

Aesthetic rehabilitation: Using provisional restorations to improve results in complex restorative cases

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The aesthetic rehabilitation of patients with a functionally compromised dentition frequently involves a multidisciplinary approach incorporating several different treatment modalities. A correct aesthetic and functional diagnosis with an appropriate treatment plan as well as careful material selection and application are critical factors in the successful restoration.

The following case presentation demonstrates a multi-disciplinary approach to recreate an aesthetic smile in a female patient with a functionally and aesthetically compromised dentition.

Patients requiring prosthodontic rehabilitation often have multiple concerns (aesthetic, functional and health) and have left rehabilitation for some time due to fear, cost and time constraints. It is the goal of treatment to provide an aesthetic and functional dentition with minimal maintenance over the long term.

The clinician has in their armamentarium the choice of contemporary aesthetic materials allowing the delivery of a truly lifelike and natural smile. The emphasis is on a team approach that includes the dental ceramist, dentist and patient. This is essential to achieve the desired results when a multidisciplinary approach is indicated.

Case presentation

A 55-year-old patient presented with aesthetic concerns and dissatisfaction with her existing smile and occlusion (Figures 1-4). Medically she was fit and well and had adequate oral hygiene. Diagnostic information was acquired prior to treatment consisting of diagnostic models, photographs, periodontal charting and radiographs.

The patient reported no parafunctional habits, however analysis of her dentition exhibited evidence of wear facets and an unstable occlusal plane due to loss of teeth, migration and over-eruption. The patient was comfortable with the vertical dimension and had no muscular or joint symptoms.

Smile analysis

A detailed analysis of the patient's smile concluded the following:

- Incisal edge display: satisfactory;
- Central incisor proportions: the width to length ratio (ideally being 77% for a central incisor) revealed very square, squat central incisors;
- Midline and canting: midline is slanted with a discrepancy between the midline and the mid-facial vertical plane. The maxilla has a cant to the left with subsequent asymmetry;



Figure 1. Smile photograph showing asymmetry in smile, maxillary cant, slanted midline, negative buccal corridor and poor axial inclinations.



Figure 2. Retracted frontal photograph.



Figure 3. Left lateral retracted photograph.



Figure 4. Right lateral retracted photograph.

- Axial inclinations of teeth: an aesthetic smile has teeth with a slight mesial inclination of the vertical axis with the centrals straightest with gradual increase in inclination posteriorly. The posterior teeth should flow with the inclinations creating smooth transition from anterior to posterior. The patient's teeth have poor alignment in relation to the rest of the maxillary teeth;
- Negative space: in the full smile, the patient has dark regions in the buccal corridor giving her a narrow smile and the appearance of missing teeth;
- Smileline: incisal edge positions of the lower lip in a convex shape in a symmetrical manner. With the patient's smile there is a definite asymmetry to her smile due to the cant of the maxilla; and
- Gingival aesthetics: tissues should be symmetrical, with even scalloping and gingival zeniths lying slightly distal to the centre of the teeth.

Treatment planning and procedures

The primary objective was to recreate an aesthetic smile and to establish a functional occlusion and this would involve orthodontic, periodontal and restorative modalities.

1. Hygiene Treatment: The patient underwent a preliminary treatment plan that included professional oral hygiene and reinforcement of oral hygiene practices.



Figure 5. Orthodontic treatment to upright tipped teeth and correct occlusal plane.

2. Orthodontic treatment: to correct the tipped and drifted mandibular teeth that were a consequence of missing teeth (Figure 5).

3. Diagnostic waxup: utilisation of a wax-up (Figures 6 and 7) can preview the desired aesthetic appearance. The diagnostic wax-up provides guidelines of the desired treatment and a blueprint of the final restorations. The wax-up also allows the manufacture of putty keys for provisionalisation and reduction guides for the preparation process.



Figure 6. Diagnostic wax-up of planned changes.



Figure 7. Occlusal view of diagnostic wax-up.



Figure 8. Bone sounding to osseous crest levels to determine biologic width.



Figure 9. Gingival recontouring with diode laser to correct gingival asymmetry and improve contours and shape.



Figure 10. Gingival recontouring completed.



Figure 11. Crowns sectioned to allow insertion of crown remover for removal. Inset: Hu-Friedy Christensen Crown Remover.



Figure 12. Crowns removed from teeth, ready for preparation.

