

# Making Occlusion Work: 2. Practical Considerations

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**Abstract:** In the first of these two articles, occlusal terminology, techniques for examining the occlusion, articulators and interocclusal records were discussed. Here the authors consider some of the practical applications.

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**Clinical Relevance:** A practical knowledge of occlusion is required for successful placement of the smallest and largest restorations.

Restorations must be planned and designed to fit harmoniously with the complexities of the neuromuscular control system, the temporomandibular joints (TMJs) and supporting structures of the teeth without introducing occlusal interferences. A stable posterior occlusion with smooth uninterrupted protrusive and lateral movement of the mandible is necessary. Once the occlusion has been assessed, which may require articulated study casts, the decision must be made as to which type of occlusal scheme should be used for the restorations.

## TO CONFORM OR REORGANIZE?

Before embarking on treatment the practitioner must decide whether to provide restorations within the existing occlusal scheme (the conformative approach) or to change it deliberately (the reorganized approach). If the entire

occlusal scheme is to be reorganized to create a new and stable position, the final restorations are made to the new ICP that coincides with RCP and may involve a change to the occlusal vertical dimension (see previous article for abbreviations).

The factors to be considered are given in Table 1.

A functional stable posterior occlusion exists when enough teeth are in simultaneous even contact to direct occlusal forces axially, stabilizing the positions of both the teeth and the TMJs. Appropriate posterior stability distributes occlusal forces over a wide area, preventing damage to the individual components of the masticatory system.

Loss of posterior stability may result in:

- increased toothwear;
- mechanical failure of teeth or restorations;
- hypermobility, drifting, rotation and tilting;
- mandibular dysfunction.

In the presence of mandibular dysfunction, which is not always the case in unstable ICP relationships, a

stable maxillomandibular relationship should be developed to allow reproducibility of the jaw registration and stability of restorations and teeth. The retruded position is the only relatively reproducible position of the mandible that is physiologically acceptable.

When the reorganized approach is indicated, and this is in a small number of patients, the new ICP is established by:

- occlusal splint therapy to achieve muscle relaxation,<sup>1</sup> allowing the condyles to move into the retruded position;
- elimination of RCP–ICP discrepancy using provisional restorations, occlusal equilibration, additions to existing partial dentures to restore the OVD, and orthodontics;
- final restorations when maxillomandibular relationships are stable.

In the previous article two theories were mentioned describing idealized occlusions – gnathology and Pankey-Mann-Schulyer. A third concept, of a *dynamic individual occlusion*, has developed, based on the fact that not all dentitions fit into a prescribed concept and so a more functional approach should be adopted. However, one fact is clear: that an occlusion should be stable and thus ideally ICP and RCP should coincide when an occlusion is reorganized.

## STABLE TOOTH CONTACTS

The morphology of the occlusal surfaces of restored posterior teeth is influenced by anterior guidance and

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<b>Posterior occlusion</b> <b>No. of teeth for restoration</b> <b>Slide from RCP to ICP</b> <b>Drifting of anterior teeth</b> <b>Mandibular dysfunction</b>	Stable Small (>6) Large/small	Unstable Large Large/small
	No No	Yes Possibly
	= <b>Stable ICP</b> <b>Conformative approach</b>	= <b>Unstable ICP</b> <b>Reorganized approach</b>

**Table 1.** Factors to be considered when considering provision of restorations.

the angulation of the condylar paths. Stable occlusal contacts in ICP are generated using a tripodized, cusp to fossa or cusp to marginal ridge contact relationship according to preference, restoring the intercuspal relation of the posterior teeth in the retruded position (Figure 1). In many natural dentitions supporting cusps contact opposing marginal ridges in ICP, directing occlusal forces along the long axis of the tooth. The *cusp to fossa* theory suggests that restored cusps should contact triangular fossae developed on the mesial or distal aspects of posterior teeth. This pattern is suited to producing restorations against an existing occlusion. A *tripodized* occlusion has each of the supporting cusps contacting the opposing teeth at three points, suspending the cusp tips above the opposing fossa and preventing them making contact.

Protrusive guidance should immediately separate posterior teeth and in lateral movement the working guidance should immediately disclude teeth on the non-working side. The steepness of anterior guidance directly influences the angle of the cuspal inclines. To achieve immediate posterior disclusion in canine guidance, mandibular cusps must be able to glide between maxillary cusps without interference. When anterior guidance is steep cusps can be made steep and the fossae deeper.

