



Combining Traditional and Adhesive Dentistry to Reconstruct the Excessively Worn Dentition

Basil Mizrahi, BDS, MSc, MEd

Clinical Lecturer, UCL Eastman Dental Institute, London

Specialist in Prosthodontics and Restorative Dentistry, Private Practice, London

Fellow, American College of Prosthodontics



Correspondence to: Dr Basil Mizrahi

39 Harley Street, London, W1G 8QH, United Kingdom

phone: 44 (0) 20 7436-3194; fax: 44 (0) 20 7323-1679; e-mail: info@basilmizrahi.co.uk; website: www.basilmizrahi.co.uk

Abstract

Adhesive dentistry has changed the face of traditional dentistry and has the potential to improve esthetics and reduce tooth preparation. However, the materials and techniques used in adhesive dentistry are generally more technique sensitive than those used in traditional dentistry. It is, therefore, important that strict guidelines and protocols are followed to ensure long-term success. Clinicians must be able to determine where adhesive techniques and materials can be used and where traditional, biomechanically sound techniques and materials should be used. There appears to be an in-

creasing trend of young to middle-aged patients presenting with advanced generalized tooth surface loss. These dentitions are conducive to treatment that combines traditional and adhesive materials and techniques. This article discusses guidelines for treatment of these dentitions and outlines the clinical treatment involved in the full-mouth rehabilitation of a worn dentition using a combination of all-ceramic crowns, porcelain and gold onlays, and porcelain veneers.

(Eur J Esthet Dent 2008;3:270–289.)





The advent of adhesive dentistry has revolutionized dentistry. As macromechanical features are not as important as in traditionally cemented restorations, tooth preparation can be greatly reduced.¹ However, there is a danger of placing exceedingly high expectations on adhesive restorations and foregoing basic, sound biomechanical principles. Compromises can be made when carrying out simple dentistry on individual teeth. However, in complex dentistry involving multiple teeth, early failure of individual units may jeopardize the overall long-term success of the entire treatment. Having spent an excessive amount of time, effort and money on a complex treatment, long-term success is a prerequisite for both patient and dentist satisfaction.

The optimal solution is to find the correct indications for adhesive restorations so that tooth reduction can be reduced without excessively jeopardizing the longevity of the tooth/restoration. The success of adhesive restorations, in particular ceramic onlays, is multifactorial and includes secondary caries, fracture, marginal deficiencies, wear, and postoperative sensitivity. However, when used with the correct indication and techniques, ceramic onlays can be a successful long-term restoration.²⁻⁴ Treatment of a dentition showing excessive generalized tooth wear is one such indication where a combination of adhesive and conventional macromechanical restorations may offer an optimal solution.

In patients with excessive generalized tooth wear, the teeth are often caries free with minimal to no restorations present. In order to restore the worn tooth surfaces, space needs to be created for the restorative material. This can be achieved by preparing the occlusal surfaces of the

teeth, which is contraindicated in an already worn down tooth surface. Alternatively, the vertical dimension of occlusion (VDO) can be increased, and this is usually the preferred method of treatment in dentitions with advanced generalized tooth wear.

To increase the VDO, traditional dentistry would require crowning of the posterior teeth. However, adhesive onlays offer a far more conservative approach. An added advantage is that despite the excessive wear, there is normally a wide rim of enamel on the posterior teeth, which has been shown to be important in long-term success of bonded porcelain restorations.^{5,6}

Despite the fact that the VDO is being increased, it is usually necessary to carry out some minor occlusal reduction of the posterior teeth to allow for adequate thickness of restorative material. In addition, unlike porcelain veneers, it is extremely difficult to create a totally invisible margin on the labial surface of the tooth and patients should be made aware of this before the start of treatment. The reason for this is the greater thickness of the onlay margin required compared with the veneer margin. This esthetic limitation is not normally a concern on posterior teeth and is outweighed by the biologic advantage of reduced tooth preparation.

On second molar teeth, where esthetics is not usually a concern and space is at a premium, metal adhesive onlays can be used. Metal is able to better withstand the high occlusal forces generated in the posterior area and requires less occlusal thickness than porcelain.

