Predictable steps to Biomimetic Class IV restorations

By Dr. Anand R. Nanekar, India

Introduction

Composite Artistry has become an important element of direct restorative treatment in dental practice today enabling clinicians to create life-like restorations with individualized characterizations to match the patient’s natural teeth.

Anterior restorations in the aesthetic zone tend to constantly challenge the clinician’s skill; therefore it is important to plan carefully by combining art and science. Adapting the Minimally invasive Cosmetic Dentistry (MiCD) concept, introduced by Dr. Sushil Kotala in my treatment protocol with emphasis on preservation of natural tooth structure “Do No Harm Dentistry” has helped create predictable aesthetic restorations that exceed patient expectations.

Fractured upper central incisors are one of the most common cases of dentoalveolar trauma in the permanent dentition. The following clinical case highlights a simple technique to achieve predictable aesthetics with natural optical characteristics in a Class IV restoration using a sculptable bio-mimetic direct restorative “Beautifil II LS”.

Patient Case

A 35 years old male patient visited our dental office with a complaint of chipped upper front teeth (tooth # 11,21) resulting from a childhood injury with no pain or sensitivity. The patient requested to enhance his smile with minimally invasive treatment.

Treatment Plan

After Intracranial examination, photographs were taken (Fig. 1) and a treatment strategy was formulated keeping in mind the patient high expectations for aesthetic restorations with less invasive treatment. A direct composite restorative material with low shrinkage, predictable aesthetics, sculptable handling and easy polishability – Beautifil ILS was selected. High value translucent enamel shade was identified to create optical effects of youthful teeth.

Materials


Adhesive system – FL-Bond II

Mock Up

- An impression is taken and model poured using die-stone material. Free hand build up of composite for both teeth to evaluate the final outcome. Both teeth were carefully analyzed and identified that each tooth required a different recipe for layering the composite material.

Tooth Preparation

- Rubber dam isolation from pre-molar to premolar, Rubber dam in place on maxillary molar to premolar, Rubber dam is placed around incisors to guide the build-up of the palatal enamel layer.

Shade Selection

Shade A2 was selected. (Fig. 2) Shade Selection

- Black and white photo is recommended for assessing value. Shade A1 was selected. (Fig. 3) Shade Selection

Step by Step Restorative Technique

Mock Up

- An impression is taken and model poured using die-stone material. Free hand build up of composite for both teeth to evaluate the final outcome.

Before and after

- Both sides, labial and palatal with a round ended tapered Diamond bur

For further retraction of gingiva to eliminate contamination with subungal fluid (Fig. 4)

- Infinite bevelling of margins to blend the composite material on both sides, labial and palatal.

Adhesive system – FL-Bond II


Fig. 1: Fractured maxillary anterior incisal edge of tooth #11 and 21
Fig. 2: Black and white photo taken with classic Vita shade guide for value assessment, Shade A2 matches with natural dentition compared to A1
Fig. 3: Buccal view of the composite build-up on the tooth model, showing differences of a fractured incisal edges
Fig. 4: Rubber dam isolation with floss ties
Fig. 5: Labial bevelling of fractured area
Fig. 6: Smoothing incisal edge with the Super Snap Black disk
Fig. 7: Putty index checked intra orally after placing rubber dam
Fig. 8: Palatal shell made using Shofu Injectable Enamel shade
Fig. 9: Build-up of deep dentin with Shofu Beautifil II LS A20, note the different amount placed in each tooth
Fig. 10: Thin layer of Beautifil ILS shade A2 placed after placement of Composite anterior matrix band with silicon wedge between both central incisors for better contact and contour of the tooth
Fig. 11: Final enamel layer build-up with Beautifil II Enamel shade HVT of for better contact and contour of the tooth
Fig. 12: After contouring, finishing done with dura white stone
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Prosthetic treatment using monolithic all-ceramic crowns and composite bridges

By Dr Meni Chatzinikolaou, Dr George Papavassiliou, Dr Panodosos Gonidis & Maria Spanopoulou, Greece

The present report describes the reconstruction of a severely worn dentition with the use of fixed restorations and with maximum preservation of the existing tooth structure. Implants were employed for the restoration of the partially edentulous lower jaw. Rehabilitation of the generated new jaw was attained with all-ceramic materials. Temporization was preceded by splint therapy and comprehensive pre-prosthetic treatment. The press technique and the CAD-CAM technique, were utilised in the transfer from the temporary to the final all-ceramic reconstruction. This report describes the individual treatment stages and discusses the approaches taken in these stages.