**OCCLUSAL ADJUSTMENT**

Occlusal interferences occurring during mandibular movement may require adjustment before restorative procedures are contemplated. Once

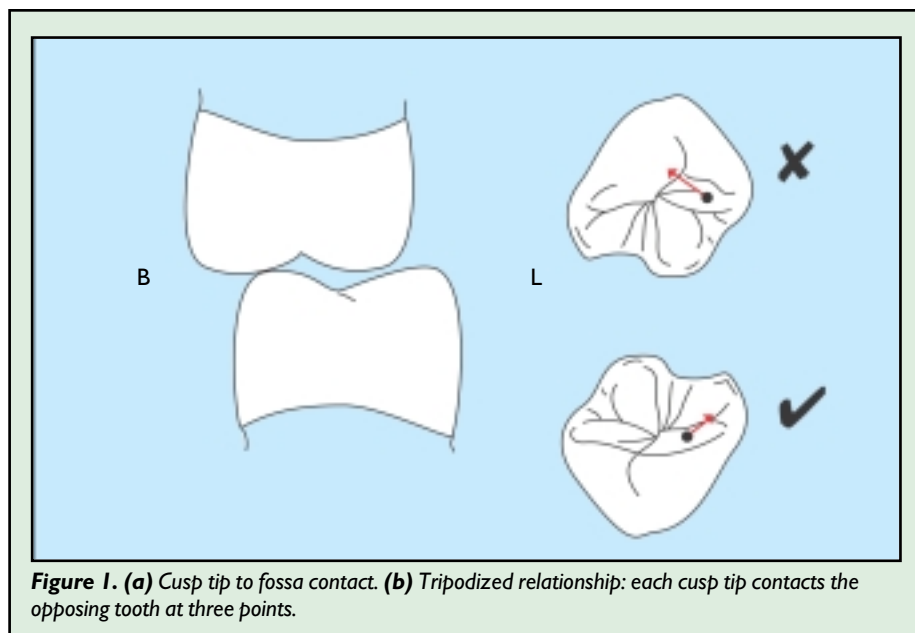
the occlusion has been assessed and unwanted contacts identified, adjustments can be made in the mouth, if uncomplicated, or through trial adjustments on articulated casts (Figure 2) to establish their effect. Such mock equilibrations allow an accurate assessment of the effects of tooth adjustment and correct planning of the stages of the adjustment without damaging the teeth.

Selective occlusal adjustment is

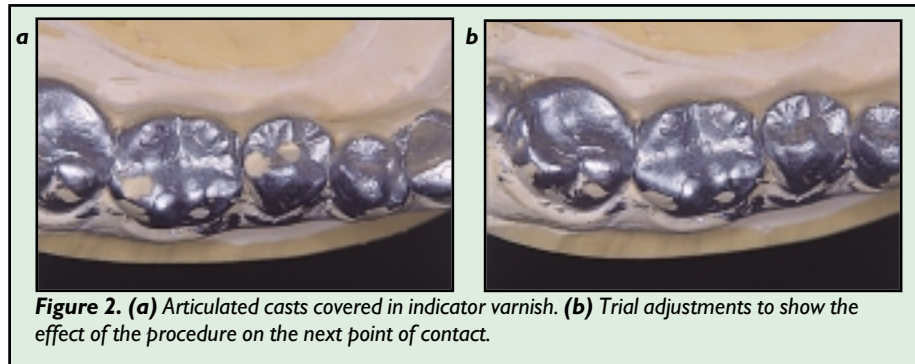
indicated before restoration when:

- the opposing tooth has over-erupted into an existing under-contoured or scooped out restoration, producing a ‘plunger’ cusp;
- tilted or over-erupted teeth have produced an uneven occlusal plane;
- the tooth to be restored has a non-working side interference;
- the tooth to be restored creates an occlusal interference in the retruded path of closure.

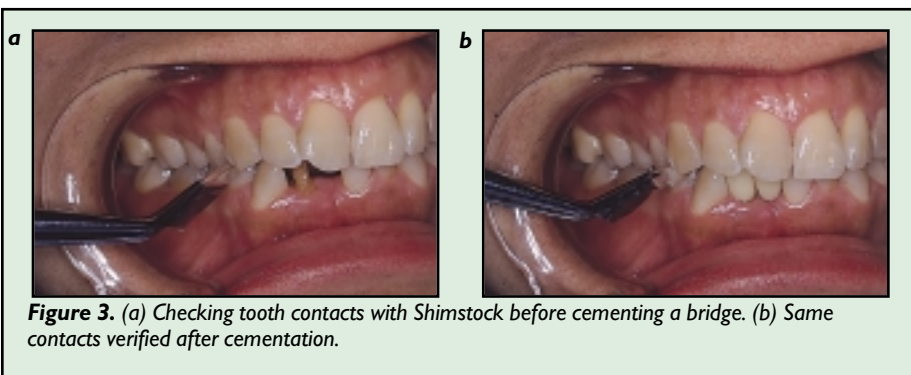
Contacts in RCP should be adjusted first, then the lateral and, finally, the protrusive interferences. Before the teeth are touched with a bur the effect of each adjustment must be anticipated. Adjustments to contacts on maxillary teeth will move the point



**Figure 1.** (a) Cusp tip to fossa contact. (b) Tripodized relationship: each cusp tip contacts the opposing tooth at three points.



