Ready to crown
Maximising clinical efficiency using the dental laboratory to facilitate the planning and execution of crown preparations.

Introduction
When multiple teeth or localised segments of the mouth require crowns, the restorative interventions involved can be psychologically and physically demanding for the operator, patient and dental technician alike. It is important that all parties involved in restorations of this nature hold a shared understanding of the expected outcome of treatment, with a realistic, common end goal in mind right from the very beginning. Such clarity of thought and communication is key to avoiding biological, mechanical and aesthetic failures in the planning and execution of advanced restorative treatments. Biomechanically stable and aesthetically pleasing provisional restorations are an essential aspect of treatment, which allow teeth to be prepared and provisionalised over multiple appointments within the comfort zone of the operator and patient. The following clinical article illustrates a diagnostic method which, prior to any invasive treatment at all, can aid the restorative operator in:
1. Determining the feasibility of a proposed treatment plan.
2. Determining the aesthetic acceptability of the proposed restorations from the perspective of the patient and operator.
3. Informing the operator of the tooth preparations required with a view towards conserving tooth structure.
4. Simply provisionalising multiple teeth simultaneously in a biomechanically stable and aesthetically pleasing manner.

These goals can be achieved by making high-quality pre-operative records, which allow the lab to form pre-operative models, diagnostically waxed-up models and provisional shell crowns. The records gathered at this diagnostic stage may be transferred back to the mouth at relevant times to inform the operator, patient and dental technician of the nature of the work required in order to fulfil the treatment plan.

Preface
It is assumed prior to commencement of the following techniques that the mouth has been suitably prepared for reconstructive dentistry, insofar that the periodontal, endodontic and caries status of the dentition is treated, and disease stability has been established and maintained for an extended period of time. Oral hygiene and diet must be persistently and consistently held to a high standard and the patient must be medically and psychologically robust enough to tolerate the necessary procedures. Segmental reconstruction is not straightforward and should only be undertaken by suitably experienced and qualified practitioners. This report shows an example of the above described technique, and the treatment of a localised segment of the mouth only, as part of a complex full mouth restoration.

Case report
The patient is a 50-year-old gentleman in good health, whose chief complaint
was of “worn, discoloured teeth which don’t look right”. Extra-oral assessment revealed a mild class III skeletal arrangement, high functional lip line and loss of the vertical dimension of occlusion, while intra-oral examination (Figure 1) displayed a class III incisor relationship in a dentition severely affected by tooth structure loss which appeared to be of attritive, abrasive and erosive origin, exacerbated by the absence of the anterior determinants of tooth-guided occlusion. There was evidence of generalised mild-moderate clinical attachment loss; however, the periodontal status was stable with good oral hygiene, no evidence of periodontal pocketing greater than 3mm and no evidence of bleeding on probing.

Initial treatment
Following a multidisciplinary assessment, an initial course of fixed orthodontic treatment was prescribed in the maxillary arch in order to procline the maxillary labial segment dentition (Figure 2). A “bite-raising” appliance is used in the mandibular arch, which allows free movement of the maxillary labial segment teeth during the orthodontic phase of treatment. Initial treatment took approximately eight months and resulted in an edge-to-edge occlusion at the first tooth contact position on the rotational arc of closure (Figures 3a-3c). No further orthodontic movement was advisable at this point following a risk–benefit analysis.

Diagnostic method
Making preoperative records
Immediately following the debonding of orthodontic fixed appliances, pre-operative records are fabricated (Figures 4a-4f). Maxillary and mandibular impressions may be made in a two-stage technique using polyvinylsiloxane. Initial impressions are made using putty only and a polyethylene spacer (Figures 4a and 4b). Once the putty has completely set and the plastic spacer has been removed, the impression can be completed using a light body wash material (Figures 4c and 4d). Polyvinylsiloxane impressions are highly accurate and are robust enough to permit multiple pours, which offers some advantages over alginate in this diagnostic method. A transfer bow recording should be made to relate the resultant maxillary cast to the transverse horizontal hinge axis and an interocclusal wax record is made (Figures 4e and 4f) in the centric maxillomandibular relation treatment position at the proposed vertical dimension of occlusion. These records can be used to mount casts in a semi-adjustable articulator such as the Whipmix 2240. A programmed semi-adjustable articulator will transfer to the lab the patient’s midline and interpupillary line, and it allows simulation of mandibular movements, thus determining the occlusal form of the final restorations with a reasonable degree of accuracy. Indirect restorations fabricated in this manner will require minimal occlusal adjustment on fitting.

FIGURES 3a, 3b, 3c: The presentation immediately following debond of the maxillary fixed appliance, now in the first tooth contact position on the rotational arc of closure.