For some years now, monolithic all-ceramic restorations have been a frequently used treatment option for the reconstruction of destroyed tooth structure. Their benefits include the ability to eliminate the use of metal, to implement a cost-efficient manufacturing procedure and to eliminate the risk of chipping associated with veneered ceramic. With the increase in the use of all-ceramic materials, the failure rate of some of these materials at high loads (bruxism and other parafunctions) has been discussed. However, advances in materials engineering and adhesive technology have led to the introduction of ceramic systems (e.g. lithium disilicate) that can be used for high load bearing restorations.

Introduction

This report focuses on the prosthetic treatment of a severely worn dentition in a bruxer. A consistent treatment plan is critical to a successful rehabilitation as it is a correct diagnosis and the implementation of pre-prosthetic treatment measures. Material selection also becomes a crucial criterion of success or failure. We are of the opinion that it is possible to use all-ceramic materials in patients with bruxism - even if the bruxer is caused by medical or psychosocial factors. The oral and physical consequences of bruxism vary in patients with bruxism, according to the severity of the parafunctions. In many cases, bruxism correlates with at least some degree of dental attrition or wear. Particularly in patients with an inadequately restored, interrupted dentition, for instance in older people, the residual teeth which still have contact to the antagonists may be affected by a severe loss of tooth structure. Generally, rehabilitation of a patient with a worn dentition presents a considerable challenge to the treatment team. In this context, extensive pre-prosthetic planning and consistent implementation of the treatment plan are essential prerequisites for the success of the treatment. Primary objective of the rehabilitation is to establish a stable occlusion and an adequate vertical dimension. Improper functioning or a diagnostic and therapeutic stage are just as essential as the pathway to a functional rehabilitation. The restoration is required to have a protective splint and performing regular check-ups. Before starting the finishing & polishing treatment, the team must take a decision to rule out chipping of the material to which materials to use has to be decided. On the one hand, the risks to which materials to use has to be decided. On the other hand, adequate strength should be provided to rule out chipping of the material or damage being caused to the teeth. To which materials to use has to be decided. On the one hand, the risks to which materials to use has to be decided. On the other hand, adequate strength should be provided to rule out chipping of the material or damage being caused to the teeth.

Rehabilitation of a dentition damaged by bruxism

The term ‘bruxism’ refers to various parafunctional activities of the stomatognathic system. Bruxism is assumed to have multiple possible causes. Causal treatment of bruxism should depend on whether the disorder is caused by medical or psychosocial factors. The oral and physical consequences of bruxism vary in patients with bruxism, according to the severity of the parafunctions. In many cases, bruxism correlates with at least some degree of dental attrition or wear. Particularly in patients with an inadequately restored, interrupted dentition, for instance in older people, the residual teeth which still have contact to the antagonists may be affected by a severe loss of tooth structure. Generally, rehabilitation of a patient with a worn dentition presents a considerable challenge to the treatment team. In this context, extensive pre-prosthetic planning and consistent implementation of the treatment plan are essential prerequisites for the success of the treatment. Primary objective of the rehabilitation is to establish a stable occlusion and an adequate vertical dimension. Improper functioning or a diagnostic and therapeutic stage are just as essential as the pathway to a functional rehabilitation. The restoration is required to have a protective splint and performing regular check-ups. Before starting the finishing & polishing treatment, the team must take a decision to rule out chipping of the material to which materials to use has to be decided. On the one hand, the risks to which materials to use has to be decided. On the other hand, adequate strength should be provided to rule out chipping of the material or damage being caused to the teeth.