**Figure 2.** (a) Articulated casts covered in indicator varnish. (b) Trial adjustments to show the effect of the procedure on the next point of contact.



of contact buccally and mesially; those on mandibular teeth will be moved lingually and distally. This will help in deciding which points to adjust when opposing teeth have been marked by articulating paper, remembering that cusp tips are sacrosanct. If, for example, the marked contact falls on the lingual facing incline of a maxillary buccal cusp and the buccal facing incline of the opposing mandibular cusp, the latter contact should be adjusted as the contact will then move towards the centre of the tooth.

For more detailed information readers are referred to expanded texts on the mechanisms of occlusal adjustment.<sup>2</sup>

### RESTORATION OF POSTERIOR TEETH

The posterior teeth provide stable vertical and horizontal relationships between the mandible and maxilla.

When planning any posterior restoration, the practitioner must consider the following questions:

- Is ICP stable?
- What are the anterior tooth contacts?
- What design of tooth preparation?
- How even is the occlusal plane?
- Occlusal vertical dimension – adequate or reduced?
- What type of occlusal scheme is desirable – conformational or reorganized?

The objectives are:

- To leave stable occlusal contacts

by ensuring: tooth-to-tooth contact in ICP; no slide from RCP to ICP if reorganizing the occlusion; no occlusal interferences; correct guidance in lateral excursions.

- There should be no mandibular dysfunction.
- Thickness of restorative materials must be adequate.
- Occlusal contour of restorations must be correct.
- Occlusal vertical dimension must be correct.

The practical application of these

objectives for various clinical situations of increasing complexity is discussed in the following paragraphs.

### Small Number of Units to be Restored

A single unit or a couple of units must fit into the existing occlusal scheme (conformational approach) and provide the correct supporting cusp contacts. Before tooth preparation the occlusal contacts must be checked with articulating paper and Shimstock, not only on the tooth to be prepared but also on the adjacent teeth. The same contacts can be verified on the articulated working casts. At the try-in stage, ICP and lateral contacts should be checked with articulating paper on the restoration and Shimstock on the adjacent teeth (Figure 3).

When the distal tooth in an arch is prepared it is especially necessary to ensure the occlusal record is accurate, as errors can readily be introduced with the vertical dimension if the casts are tipped or rotated. One way to guarantee accuracy is to try-in self-curing acrylic resin copings, ensuring

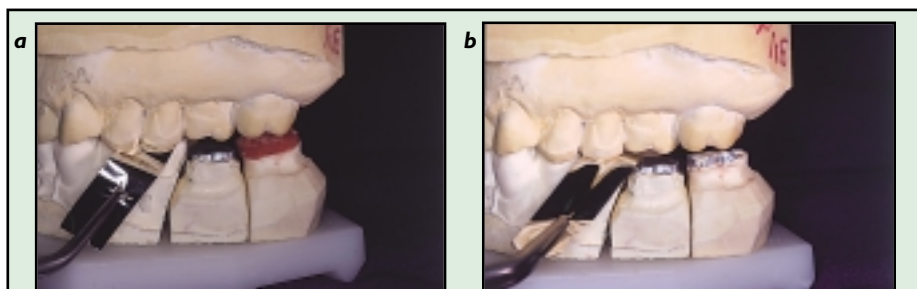


Figure 4. (a) Self-curing acrylic copings on distal abutments to verify occlusal contacts on the cast. (b) Ensuring contact and assessing available space for correct thickness of material for crown.