On the maxillary anterior teeth, besides the aspect of controlling the occlusion and increasing the VDO, esthetic considerations



need to be taken into account. Unsightly appearance of the anterior teeth is usually a primary presenting concern of these patients, and although palatoincisor build up of these teeth^{7B} would address the aforementioned occlusal aspects, the tooth–restoration junction high up along the worn labial surface of the teeth would be esthetically unacceptable to most patients. For this reason, full-coverage crowns are normally the restoration of choice in treatment of advanced generalized tooth wear. Although this may appear to be an aggressive option, the reality is that minimal tooth preparation is required, as these worn teeth usually need to be built up labially, incisally, and palatally.

Another reason for using full-coverage crowns is that diagnostic provisional crowns can be used for an extended period of time prior to placing the final crowns. This is an essential requirement in these dentitions, where there is usually occlusal instability and many of the esthetic landmarks have been lost. A stable, esthetic, and well-functioning anterior guidance needs to be established in provisional restorations and tested prior to placing the definitive restorations. Long-term, diagnostic, modifiable provisional restorations are not possible with palatal-incisor veneers.

On worn mandibular anterior teeth, where the opposing surface is porcelain, incisolabial porcelain veneers offer a good restorative solution. Wall et al showed that mandibular incisal length can be increased by 2 mm without significantly reducing the fracture resistance of either the tooth or the tooth–veneer complex.⁹ In a similar study, Wylie et al showed that mandibular incisors restored with <1 mm of incisal porcelain fractured at a signifi-

cantly lower level than unrestored incisors.¹⁰ It, therefore, appears that 2 mm is the optimal incisal-edge porcelain that should be present when building up mandibular incisors.

Case report

The following treatment illustrates the use of a combination of adhesive onlays, porcelain veneers and full-coverage crowns to restore a dentition with advanced generalized tooth wear.

The patient was a healthy 29-year-old male whose main complaint was the appearance of his worn front teeth, which he felt had been gradually getting worse over the years. He was also aware that his posterior teeth were severely worn and were becoming increasingly sensitive.

On examination there was evidence of advanced tooth wear on the occlusal surfaces of the posterior teeth, the palatal and incisal surfaces of the maxillary anterior teeth, and the incisal edges of the mandibular anterior teeth (Figs 1 to 6). The teeth showed signs of all three components of wear, as follows:¹¹

- *Erosion* – acid attack of tooth structure:
 - Saucerized cupping of palatal surfaces of maxillary incisors, occlusal and/or palatal surfaces of posterior teeth, and buccal surfaces of anterior or posterior teeth
 - Teeth appear shiny when erosion is active
 - Metal restorations protrude from tooth tissue.
- *Attrition* – excessive contact between occlusal surfaces of the teeth:
 - Mandibular and maxillary teeth affected simultaneously



- Even contact between worn mandibular and maxillary teeth in excursive movements
- Flattening of the entire tooth surfaces.
- *Abrasion* – excessive contact between tooth and a physical agent:
 - Wear on buccal aspect of teeth that corresponds with agent, for example toothbrush.

The teeth were generally not heavily restored, with small one- and two-surface amalgams present. There was an existing gold crown on tooth 36, and a large complex amalgam on tooth 26 that showed evidence of marginal breakdown and leakage (Fig 5).

A discrepancy was noted between centric relation and centric occlusion, with centric occlusion being slightly forward of centric relation. There was no evidence of anterior guidance or posterior disclusion during excursive movements.

On questioning, the patient admitted that in the past he had a high intake of sugary soft drinks and alcohol, but he had adopted a far healthier eating pattern in recent years. He was also aware that he “ground his teeth at night.” He was given dietary counseling, instructed in correct tooth brushing technique, and advised that he should wear a night-time occlusal splint following treatment.

The primary aim of treatment was to create a mutually protected occlusion where the posterior teeth would prevent excessive contact of the anterior teeth in maximum intercuspation and the anterior teeth would disengage the posterior teeth in all mandibular excursive movements.¹² This occlusal scheme is designed to prevent further wear of the teeth. As the wear had already penetrated the protective

enamel, it was important that any treatment plan included coverage of the exposed dentin surfaces, which would otherwise continue to be eroded at an increased rate.