FIGURES 4a, 4b, 4c, 4d, 4e, 4f: Maxillary and mandibular two-stage polyvinylsiloxane impressions, a maxillary transfer bow recording and an interocclusal wax record in the centric maxillomandibular relation position are made immediately following orthodontic debond. The two-stage impression technique illustrated produces exceptionally accurate study models.

A
B
C
D
E
F
Fabrication of casts

At the dental laboratory, mounted casts may be fabricated in triplicate from the aforementioned pre-operative records. These casts may be used as follows:

1. **Pre-operative models**

   Pre-operative models (Figures 5a-5c) will allow analysis of the existing occlusal scheme and the pre-operative condition of the teeth. Further, they will aid as a starting reference point for treatment planning, which can prove important particularly as the treatment plan is being implemented and changes are made to the dentition. Finally, pre-operative models are an important medico-legal record for complex cases.

2. **Diagnostic wax-ups**

   The models fabricated for the purpose of diagnostic wax-ups may be modified, within reason, to permit freedom in the design of the final proposed restorations (Figures 6a-6d). This is known as a feasibility study and can be used to inform the dentist of the restoration type required to achieve the proposed result. In this case, the feasibility study suggests that full coverage crowns are required in the maxillary labial segment to produce a biomechanically-stable, long-term restoration. The incisal edge of the maxillary central incisor (Figures 7a-7b) is the “north star” for determination of the new incisor relationship (Figures 8a-8c).
8c), tooth-guided articulation and maxillary occlusal plane, and thus of the contours of all teeth to be restored (Figures 9a-9c). Initially, the incisal edge can be waxed to average dimensions according to published data for the population being treated and can be later modified to the subjective preferences of the patient if required. A well-made diagnostic wax-up permits clear communication between the dental technician and dentist with regards to the desired outcome of treatment and, in combination with a diagnostic mock-up, will highlight pre-operatively any potential limitations of treatment from a biological, mechanical and aesthetic perspective.

3. Provisional shell crowns
A third set of models produces casts from which provisional shell crowns can be fabricated (Figures 10a-10f). Shallow depth cuts and shallow trial preparations are carried out on these models. A putty matrix made from
the diagnostic wax-up is used to fabricate heat- and pressure-processed polymethylmethacrylate fixed-splinted provisional shell crowns. These provisional shells can be simply relined chairside following the actual tooth preparations and thereby permit preparation of multiple teeth during a single appointment. This simple method makes biomechanically stable and aesthetically pleasing provisional restorations within the comfort zone of the dentist and patient.

**Transferring the diagnostic work to the mouth**

Using a putty matrix, the diagnostic wax-up may be transferred to the mouth using a bis-acryl material, such as Protemp, prior to any invasive operative procedures (Figure 11a). At this point, the patient and dentist can make an informed decision to accept, modify or even decline the arrangement and form of the proposed final restorations. This technique is known as a diagnostic mock-up and it permits a meeting of the minds between the dentist’s esoteric understanding of the treatment plan and the lay understanding that the patient may have regarding the proposed treatment outcome. Any disagreements regarding the final outcome may be identified at this early stage before the dentist and patient become committed and effectively locked in to carrying out extensive, complex treatment. Furthermore, this method allows the dentist to assess the effect any proposed changes might have on the vertical dimension of occlusion and the enunciation of sibilant and fricative sounds. Once all involved parties have accepted the proposed treatment plan the diagnostic mock-up may be used to inform the dentist of the tooth preparations required to achieve the desired outcome. Depth cuts may be prepared into the diagnostic mock-up (Figure 11b) prior to completing the initial tooth preparations (Figure 11c) with a view towards conserving tooth structure.

Finally, the provisional shell crowns can be seated in the mouth with a putty matrix, using the unprepared posterior teeth as indexing points to allow accurate positioning of the provisional shells. Adjustments of the intaglio surfaces of the shells may be required to permit accurate positioning if the shells are too thick in any areas. The shells may be relined using a chairside polymethylmethacrylate material such as Duralay Crown and Bridge. Care is required at this stage to prevent inadvertent binding as the reline material sets, particularly when multiple preparations are involved. On full setting of the reline, the margins and embrasure spaces can be trimmed to allow for excellent marginal fit (Figure 11d). Note that attention must be paid to ensuring occlusal and soft tissue stability throughout the provisional phase of treatment (Figures 12a-12c). Now that initial preparations have been completed and the teeth have been well provisionalised, due time and concentration can be paid to refining each tooth preparation at the leisure of the dentist and patient at subsequent appointments.

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**References**