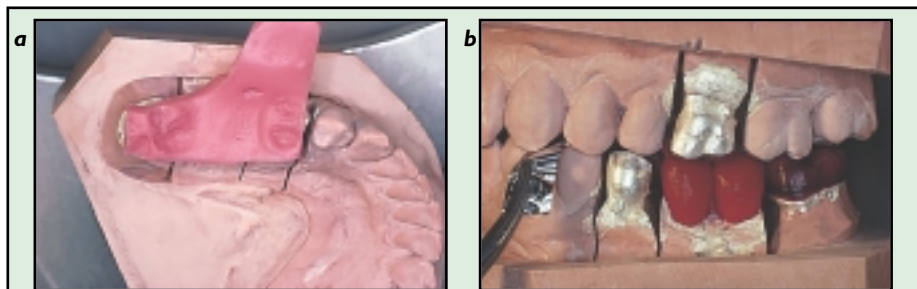
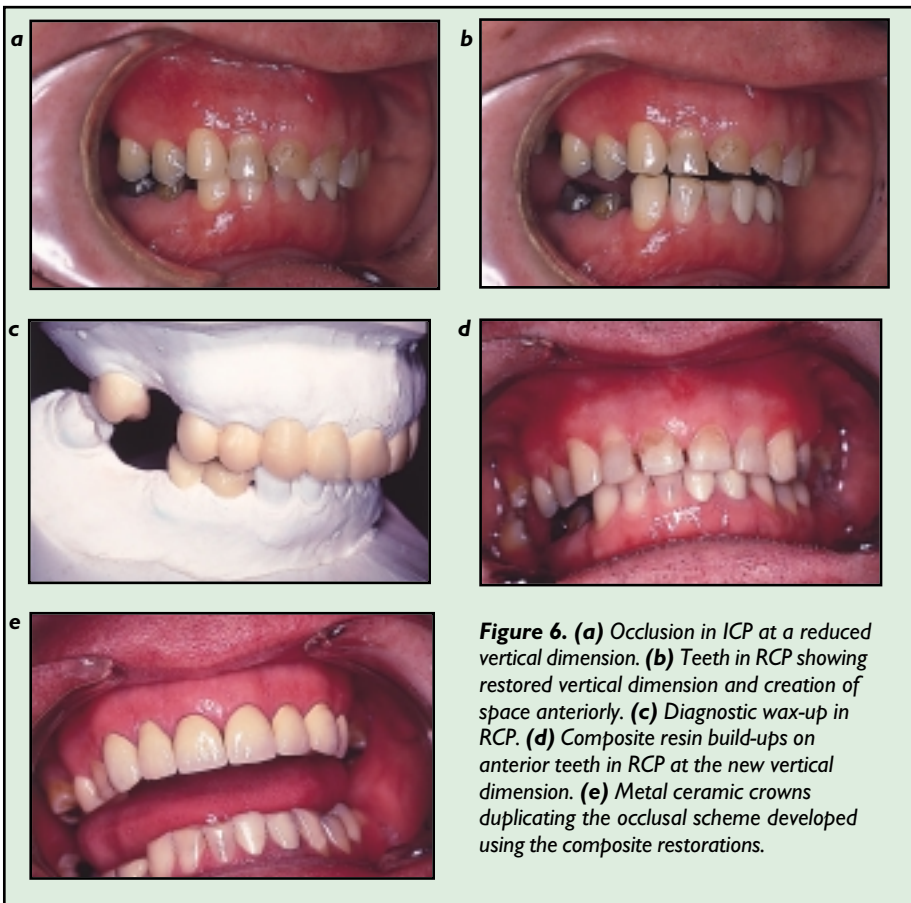


Figure 5. (a) Single-quadrant interocclusal record and (b) self-curing acrylic copings. The over-erupted first molar has been prepared and waxed-up to produce an even occlusal plane.





**Figure 6.** (a) Occlusion in ICP at a reduced vertical dimension. (b) Teeth in RCP showing restored vertical dimension and creation of space anteriorly. (c) Diagnostic wax-up in RCP. (d) Composite resin build-ups on anterior teeth in RCP at the new vertical dimension. (e) Metal ceramic crowns duplicating the occlusal scheme developed using the composite restorations.

### Reduced Vertical Dimension Associated with Short Clinical Crown Height

Both the OVD and ICP may be altered in this situation (Figure 6). Such cases usually require restoration in RCP and the production of a stable and coincident ICP using the reorganized approach. Occasionally, the anterior tooth contact and condylar position are stable, allowing the existing ICP to be used. The details of recording the OVD were discussed in the previous article.

On articulated study casts mounted in RCP at the correct OVD, occlusal adjustments are carried out to eliminate any discrepancy between RCP and ICP. These are then carried out on the patient's teeth as an occlusal equilibration. On the casts, the teeth to be restored are next prepared and waxed up to full contour, bringing them into occlusal contact with the opposing arch. The new ICP and OVD are maintained by developing the cusp height and fossa depth. Temporary restorations are constructed from this wax-up and cemented onto the prepared teeth; minor occlusal adjustments may be necessary to develop coincident ICP and RCP.