The secondary aims were to reduce the tooth sensitivity and to improve the esthetic appearance of the patient’s smile.

Following detailed clinical recording, it was decided that the optimal way to achieve these aims was to increase the VDO and restore the worn surfaces of all the teeth except the wisdom teeth. Unfortunately, the patient would not consent to extraction of the wisdom teeth prior to treatment and these were left untreated and earmarked for extraction sometime in the future.

The treatment plan was carried out using a combination of porcelain crowns, veneers and onlays, and gold onlays. The use of adhesive onlays on the posterior teeth offered a more conservative approach than traditional full-coverage crowns. Simple placement of direct adhesive restorations over the exposed dentin surfaces would not have allowed control of the occlusion, and because of their limited longevity, would have required continual replacement and caused ongoing occlusal instability.

Diagnostic build up

An initial and simple waxup of the maxillary and mandibular anterior teeth at an increased VDO was carried out on study casts mounted in centric relation. Only the palatal and incisal surfaces of the maxillary teeth and the incisal edges of the mandibular teeth were built up.

At this early stage, the waxup was empirical and based on supposed restorative and esthetic requirements (Fig 7). This waxup was then duplicated in resin



Fig 1 Anterior unretracted preoperative view.



Fig 2 Anterior retracted preoperative view.



Fig 3 Right lateral preoperative view.



Fig 4 Left lateral preoperative view.



Fig 5 Maxillary occlusal preoperative view. Note cupping of dentin and severe erosion of palatal surfaces of anterior teeth.



Fig 6 Mandibular occlusal preoperative view.



Fig 7 Initial waxup of anterior teeth at arbitrarily increased VDO.



Fig 8 Light curing of resin composite inserted in a clear silicone stent made on the waxup and seated onto the maxillary anterior teeth.



Fig 9 Mandibular silicone stent in place prior to commencement of direct resin composite build up.



Fig 10 Completion of resin composite build up of maxillary and mandibular teeth. Note the separation of posterior teeth.



Fig 11 Mandibular posterior bite splint worn by the patient.



Fig 12 Initial preparation of maxillary anterior teeth for initial chairside temporary crowns.

composite directly in the mouth using custom-made matrices of the waxup¹³ (Figs 8 to 10). A removable mandibular posterior flat bite splint was given to the patient to wear for comfort and to maintain the space created between the posterior teeth (Fig 11). The composite buildups were adjusted to provide a comfortable VDO and anterior guidance as well as an esthetically pleasing maxillary incisor length. The patient appeared to tolerate this increased vertical dimension and anterior guidance well over a period of about 2 months.

Anterior tooth preparation and initial chairside temporary crowns

Following this early stage of assessment and adaptation, the maxillary anterior teeth were prepared for initial, chairside, acrylic resin, temporary crowns (Fig 12). These temporary crowns were based on the composite buildups carried out in the previous stage. The temporary crowns were made from acrylic resin (methylmethacrylate), which is the preferred material when adjust-

ments are to be made over a period of time.¹⁴ Further refinements of the esthetic appearance and occlusal scheme were made over a period of time, and the maxillary anterior tooth preparations were finalized. The patient now had maxillary anterior temporary crowns opposing mandibular anterior composite buildups and a mandibular posterior bite splint (Fig 13).

Definitive waxup and anterior provisional crowns

Once the incisal edge position and VDO had been established and the anterior tooth preparations had been finalized, maxillary and mandibular, irreversible hydrocolloid impressions were made with the temporary crowns in place. At the same appointment, a polyvinylsiloxane impression was made of the six maxillary anterior tooth preparations (Fig 14). Jaw relationship records (JRR) at the new VDO and a facebow recording were made.

In the laboratory, a full-mouth definitive diagnostic waxup, based on information obtained from the maxillary temporary



Fig 13 Maxillary initial temporary crowns opposing mandibular composite buildups.