Conclusion

The before and after clinical photographs of this patient case highlights that predictable life-like restorations can be created to mimic natural teeth using a conservative approach with minimal tooth preparation, selection of the right type and shades of composites followed by a comprehensive finishing and polishing protocol.

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Fig. 13: Polishing with Super Snap X-Treme green disc followed by pink disc clearly showing the reflection on the tooth
Fig. 14: Intra oral image showing final restoration
Fig. 15: Before and after image digitally overlapped to showcase extent of actual build-up of the composite restoration
Fig. 16: Frontal view of maxillary anterior teeth showcasing bio mimetic aesthetics of composite resin with a close match to natural tooth translucency and effects in the incisal area
Fig. 17: Artistic side view of both dental arches in anterior guidance 1 week post treatment showcasing complete rehabilitation of teeth and natural 634 life-like aesthetics

maximise the aesthetic outcome of the restoration.

The use of a proper protocol for finishing and polishing helped achieve a glazed-like composite surface similar to ceramic or natural teeth as seen in the extreme close up clinical photographs.

Strength of all-ceramic materials in dentition of patients with bruxism

First, we have to decide which of the two aspects should be given pre-dominance: aesthetics or adequate strength under high masticatory stress. Strength is decisive for the long-term stability of a restoration, particularly in patients with bruxism. The higher the crystalline stiffness, the stronger the ceramic material is. This is particularly true for oxide ceramics (zirconium ox-

ide, strength > 1000 MPa), which is a material that has a dense micro-
structure and is consequently highly opaque. It may therefore not always meet the aesthetic requirements of a restoration. While more recent zircon-

oxide versions offer increased translucency, their strength is consid-

erably lower than the strength of their predecessors. Conventional di-

ceramic composites are based on a leucite-reinforced glassy phase, which has a beneficial effect on aesthetics. With a
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strength of 80 to 200 MPa, however, their strength is woefully low. Having initial flexural strength compari-
sing from 360 to 400 MPa, lithium-di-
silicate glass-ceramic materials (IPS e max Press and CAD) are located be-
tween the strength values of zirconi-
um oxide and conventional silicate ceramics. Lithium disilicate is natu-
really translucent and is indicated for
monolithic single-tooth restorations, three-unit bridges (premolar region), hybrid abutments and hybrid abut-
ments crowns. Monolithic restora-
tions significantly reduce the risk of
chipping compared with veneered restorations and are therefore par-
ticularly advantageous for patients with bruxism. A possible route to
employ this material also for post-
breasure is to use the CAD-on-
technique (IPS e max CAD / Veneer-
ning Solutions) to produce composite bridges. If this technique is used, the
framework is created from high-
strength zirconium oxide and then a
monolithic veneering structure made from comparatively “elastic” and
above all aesthetic lithium di-
silicate is sintered to it. This special
combination of materials and the
homogeneous ceramic bond cre-
ated between them results in strong
restorations that can withstand se-
vere masticatory forces and prevent
fractures from occurring. Even if, ac-
cording to the manufacturer, those indications are contraindicated for
patients with bruxism, from a prag-
matic point of view, two material
concepts emerge as possible routes to
an all-ceramic full-mouth reha-
bilitation: monolithic restoration
using high-strength lithium di-
silicate glass-ceramics and the CAD-on
/ Veneering Solution technique for
posterior bridges.