4. Gingival recontouring: a 940nm diode laser (Biolase EZlase) was utilized to improve soft tissue aesthetics. Periodontal bone sounding was performed to ensure that biologic width was not invaded (Figure 8), and then gingival tissues were lased to improve the gingival contour, symmetry and gingival zeniths (Figures 9 and 10). Due to the atraumatic cutting nature of the diode laser, preparation of teeth were carried out at the same appointment. This is in contrast to use of

instrumentation like scalpel, or electro-surgery where there is high chance of gingival recession and a need for tissues to stabilise by waiting a suitable healing time prior to final impressions (Note: if an osseous recontouring procedure is required, there may be a need to wait up to 6 months prior to final preparations).

5. Removal of crowns: were completed by cutting slots into the labial surfaces (Figure 11) and using a Christensen Crown

Remover (Hu Friedy) to torque the crowns to remove (Figure 12).

6. Preparation: Core buildups with composite resin and preparation of teeth for all ceramic crowns from 14-25. It is recommended that an axial reduction of 0.8-1.0mm and an occlusal reduction of 2.0mm be made as aesthetic materials are brittle in thin sections, and these materials are of certain thickness to withstand masticatory and parafunctional stresses



Figure 13. Reduction indexes made from diagnostic wax-up to ensure sufficient reduction of tooth structures.



Figure 14. Retraction cord (Ultrapak #00 - Ultradent) being inserted as the first cord.



Figure 15. Use of Expasyl (Pierre Rolland) for haemostasis and retraction applied over the first cord.



Figure 16. Use of putty impression (3M ESPE Imprint 3 Putty Soft) material.



Figure 17. Trough created into putty material in approximate position of teeth and material covered with spacer (plastic barrier).



Figure 18. Spacer removed from material with indentation of the teeth and preparations into the putty material.



Figure 19. Set putty material now ready for loading with light body (3M ESPE Imprint 3 Light Body) wash material into indentations.



Figure 20. Light body is lightly air blown to allow complete adaptation around preparations as well as to minimise possibility of voids around the margins of preparations.



Figure 21. Completed 3M ESPE Imprint 3 Light Body impression showing excellent detail of preparations as well as adjacent teeth and tissues.

(Figure 13). Finish lines are recommended to be chamfers or 90 degree rounded shoulders to firstly provide sufficient bulk at the margins and secondly allows the transference of stresses adequately around the margins. To minimise stress concentration within the restoration, all line angles should be rounded, all sharp edges smoothed and boxes, grooves and 'butt' type shoulders are contra-indicated.

7. Gingival retraction and Haemostasis:

the impression requires access to the margins of the preparation and to a small area of unprepared apical tooth structure so that the restoration can be made to have good marginal fit as well as the correct emergence profile. The use of a double zero retraction

cord (Ultrapak #00 - Ultradent) was placed into the gingival sulcus as a first cord (Figure 14) and then a retraction paste - Expasyl (Pierre Rolland) was then placed over the first cord (Figure 15). The correct use of this retraction paste should see blanching of the gingival tissues as the paste is extruded into the gingival sulcus. This is left for two minutes prior to then being completely washed away with air/water spray. Expasyl containing aluminum chloride and kaolin works as an astringent and haemostatic agent, as well as the compressive action of the paste into the sulcus providing a convenient and atraumatic retraction method.

8. Impression Procedure: a putty wash technique in a two-stage approach with

spacer in a stock tray was utilised. The putty (3M ESPE Imprint Penta Putty) is first inserted into the mouth with a spacer sheet on the putty surface (Figures 16 and 17). The spacer prevents the putty taking a detailed impression of the teeth, and prevents contamination of the surface of the putty from saliva that may affect bonding of the light body to the putty. The putty is then removed and allowed to set outside the mouth, which minimizes any distortion from plastic trays (Figure 18). The spacer sheet is then removed and light body material (3M ESPE Imprint 3 - Light body) is placed into the trough and also applied to the teeth and lightly air blown to ensure complete adaptation without introduction of voids (Figures 19-21).