The patient is reviewed over several weeks to check his/her adaptation to the new occlusal scheme. This is determined by a lack of symptoms from the TMJs, a feeling of comfort and stability of the restorations. Definitive restorations are then made duplicating the newly established occlusion.

### Multiple Units in One Arch

If most occlusal contacts will be lost in the preparation of teeth, then a reorganized approach should be used. A diagnostic wax-up on articulated casts in RCP will determine the new position of ICP and temporary restorations will be constructed maintaining the occlusal vertical dimension (Figure 7).

### Full Mouth Rehabilitation

The restoration of all four quadrants together requires that all the

the occlusal contacts on the teeth are the same as on the casts (Figure 4). The thickness of the copings can also be measured to see how much available space has been created.

### Single Quadrant

Following loss of posterior teeth in a quadrant the antagonistic teeth may over-erupt or tilt, producing an uneven occlusal plane. Unless the over-erupted teeth are recontoured by selective occlusal adjustment or restoration, any replacement of the missing teeth will have contact in ICP and an irregular occlusal form that is determined by the shape of the opposing teeth. By eliminating the irregularities, a harmonious occlusal contour will be created that ensures stable ICP contacts and avoids lateral interferences. The replacement has been developed to a modified occlusion, but as ICP remains

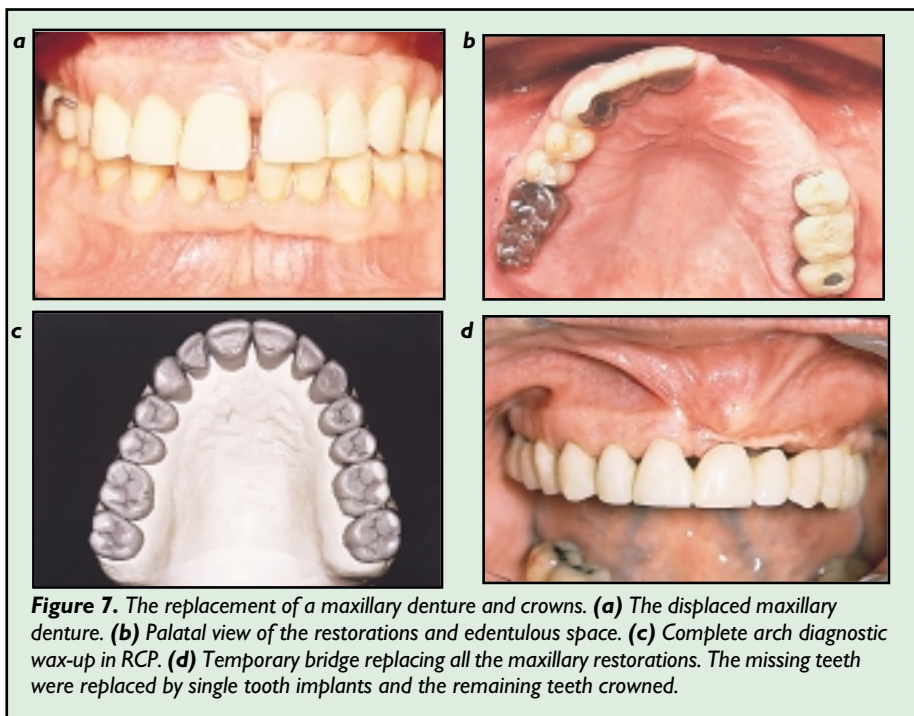
unchanged the approach is conformative.

The inter-occlusal record (Figure 5) is taken following adjustment and tooth preparation. This only needs a record of the relationship on the prepared side, providing a full arch impression has been taken and there are adequate occlusal contacts on the contralateral side to maintain stability.

### Opposing Quadrants

In this situation the occlusal plane and curves of Spee and Monson can be restored to produce the most favourable occlusal contacts. The OVD is maintained by tooth contact anteriorly and on the contralateral side, posteriorly by the condylar position in ICP using the conformative approach.

When the abutment teeth form interferences and ICP is unstable it is advisable to reorganize the entire occlusion.



**Figure 7.** The replacement of a maxillary denture and crowns. (a) The displaced maxillary denture. (b) Palatal view of the restorations and edentulous space. (c) Complete arch diagnostic wax-up in RCP. (d) Temporary bridge replacing all the maxillary restorations. The missing teeth were replaced by single tooth implants and the remaining teeth crowned.

determinants of occlusion be developed in unison. It is advisable to provide long-term temporary restorations in such cases as the patient's tolerance to changes in ICP, RCP, excursive movements and possibly the OVD must be monitored over a long time. The proposed changes can be gradually introduced on the temporary restorations, which are easier to adjust or add to. Such restorations should have a metal substructure overlaid with acrylic or composite resin. The principles of a reconstruction are no different from those already described.