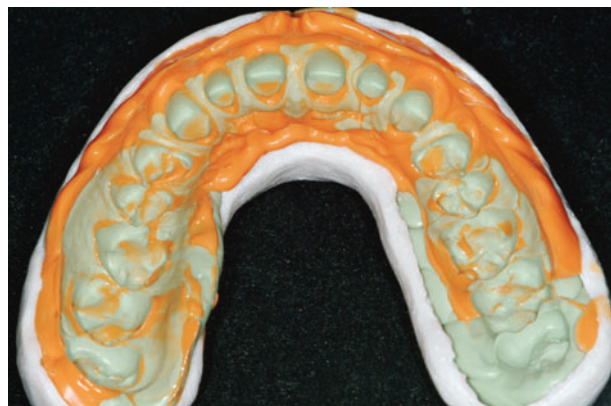


Fig 14 Maxillary polyvinylsiloxane impression for laboratory processed provisional crowns.



Fig 15 Maxillary definitive waxup.



Fig 16 Mandibular definitive waxup.



Fig 17 Silicone putty preparation guide.



Fig 18 Silicone putty matrix for fabrication of chair-side temporary onlays.



Fig 19 Acrylic resin provisional restorations in place on cast of tooth preparations.



Fig 20 Palatal aspect of laboratory-processed provisional crowns.



Fig 21 Laboratory-processed acrylic resin provisional crowns in situ. Note multichromatic layering and natural morphology.

crowns and the mandibular composite buildups, was carried out (Figs 15 and 16). Two sets of silicone matrices were made on these waxups. One set was sectioned to be used intraorally for tooth preparation guides (Fig 17). The other set was to be used for making the posterior, chairside temporary restorations (Fig 18). Definitive acrylic resin, provisional crowns based on this waxup were then processed on the preparations of the maxillary anterior teeth (Figs 19 and 20).

The advantages of making a secondary set of definitive, laboratory-processed provisional crowns include strength, marginal accuracy, and occlusal and esthetic precision. These definitive provisional crowns are based on information obtained from the initial temporary crowns as well as the definitive diagnostic waxup, and should be blueprints of the final crowns (Fig 21). Their precise marginal fit and contour allow for optimum gingival health, which, in turn, contributes to the



Fig 22 Existing amalgam restorations prior to removal under rubber dam.



Fig 23 Reinforced glass-ionomer bases were placed.



success of the future final impression. These provisional crowns were cemented in place with a non-eugenol containing temporary cement (TempBond NE, Kerr, USA).

Posterior tooth preparation and temporization

Once the anterior provisional crowns were in place, preparation and temporization of the posterior segments was carried out. For reasons discussed earlier, the premolar and molar teeth were prepared for ceramic onlays and the second molar teeth were prepared for adhesive gold onlays. Tooth 36 had a previous crown gold crown and was prepared for a new metal-ceramic crown.

The existing amalgam restorations were removed and replaced with a restorative glass ionomer (Ketac Molar, 3M ESPE), which would serve as a base for the definitive porcelain onlays (Figs 22 and 23).

The posterior sextants were prepared and temporized over four separate appointments with the help of the silicone matrices prepared on the waxup (Fig 24). The tooth preparation for porcelain onlays allowed for 2 mm of occlusal porcelain and was smooth and rounded with no sharp angles to create internal stresses on the porcelain. Definitive and smooth deep chamfer margins of about 1 mm were prepared to provide an adequate bulk of porcelain for strength.¹⁵ The preparations for the adhesive gold onlays allowed for 1 mm of occlusal gold. The margins were prepared with a 0.5 mm deep chamfer (Fig 25).

When preparing occlusal onlays, better morphology and a more harmonious transition between tooth and restoration can be created if the preparation margins are carried below the contact point. However, in

worn teeth there is often a wide, long contact area, stretching from the gingivae to the occlusal surface, and breaking the contact point would result in excessive tooth removal. If the contact point/area is not broken, care must be taken when making the impression that the entire margin is captured accurately. One way of overcoming this is by placing a thin piece of mylar strip between the teeth when the impression is made.¹⁶

In areas where there was exposed dentin and no glass ionomer was present, immediate dentin sealing was carried out as described by Magne.¹⁷ The silicone matrices were utilized for the provisional onlays, which were made from acrylic resin and cemented in place with a polycarboxylate cement for additional retention (Figs 26 and 27).

The mandibular bite splint was modified to maintain opposing tooth contact and comfort between appointments.

