regeneration Cycle:** Following refinement of the frameworks, microfractures are 'regenerated', to maintain their integrity.
2 **Sprinkle Firing**: The frameworks were coated in glaze liquid followed by a sprinkle of Opal Essence 1, ensuring to turn the frame, as this allows the liquid to

Figure 36

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Figure 41

be fully absorbed within the ceramic particles. This stage was fired at 760°C for 60 seconds to increase value, and create micromechanical texture to bond the subsequent porcelain.

3 **Dentine Firing**: This stage is isolated due to the complexity in working on greater than two units. The coverage of dentine porcelain will vary across the frames, therefore creating a shrinkage differential. Isolating this step allows control over the chroma across all abutments. This was fired at 750°C for 60 seconds.

4 **Effects Firing**: Well documented colours within teeth such as increased chroma at the neck, raising value across the mid-buccal, blue/violet across disto-incisal and warmth across the mid-incisal may be considered depending on the case requirements. Mammelon effects were combined with glaze medium, which allows it to give an illusion of depth of colour within the build.

5 **Enamel Firing**: As the primary corrective stage of previous steps, it also allows texture creation and contact adjustment. The marginal areas were refined to ensure an ideal gingival response.

6 **Glaze firing**: A sand paper cone is used to smooth the polished surface, whilst retaining the texture incorporated within the build. The glaze cycle was set at 725°C for 60 seconds in order to seal the ceramic, without use of glaze liquid or powder.

Upon cooling, the restorations were verified against an incisal transfer matrix of the approved patient provisionals, and adjustments made

where necessary. The intaglio surfaces were etched for 60 seconds with hydrofluoric acid 9.5%, washed and dried (*Figures 36-41*).

Insertion

Following the temporisation period, minor changes were requested to the shape of the central incisors. The bisacryl resin provisional veneers were removed via torsional stressing, and the abutments were mechanically cleaned and treated with 4% chlorhexidine gel. A transparent water based try-in paste was used to ascertain the colour integration, as well as to reaffirm the aesthetics to the patient. Intaglio surface treatments included cleaning of contaminants with phosphoric acid, followed by a two-part silanisation process. The silane reacts and forms covalent chemical bonds with the exposed hydroxyl groups on the ceramic surface.[20] The abutments were isolated with an elastomeric retraction ring and treated with phosphoric acid for 30 seconds, a three-step etch-rinse bonding system, followed by the corresponding clear resin light cured cement. A flowable veneer cement is the author's preferred material due to the pairing with try-in gels, and ability to seat restorations without high seating stress. It is recognised that preheated restorative composite resin may be used without affecting the film thickness.[21] The accurate and positive seating of the veneers was confirmed multiple times through firm apical-buccal pressure with three phases of tack curing. Excess cement was removed with a No.12 surgical blade, hand scalers and dental floss.[22-24]

Occlusal parameters were initially assessed with 40 micron articulating paper in maximum intercuspation position (blue), and in all excursions (red). The priority was to avoid introducing additional interferences or steepening of existing lateral guidance. A stepwise method for reducing interferences was used as per Dr Lane Ochi's selective grinding sequence, originally developed by Solnit. The existing working and non-working side interferences had been adapted to by the patient and any additional loading may disrupt this beyond the adaptive capacity. A light anterior guidance was introduced across coupled central incisors, and during the four week test-drive in provisional veneers, this showed no fremitus, discomfort or breakage. Adjustments were made with a fine convex diamond, and polished with three grades of polishers. Guidance patterns were shallowed to provide smooth excursions but without excessive removal, that would risk mutilating aesthetics and introducing non-working side interferences.[25,26] Excessive loading of the ceramic-tooth interface is controlled in this way, which was reconfirmed at the review appointment (*Figures 42-58*).

Clinical advancement

1. Photographing the case after 12 months will ensure gingival maturation, improving the soft tissue aesthetics.
2. Axial inclinations of premolars could be improved, however, this was limited by functional parameters.

Acknowledgements

The author wishes to credit the ceramist, Rachelle Webb, and dental assistant, Zoe Allaway, in providing their support throughout this case. The clinical images that support this case have been presented as photographed. Editing was restricted to crop, rotate and global changes.

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