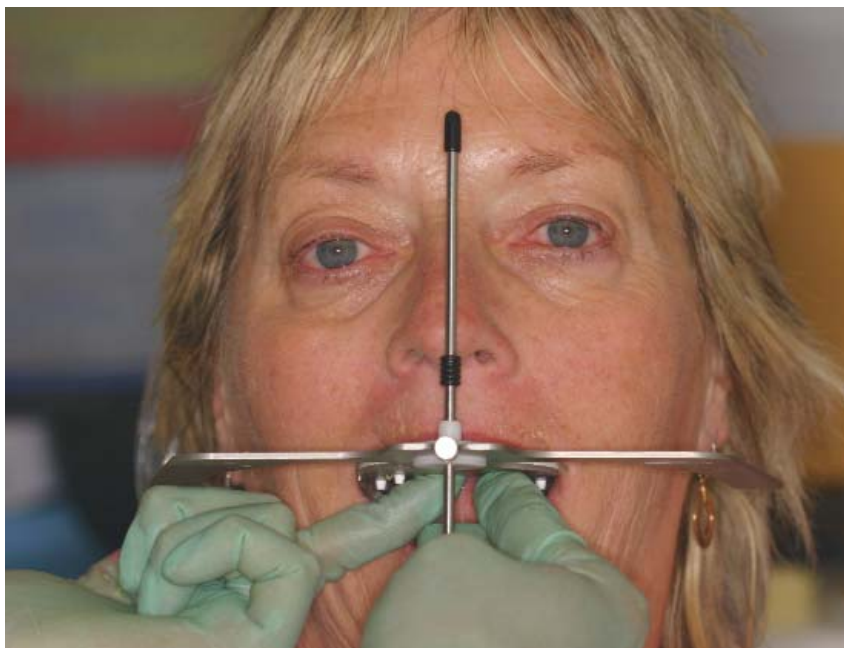


Figure 22. Use of Kois Dentofacial Analyser to align midline and incisal plane.

9. Maxillo-mandibular relations: The Kois Dento-Facial Analyser System registers and transfers the patient's occlusal plane as well as tilts in the occlusal plane in three planes of space to the articulator related to an average 100mm axis-incisal distance (Figure 22). This allows orientation for aesthetic positioning of the anterior teeth in relation to the midline of the face and ensuring correct orientation of the incisal plane.

10. Provisionalisation: the provisional restorations are duplicated from the diagnostic wax-up that incorporates the proposed changes that the patient, clinician and ceramist have planned. It gives the patient a "test run" or preview of the final result planned. This step is an essential step in the planning process.

The aims in provisionalisation are:

- a) Health - pulpal protection and periodontal health and gingival stability;
- b) Function - the provisional restorations can be used to assess and alert if there are any occlusal and phonetic problems with the proposed changes. The pronouncing of "V" and "F" sounds should create a light contact between the central incisor and the "wet-dry" line of the lower lip; and
- c) Aesthetics - the provisional restorations can be used to assess the basic shade to be chosen, incisal edge display, form

and shape of teeth, dental midline location, lip support, parallelism of incisal plane to interpupillary line as well as the curvature of lower lip. Evaluation of aesthetics provided by the provisionals at this stage is crucial in guiding the patient to the amount of display necessary for an aesthetic smile.

The provisional crowns were constructed with Protemp 4 Temporization Material (3M-ESPE), a bis-acryl resin composite. This material has the highest fracture toughness of any of the current popular provisional materials, with outstanding mechanical and compressive strength and was used due to the multiple units of crowns planned. The material was applied by injecting into the putty key in a careful manner keeping the tip always within the material while injecting (Figure 23). This is then loaded onto the teeth and allowed to set. Once the material is set, it is removed, trimmed and polished (Figures 24-26). All contours are kept curvaceous and smooth with space made available for the patient to use interdental cleaning aids due to the provisionals being totally splinted together. The patient is given instructions on oral hygiene during the provisional phase and is asked to return in two to three day's time for approval.

The author recommends this delayed approach of assessing the provisionals, because the patient is not pressured into



Figure 23. Loading of provisional material (Protemp 4 Temporization Material, 3M ESPE) into putty key of diagnostic wax-up.



Figure 24. Provisional material straight after removal from putty. Note: voids and areas of deficiency can be added with flow-able composite resin to repair or modify.



Figure 25. Polishing of provisional materials with discs (Soflex XT, 3M ESPE).



Figure 26. Contouring of the interdental spaces to allow sufficient space for access to cleaning.

deciding if they do or do not like the provisionals on the day of preparation. The patient is often anaesthetised with associated facial palsy and cannot adequately assess aesthetics at this time. The patient



Figure 27. Patient has returned after two to three days for review of provisionals to ensure approval of change in shape, colour and other desired changes before final crowns are made.



Figure 28. Lateral smile of provisionals in place. Assessment of the buccal-lingual position of teeth, as well as the incisal edge display are critically assessed during this phase and any changes are completed on the provisionals and conveyed to the dental ceramist.



Figure 29. Stone models of preparations. Note the use of rounded internal line angles as well as defined chamfered margins necessary for all ceramic crown construction.