Preparation of the porcelain veneers on the mandibular anterior teeth was delayed until the time the impression was taken to minimize the amount of time the patient would need to spend with provisional veneers, which are notoriously unpredictable.

At the end of this stage, the maxillary anterior teeth contained provisional crowns, the mandibular anterior teeth contained resin composite buildups, and the posterior teeth contained chairside provisional restorations (Figs 28 and 29).

Impression 1

For ease of management, it was decided to complete the full-mouth restoration in segments rather than simultaneously.

The position and relationship of the anterior teeth determine the esthetics and occlusal function, and are key factors in



Fig 24 Utilization of silicone preparation guide.

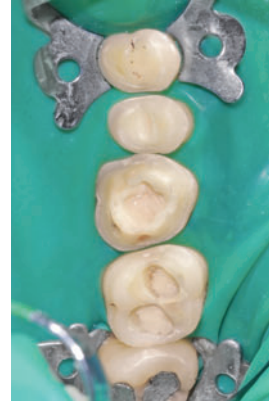


Fig 25 Porcelain and adhesive gold onlay preparations.



Fig 26 Silicone matrix filled with acrylic resin in place over tooth preparations.



Fig 27 As yet untrimmed provisional onlays from silicone matrix.



Fig 28 Maxillary arch with anterior provisional crowns and posterior provisional onlays.

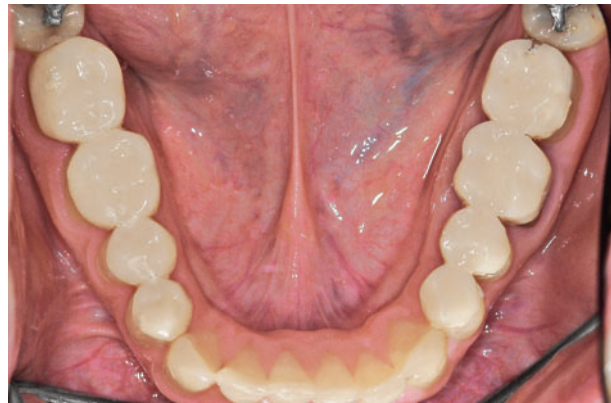


Fig 29 Mandibular arch with anterior composite buildups and posterior provisional restorations.



determining the posterior tooth morphology and occlusal scheme. As such, the establishment of the correct maxillary incisal edge position and incisal guidance should precede any definitive posterior restorations.¹⁸

In this treatment it was decided to define the anterior guidance by completing the mandibular anterior porcelain veneers against the definitive maxillary anterior provisional crowns. A custom anterior guidance table was used to replicate the anterior guidance created in the provisional stage.¹⁹ In order to prevent loss of the VDO occurring due to wear of the maxillary provisional crowns against the mandibular porcelain veneers, it was decided to fabricate and cement the definitive gold onlays on the four opposing second molar teeth at the same time.

For the definitive impressions, a one-stage, two-phase impression technique was used. Heavy-body (polyvinylsiloxane) impression material was placed in a custom tray and light-body material syringed around the preparations.

In the mandibular arch, the porcelain veneers were prepared and an impression was made of the anterior six teeth and teeth 37 and 47 for bonded gold onlays. For the veneers, tooth preparation with a bur did not penetrate the contact points, but these were opened minimally with an ultra thin diamond disk. This allowed accurate capture of the marginal detail in the impression (Figs 30 and 31). Following the mandibular impression, nonremovable shrink-fit bisacryl (PreVISION CB, Hereaus Kulzer) provisional restorations were made directly on the veneer preparations (Fig 32).²⁰

In the maxillary arch a definitive impression was made of the bilateral posterior sextants for the adhesive porcelain and

gold onlays. The anterior provisional crowns, which were to be blueprints of the definitive crowns, were left in place for this impression (Fig 33).

JRRs were made at the desired VDO provided by the anterior provisional crowns. Lateral and protrusive JRRs and a facebow recording were also made.

Despite the complexity of the treatment and the occlusal reconstruction, it was deemed acceptable to use a semi-adjustable articulator as opposed to a fully adjustable articulator and pantographic tracing for the following reasons:

- The anterior guidance had been determined intraorally on the provisional crowns and could be replicated in the final restorations using a custom anterior guidance table.
- The JRRs were taken at the desired VDO and no change of VDO was required on the articulator.
- Lateral and protrusive JRRs allowed setting of the posterior elements on the articulator.