The treatment plan is divided into four stages:

1. Occlusal splint therapy.
2. Occlusal equilibration so that ICP = RCP.
3. Restoration of the anterior teeth.
4. Restoration of the posterior teeth, either by opposing quadrants or all at one time.

### Materials for Restoring Occlusal Surfaces

Amalgam is an excellent material for restoring posterior teeth as it has a high resistance to wear, producing

stable ICP contacts. The wear characteristics of direct composite resins are less favourable and more abrasive to the opposing dentition: this material should not be used when restoring large cavities where tooth contact is solely on the material. Small Class II restorations can be restored with composite, providing that the occlusal contacts are primarily on the tooth and not the material.

#### Porcelain versus Gold

Porcelain occlusal surfaces offer improved posterior aesthetics but the technique for developing them is more difficult than in gold and the highly polished surface does not readily mark

with articulating paper. Matt gold surfaces more easily show such marks and should be used at the try-in stage to verify occlusal contacts before polishing and cementation.

Gold occlusals would be preferred where:

- there is a history of parafunctional activity;
- clinical crown height is reduced;
- optimal occlusal control is necessary in the reorganized approach.

### RESTORATION OF ANTERIOR TEETH

Preoperative considerations:

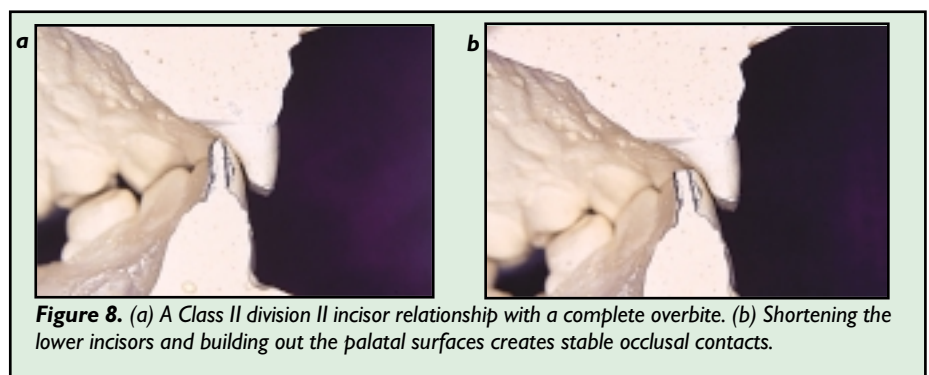
- stability of ICP;
- reproduction of correct palatal contours;
- tooth preparation;
- metal coping design;
- protrusive and working guidance;
- incisor relationship;
- phonetics and appearance.

Objectives (in addition to the posterior objectives):

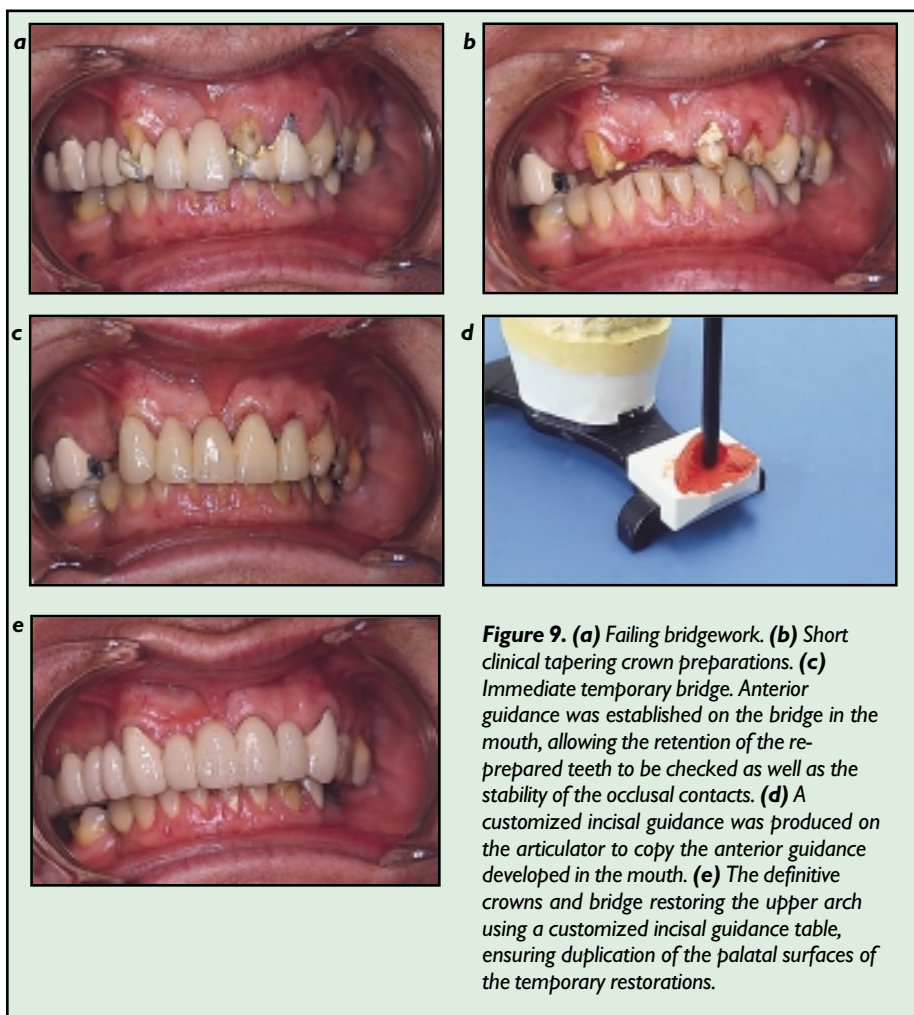
- even distribution of forces in incisal guidance;
- immediate posterior disclusion (except in Class III occlusions).