Figure 30. Final lithium disilicate crowns (e.max crowns).

will often ask friends and family about the proposed changes and as well the extra time allows the patient to accustom himself or herself to the new “look”. If there are major changes to the lengths of teeth or occlusion, then time is also required to let the patient accustom themselves to the new changes (Figures 27 and 28).

If the patient is happy with the provisional restorations, then the ceramist may construct the final restorations using the original wax-up as a blueprint for the final restorations. If the provisional restoration requires modifications, the temporaries can be adjusted or composite resin can be added and an impression of the temporaries is then made as a template and communication tool to the ceramist to identify the additional changes.

11. Laboratory construction: the all-ceramic crowns were pressed from e.max ingots and layered with e.max ceram



Figures 31 and 32. Alternate views of lithium disilicate crowns (e.max crowns).

(Ivoclar Vivadent). This is a lithium disilicate ceramic that can be etched and bonded to teeth (Figures 29-32). These were constructed according to the diagnostic wax-up that was approved during the provisional process.

12. Cementation: the crowns are received back from the laboratory and tried in the mouth. The author prefers not to use local anaesthetic for the patient to approve the final aesthetics prior to cementation. However, if local anaesthesia is required, an



Figure 33. Use of hydrofluoric acid to prepare intaglio of crowns. This is left for over 90 seconds prior to washing and cleaning in distilled water or alcohol and dried ready for silanisation.



Figure 34. Silane primer is added to etched surface and left for over 60 seconds.



Figure 35. Application of Expasyl to minimise chance of bleeding and minimise gingival crevicular fluid prior to cementation (notice blanching of gingival tissues signifying good compression of paste into sulcus).



Figure 36. Frontal view of completed all-ceramic crowns.



Figure 37. Left lateral view of completed all-ceramic crowns.

alternative technique is to use the AMSA local anaesthetic block technique so that the injection achieves pulpal anaesthesia of the central incisors through the second premolar without collateral numbness of the face and facial muscles of expression. This is best achieved with the computer controlled injection system - the Wand (Milestone Scientific) which delivers a virtually painless palatal injection.

Once the patient is happy and approves the final aesthetics, the restorations are prepared for cementation. The e.max crowns, being silica-based restorations, must be etched with hydrofluoric acid (Ultradent Porcelain Etch) (Figure 33) to roughen the surface, which allows a micro-mechanical bond when adhesively bonded. The intaglio surface is etched for 90 seconds with 9.5% HF acid and then thoroughly washed with air-water spray. This is then placed into a container of distilled water, or alcohol and placed into an ultrasonic bath for 2 minutes to remove any residues remaining on the surface. The crowns are removed, dried and silane primer (Figure 34) is applied to the fitting surface, which helps provide a chemical covalent bond to the ceramic. Once the crowns were prepared, the preparations were retracted and haemostasis achieved

with Expasyl (Figure 35). Due to the gold post cores present in teeth 11 and 21, white opaque resin cement (RelyX Veneer White Opaque, 3M ESPE) was used to block out the metallic stump colours, and the remaining crowns were cemented with a clear self adhesive resin cement - RelyX Unicem (3M ESPE). Following the cleanup of cement, the restorations were finished and polished with the occlusion adjusted for centric contacts and anterior guidance. The patient returned to the practice one week later to allow a final examination of the aesthetics, phonetics and occlusion. She was extremely happy with the final aesthetic enhancement (Figures 36 and 37) and the next phase of her ongoing treatment is to replace the mandibular posterior teeth with dental implants.

Conclusion

The aesthetic rehabilitation of a patient with a functionally compromised dentition frequently involves a multidisciplinary approach. The proper sequence and planning involving periodontal, orthodontic, aesthetic and restorative treatment is required with communication between the whole team, from the patient and ceramist to the treating clinicians.

The use of provisionalisation is a significant factor in achieving a successful aesthetic outcome for both patient and the dental team. Provisionalisation allows the patient to preview their future teeth, allowing them to assess the aesthetic and functional changes. Invaluable information can be learnt at this stage in regards to aesthetic factors including incisal display, buccal-lingual position of teeth, smile line, shade and in addition, functional criteria can be assessed with phonetic and occlusal changes.

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About the author

Dr Christopher Ho graduated in Dentistry with First Class Honours at the University of Sydney and completed postgraduate studies in the Graduate Diploma in Clinical Dentistry in Oral Implants. Dr Ho is a regularly invited lecturer on aesthetic and implant dentistry within Australia and internationally. He is a faculty member of the Global Institute for Dental Education.