Clinical case
Preoperative situation, diagnosis and treatment planning
A 67-year-old male patient present-
ed with a functionally and aestheti-
cally severely compromised denti-
tion. His pressing need at the initial
assessment was to have his dental
situation improved. He wanted his
Teeth 11, 12 and 12 received restora-
tions, the loss of proximal contacts.
caused by the loss of tooth structure,
was recorded using a facebow. By deter-
mining the interocclusal space at rest ( freeway space), we were able to
evaluate the loss of height in the ver-
tical relation (Fig. 2). In the lab, the
models were mounted on a semi-
adjustable articulator. The pre-pro-
thetic phase was begun by having
the patient wear a splint to stabilize
the bite. For this purpose, an occlus-
al position was transferred to the
permanent restoration (Fig. 3). When the diagnostic wax up was
created, the functional requirements and aesthetic expectations of the
patient were taken into considera-
tion (Fig. 3). Removal of the existing
restorations was followed by surgi-
cal crown lengthening of the upper and
lower teeth in the anterior and
premolar region. A vacuum-formed
tray was created from the diagnos-
tic wax-up and used as a template, or
guide to attain the planned tooth
length (Fig. 4). Excess tissue was care-
fully removed, the gingival tissue
around the teeth intact and tem-
porarily folded back and the bone
reduced by the necessary height. The
Fig. 1A: Bite registration at rest and assessment of the
loss of height in vertical dimension
Fig. 1B: Diagonal view of the panoramic skull.
Fig. 1C: CAD/CAM based fabrication of long-term temporaries from high performance PMMA
Fig. 1D: X-ray template (derived from the wax-up)
Fig. 2: Build-up of teeth 12, 11 and 21 with endodontic posts made of glass fiber reinforced composite
Fig. 3: Cast build-ups on teeth 12, 11 and 22 and cast build-ups on teeth 22, 23 and 24
Fig. 4: Vacuum-formed try prepared from the wax-
up as guide for surgical crown lengthening procedure
Fig. 5: Softure after surgical crown lengthening in the
maxillary jaw
Fig. 6: Build-up of teeth 12, 11, and 22 with endodontic posts made of glass fiber reinforced composite
Fig. 7: Composite build-ups on teeth 12, 11 and 22 and cast build-ups on teeth 22, 23 and 24
Fig. 8: Guided technique for surgical crown lengthening
Fig. 9: X-ray template (derived from the wax-up)
Fig. 10: Implant position planning on the CT Image
Fig. 11: Insertion of the implants with the help of the
guiding template
Fig. 12: Implant abutments in situ
Fig. 13A-B: CAD/CAM fabricated long-term temporaries from high performance PMMA
Figs 6 and 7: Build-up of teeth 12, 11, and 22 with endodontic posts made of glass fiber reinforced composite
radiographic treatment with glass fibre
reinforced endodontic posts (IRC Poster, Plus, Ivoclar Vivadent, see Figs 6 and 7) and a core build-up made of self-curing composite (McBare Flow, Ivoclar Vivadent). The endo-
dontic posts consisting of a specially
developed composite matrix offer a
natural translucency and dentin-
like elasticity (flexural strength). The
composite used for the core build-
up is available in several shades and
provides favourable mechanical
and aesthetic properties. Teeth 23, 23 and 24 received cast gold posts (Fig. 8) and the other teeth were built up
with composite to enable them to be
used as abutments.
Implant insertion
An X-ray template was created on the
basis of the wax-up and then used for planning the position of the
implants in the lower jaw. Perfor-
tions were applied to the occlusal
region of the template at the im-
plant exit points that were deemed
most suitable for achieving an ideal
prosthetic restoration and filled with
radiopaque material (Fig. 9). Prepara-
tion of a CT scan with the template in place was followed by virtual im-
plant position planning in region 36,
43 and 46 (Fig. 10). We recorded the
X-ray template into a guiding/deli-
ting template for the insertion of the
implants. The surgical intervention
was uneventful. Subsequently, the
three implants (Astra Tech, Dentply Implants) were inserted into the lo-
cal bone (Fig. 11), healing abutments were screwed onto the implants and the implant sites were closed with
sutures.

Long-term temporization
The patient received a long-term
temporary restoration to stabilize the
planned vertical occlusal dimen-
sion and to validate the aesthetic ob-
jectives. A high-performance FMMA
(TeloCAD, Ivoclar Vivadent) was used
for the fabrication of the tem-
poraries. Wax-up and CAD/CAM em-
braced a swift implementation of this
stage (Fig. 12). Although a monolithic
design was used, the translucent properties of the polymer lend a life-
like appearance to the temporaries
(Fig. 13). The patient was very com-
fortable with the restorations and
did not report any functional com-
plaints. The aesthetic appearance
was considerably improved, which was reflected in both the patient’s speech
and facial expression.