#### Anterior Guidance

The anterior teeth are in a balanced position determined by the lips, tongue, occlusal relationship and



**Figure 8.** (a) A Class II division II incisor relationship with a complete overbite. (b) Shortening the lower incisors and building out the palatal surfaces creates stable occlusal contacts.



**Figure 9.** (a) Failing bridgework. (b) Short clinical tapering crown preparations. (c) Immediate temporary bridge. Anterior guidance was established on the bridge in the mouth, allowing the retention of the re-prepared teeth to be checked as well as the stability of the occlusal contacts. (d) A customized incisal guidance was produced on the articulator to copy the anterior guidance developed in the mouth. (e) The definitive crowns and bridge restoring the upper arch using a customized incisal guidance table, ensuring duplication of the palatal surfaces of the temporary restorations.

alveolar bone support. Changes to the shape of the teeth can produce unwanted movement if these factors are disrupted, leading to migration, rotation over-eruption or formation of diastema. Restorations must be placed in this balanced envelope to achieve stability and longevity. Anterior guidance should provide smooth even contact on as many anterior teeth as possible from ICP through the excursions discluding the posterior teeth immediately. It should be shallow, work harmoniously with condylar guidance and fit in with the skeletal and incisor relationship, appearance and speech. If a single tooth is to be restored the existing guidance can be readily duplicated. When all the anterior teeth are to be restored some changes to the guidance, crown position and appearance can be made.

In Class II division I incisor relationships the overbite and overjet will be increased, leading to the mandibular incisors occluding to the palatal aspect of the cingulum close to the dentogingival junction. If this relationship is copied in maxillary restorations, ICP contacts may become unstable, leading to an increase in tooth mobility, migration and splaying. The incisal guidance can be altered by building out the palatal surfaces of the restorations to provide occlusal rests in the area of contact of the lower teeth; it may also be necessary to shorten the mandibular incisors. The edges are reduced horizontally to produce a flat rather than bevelled incisal edge, which would make it difficult to achieve stable contacts (Figure 8), especially in Class II division II relationships. This will create harmonious movements from ICP

into protrusion and lateral excursions.

Anterior guidance can be duplicated on an articulator with a customized incisal guidance table. Self-cure acrylic resin is shaped by moving the upper member of the articulator while maintaining contact with the incisors and canine tooth on the study casts. The incisal pin carves out a path in the setting resin resembling a Gothic arch tracing (Figure 9). This technique is used when a new reorganized guidance to which a patient has adapted has been established on multiple temporary crowns or when the existing guidance must be copied.

The canine tooth has a favourable crown/root ratio for absorbing occlusal forces as well as a root configuration providing greater surface area, more periodontal ligament and proprioception than adjacent teeth.<sup>3</sup> It is eminently suited to guide lateral excursive mandibular movements and produce immediate disclusion of the posterior teeth. Scaife and Holt<sup>4</sup> reported an incidence of 57% bilateral canine guidance in 1200 individuals. There is little scientific evidence to assist in identifying exactly what canine guidance should be. McHorris<sup>5</sup> suggested that the disclusive angle (which governs the palatal contour of the working canine) should be 5° greater than the condylar guidance angle. There are several mechanical advantages in providing canine guidance:

- easier access in the front of the mouth for adjustments;
- smooth mandibular movements can be produced with immediate disclusion posteriorly;
- recording and producing canine guidance is less complicated, both clinically and technically.