In the laboratory, a feldspathic porcelain (Vintage Halo, Shofu) on refractory dies was used for construction of the mandibular veneers. The porcelain onlays were fabricated using a leucite-reinforced glass ceramic (IPS Empress Aesthetic, Ivoclar Vivadent). A cutback and layering technique was used (Figs 34 and 35).

The gold used for the onlays was a type 3 high-noble gold (Jensen JRVT, Jensen Industries). It was heat treated at 450°C for 15 minutes to allow the formation of an oxide layer and facilitate adhesive bonding. It has been shown that heat treatment of the gold surface provides superior bond strength compared with sandblasting and tin plating.²¹



Fig 30 Mandibular anterior teeth prepared for porcelain veneers. Note slight separation of teeth accomplished with diamond disk to allow accurate capture of margins in impression.



Fig 31 Mandibular polyvinylsiloxane impression of anterior teeth and teeth 37 and 47. Note no tearing of impression material between anterior teeth due to interproximal disking.



Fig 32 Shrink-fit bis-acryl provisional veneers in place, opposing provisional maxillary acrylic resin crowns.



Fig 33 Maxillary arch ready for impression of posterior teeth.

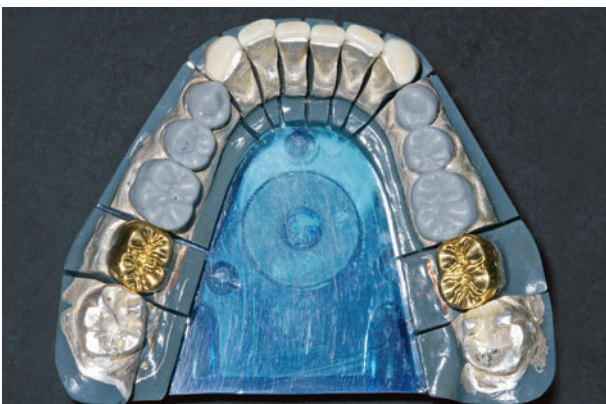


Fig 34 Mandibular porcelain veneers and gold onlays on working cast. The teeth in-between the restorations have been waxed up to their planned definite shape.



Fig 35 Maxillary porcelain and gold onlays on working cast.



Cementation 1

Following try-in and prior to bonding, the porcelain surfaces were treated according to the protocol outlined by Magne, as follows:²²

1. Etch for 90 seconds with 9% hydrofluoric acid
2. Rinse with water for 20 seconds
3. Clean with 37% phosphoric acid – gentle brushing with microbrush for 1 minute
4. Rinse with water for 20 seconds
5. Immerse in 95% alcohol in ultrasonic bath for 5 minutes
6. Apply silane and dry thoroughly
7. Cementation.

All the adhesive restorations were bonded under rubber dam. The gold onlays were bonded using a chemically cured resin cement (Panavia EX, Kuraray).²³ The ceramic onlays were bonded using a dual-cured resin cement (Rely X ARC, 3M ESPE). The mandibular porcelain veneers were bonded using a light-cured resin cement (Rely X Veneer Cement, 3M ESPE) (Figs 36 to 38).

The maxillary arch now contained provisional crowns on the anterior teeth and the definitive porcelain and gold onlays on the posterior teeth. In the mandibular arch, the anterior teeth contained porcelain veneers, and teeth 37 and 47 contained bonded gold onlays (Figs 39 and 40).

Occlusal adjustment, predominantly on the provisional restorations, was carried out following cementation.

Impressions 2

The next stage of treatment involved making definitive impressions of the maxillary anterior teeth and the bilateral mandibular premolar and first molar teeth. The same impression technique as described earlier was used (Fig 41). New JRRs and a face-bow recording were also made.

In the laboratory, all-ceramic crowns were fabricated for the maxillary anterior teeth (WOL-CERAM (AIO), WOL-DENT) (Fig 42).