### Occlusion on Pontics

Occlusal contacts on full-sized pontics should be in ICP. When the canine is replaced by a pontic on a fixed bridge canine, guidance can be developed, providing there are anterior and posterior retainers. If a cantilever bridge



is made using the premolars, group function should be developed.

The occlusal contacts on a simple cantilever bridge must be in ICP on both units but the pontic must be free of any lateral contacts. This reduces the lateral forces on the pontic that would otherwise cause a lever effect, forcing the bridge to rotate outwards.

## CONCLUSION

The basic principles in restoring anterior and posterior teeth have been discussed, highlighting the necessity for careful preoperative planning. The conformative approach is applicable to most patients: reorganizing an

occlusion requires a high level of skill and knowledge from both technician and clinician to ensure a good result.

A functional dynamic approach to occlusion based on theoretical principles is a useful concept in restorative dentistry. Most patients require little more than an acceptance of their existing occlusions, ensuring that restorations fit into their individual schemes, providing they are harmonious and stable. There are a number of approaches to extensively reorganizing the occlusion that will produce an acceptable result, providing the underlying principles of each theory are fully understood and their individual practical application adhered to.

## ACKNOWLEDGEMENT

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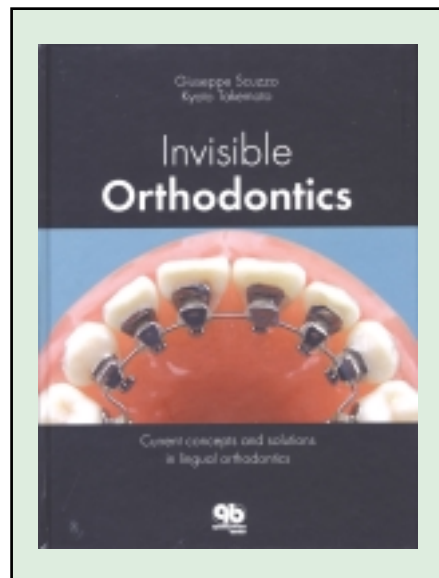
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## BOOK REVIEW

**Invisible Orthodontics: Current Concepts and Solutions in Lingual Orthodontics.** By Giuseppe Scuzzo and Kyoto Takemoto. Quintessence Books, New Malden, 2002 (173 pp., £65.00 h/b). ISBN 3-87652-181-5.

Lingual orthodontics has been part of the orthodontic profession for some time, although apparently only about 10,000 orthodontic cases are treated using this technique in Europe, Japan and the USA. Considering the high numbers of orthodontic cases treated each year worldwide, the number of clinicians using lingual orthodontics must be very small.

The authors have written this book largely on their own experiences and are well supported with excellent illustrations of case studies. The book starts by introducing the topic of lingual orthodontics aimed at specialist orthodontists. It skips over the diagnostic and therapeutic considerations in lingual orthodontics and suggests useful hints for successful treatment. These include the use of loop mechanics, power arm auxiliaries and force delivery systems and mechanics in lingual orthodontic extraction cases. Two chapters of the book are devoted



to four different laboratory techniques in the pre-clinical set-up of lingual orthodontics. The book seems to emphasize the reliance upon good technicians and laboratory facilities which may be a reason for its limited use.

The well illustrated case reports indicate how the lingual appliance technique can be utilized to a high standard. The malocclusions presented certainly require some lateral thinking and boldness in execution, even for most well-seasoned orthodontists. Two contrasting biomechanics, closing loops and sliding mechanics, are

illustrated at different stages of treatment. Advantages and pitfalls of the treatment mechanics are mentioned as the cases progress to completion. The precision involved in loop mechanics not only bears a heavy resemblance to laborious wire bending in edgewise mechanics, but seems more demanding when trying to fit these systems intra-orally. Sliding mechanics also requires greater care because the force moment ratios are applied differently from the lingual aspect and these then tend to tip teeth in unwanted directions. In the final chapter, the authors describe the various ways in which the finished results are retained with lingual retainers, clear positioning splints and transparent retainers.

This book will be of interest to postgraduate students and orthodontic practitioners who want to develop a private 'invisible orthodontics' practice. It provides an excellent overview of the lingual technique and has brought to light the immense technical skills from both laboratory and clinician in the treatment of a single case. Although this book is not fully comprehensive, it does provide a structured approach to lingual orthodontics.

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