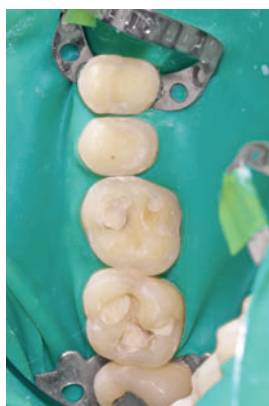


Fig 36 Isolation of preparations in first quadrant prior to cementation.



Fig 37 Cementation of restorations in first quadrant.



Fig 38 Definitive mandibular porcelain veneers against maxillary provisional crowns. Mandible is in protrusive position.



Fig 39 Maxillary arch with anterior provisional crowns and posterior definitive restorations.



Fig 40 Mandibular arch with definitive porcelain veneers on anterior teeth, provisional restorations on teeth 34 to 36 and 44 to 46, and definitive bonded gold onlays on teeth 27 and 47.

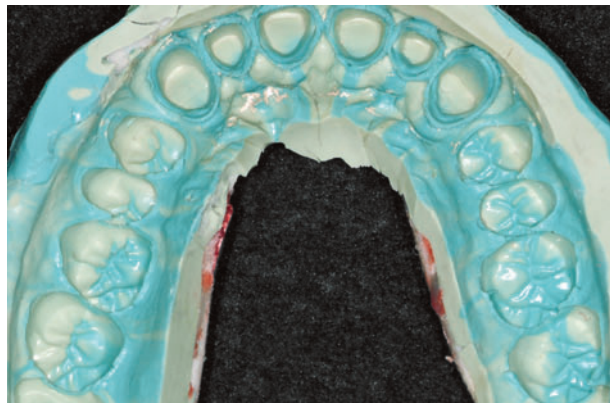


Fig 41 Maxillary impression of anterior teeth.



Fig 42 WOL-CERAM (AIO) all-ceramic crowns at bisque bake stage.



Fig 43 Esthetic try-in of maxillary crowns in bisque bake stage.



Fig 44 Occlusal refinement in bisque bake stage.



Fig 45 Pick-up impression of bisque bake crowns for soft tissue cast.



Fig 46 Working cast with nonretracted soft tissues and removable dies.



Fig 47 Definitive anterior crowns.



Fig 48 Mandibular porcelain onlays and metal-ceramic crown (tooth 36).

An esthetic try-in of the maxillary crowns in a bisque bake stage was carried out and assessed jointly by the patient, dentist, and technician (Fig 43). Occlusal accuracy was verified and minor occlusal adjustment was carried out (Fig 44). The crowns were then picked up in a polyvinylsiloxane impression to obtain a cast of the soft tissues in their natural nonretracted state (Figs 45 to 47).



The mandibular porcelain onlays were fabricated using the same technique and materials as the other porcelain onlays. A metal-ceramic crown was fabricated for tooth 36 (Fig 48).

Cementation 2

The maxillary all-ceramic crowns and the metal-ceramic crown on tooth 36 were cemented using a resin-reinforced glass-

ionomer luting cement (GC Fuji Plus, GC Europe). The porcelain onlays were bonded under rubber dam, as described above.

Final occlusal adjustment and polish were carried out once all the restorations had been cemented (Figs 49 to 54). A maxillary "Michigan" style maxillary protective bite splint was made for the patient to wear at night while sleeping.



Fig 49 Maxillary arch postoperative view.



Fig 50 Mandibular arch postoperative view.



Fig 51 Right lateral postoperative view.



Fig 52 Left lateral postoperative view.



Fig 53 Anterior retracted postoperative view.



Fig 54 Postoperative view of smile.

Discussion

Conservation of tooth structure is a major goal of restorative treatment, and with the advent of adhesive dentistry this goal has become even more attainable. However, it is important to understand the limitations associated with adhesive dentistry and not to forgo traditional biomechanical dentistry where it is indicated.

With the increased emphasis on esthetic outcomes, there is a tendency to place excessively high expectations on adhesive restorations and for biomechanical aspects such as preparation design and occlusal relationship to be relegated to secondary importance.

Adhesive dentistry and traditional dentistry should not be mutually exclusive, but rather symbiotically inclusive so that the advantages of both types of dentistry can be utilized together to give optimum results. Treatment of severely worn dentition allows both types of dentistry to be utilized in this way.

Acknowledgement

Thanks to Mr Salvatore Sgro of L'Eccellenza Odontotecnica, Rome, Italy for the esthetic and technical precision of all the laboratory work shown. I am privileged to work with a true genius in both the art and science of dental technology.

References

1. Burke FJ. Fracture resistance of teeth restored with dentin-bonded crowns: The effect of increased tooth preparation. *Quintessence Int* 1996;27:115–121.
2. Hickel R, Manhart J. Longevity of restorations in posterior teeth and reasons for failure. *J Adhes Dent* 2001;3:45–64.
3. Blatz MB. Long-term clinical success of all-ceramic posterior restorations. *Quintessence Int* 2002;33:415–426.
4. van Dijken JW, Hasselrot L, Ormin A, Olofsson AL. Restorations with extensive dentin/enamel-bonded ceramic coverage: A 5-year follow-up. *Eur J Oral Sci* 2001;109:222–229.
5. Tjan AH, Dunn JR, Sanderson IR. Microleakage patterns of porcelain and castable ceramic laminate veneers. *J Prosthet Dent* 1989;61:276–282.
6. Ibarra G, Johnson GH, Geurtsen W, Vargas MA. Microleakage of porcelain veneer restorations bonded to enamel and dentin with a new self-adhesive resin-based dental cement. *Dent Mater* 2007;23:218–225.



7. Cardoso AC, Canabarro S, Myers SL. Dental erosion: Diagnostic-based noninvasive treatment. *Pract Periodontics Aesthet Dent* 2000;12:223–228.
8. Bernardo JK, Maia EA, Cardoso AC, de Araujo Junior EM, Monteiro Junior S. Diagnosis and management of maxillary incisors affected by incisal wear: An interdisciplinary case report. *J Esthet Restor Dent* 2002;14:331–339.
9. Wall JG, Reisbick MH, Johnston WM. Incisal-edge strength of porcelain laminate veneers restoring mandibular incisors. *Int J Prosthodont* 1992;5:441–446.
10. Wylie SG, Tan HK, Brooke K. Restoring the vertical dimension of mandibular incisors with bonded ceramic restorations. *Aust Dent J* 2000;45:91–96.
11. Allen PF. Use of tooth-coloured restorations in the management of tooth wear. *Dent Update* 2003;30:550–556.
12. Glossary of prosthodontic terms. *J Pros Dent* 2005;94:10–92.
13. Mizrahi B. A technique for simple and aesthetic treatment of anterior tooth wear. *Dent Update* 2004;31:109–114.
14. Mizrahi B. Temporary restorations: The key to success. *Alpha Omegan* 2007;100:80–84.
15. Stappert CF, Att W, Gerds T, Strub JR. Fracture resistance of different partial-coverage ceramic molar restorations: An in vitro investigation. *J Am Dent Assoc* 2006;137:514–522.
16. Crispin BJ (ed). *Contemporary Esthetic Dentistry: Practice Fundamentals*. Carol Stream, IL: Quintessence Publishing Co., 1994.
17. Magne P. Immediate dentin sealing: A fundamental procedure for indirect bonded restorations. *J Esthet Restor Dent* 2005;17:144–155.
18. Dawson P. *Functional Occlusion – From TMJ to Smile Design*. St Louis, MO: Mosby, 2006:chap 15.
19. Kaiser DA. Fabricating a customized incisal guide table. *J Prosthet Dent* 1981;45:568–569.
20. Sneed WD, Knight JS. Simple technique to fabricate provisional restorations for porcelain veneers. *J Esthet Restor Dent* 2001;13:115–119.
21. Eder A, Wickens J. Surface treatment of gold alloys for resin adhesion. *Quintessence Int* 1996;27:35–40.
22. Magne P, Cascione D. Influence of post-etching cleaning and connecting porcelain on the microtensile bond strength of composite resin to feldspathic porcelain. *J Prosthet Dent* 2006;96:354–361.
23. Ogunyinka A. The bond of two adhesive resins to alumina blasted and heat-treated gold alloy surfaces. *J Oral Rehabil* 2000;27:403–406.