Permanent prosthetic restoration
The patient was wearing the long-
term temporaries for an adequate
length of time to get used to the
new VDO, which was then to be
transferred to the permanent resto-
ration. Once the temporaries were
removed, an impression of the pre-
pared teeth was taken using a vinyl
polyisocyanate precision impression
material (Virtual, Ivoclar Vivadent). The propriosity hydrophilic proper-
ties of the impression material allow
for a detailed and accurate record-
ing of the oral hard and soft tissues
[B. K. Nøvling. University of Texas
2001], providing the ideal condi-
tions for obtaining high-precision
working models. The validated oc-
cusal position was transferred to the
articulator using a sequential split
mouth method (Fig. 16). A facebow
registration was performed for the
skull-related repositioning of the up-
per jaw model.

All-ceramic single-tooth crowns
In line with the treatment plan, the
dental technician created monolith-
ic: single-tooth crowns using lithium disilicate Poly-chromatic press in-
gots were used for the press tech-
nique (IPS e max Press Multi, Ivoclar Vivadent) to achieve the planned

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The implants were fitted with customised hybrid abutment crowns made of lithium disilicate (IPS e.max CAD). The hybrid crowns were designed using CAD software, ground from specially developed lithium disilicate blocks and extraorally bonded to a titanium base using a specialist luting composite (MultiLink Hybrid Abutment, Ivoclar Vivadent, see Figs 19 and 20). Subsequently, the monolithic hybrid abutment crowns were screwed into place in the oral cavity. The IPS e.max CAD blocks for the manufacture of hybrid abutments or hybrid abutment crowns feature a pre-fabricated interface (e.g. for the Sirona Ti base) and ensure a pre-fabricated interface (e.g. for the Sirona Ti base) and ensure a high accuracy of fit. In our opinion, the reduced fixural strength of the lithium disilicate, compared with zirconium oxide, has a favourable effect on the patient’s chewing comfort and the implants. In view of the fact that implants have no inherent mobility and therefore have only reduced tackiness, we assume that lithium disilicate provides a suitable abutment material for restorations in patients with bruxism.

All-ceramic abutments

For somewhat cushion the high masticatory forces that are to be expected in a bruxer to be occurring in the posterior region, we opted for lithium disilicate, here too. However, here the focus was on reliability and strength. For this reason, we decided to design what is termed as a composite bridge (IPS e.max CAD Veneering Solutions). This unique combination of lithium disilicate (LSi) and zirconium dioxide (ZrO2) allows the fabrication of tooth- and implant-supported bridge constructions that offer an exceptional overall strength and aesthetically pleasing properties. Two structures are required to create the restoration: a high-strength zirconium oxide framework (IPS e.max ZirCAD) and a glass-ceramic veneering structure (IPS e.max CAD, see Fig. 21). After both structures were manufactured using a CAD/CAM procedure (iLab MC-XL, Sirona), the framework was tried in and fine-tuned down to the last fine details before finalisation (Fig. 22). The short processing times required to complete the structures increase the rate of efficiency and productivity. After the try-in, the two structures, which had been milled or ground separately, were fused together to achieve a homogeneous ceramic bond using a fusion glass-ceramic (IPS e.max CAD Crystal). Connect, Ivoclar Vivadent, see Fig. 23). The fusion process takes place at the same time as the crystallisation process of the lithium disilicate.

Seating the restorations

The IPS e.max Press restorations were seated using a dual-curing luting composite (Variolink Esthetic DC, Ivoclar Vivadent) that features optimum aesthetic properties. The glass-ceramic components were pre-treated using a single-component primer (Monobond Etch & Prime, Ivoclar Vivadent) according to the manufacturer’s instructions. The tooth preparations were conditioned with an adhesive (Adhese Universal, Ivoclar Vivadent, see Figs 24 and 25). Once an appropriate shade of luting composite was selected, the glass-ceramic restorations were permanently seated using an adhesive luting technique (Fig. 26).

The IPS e.max CAD hybrid crowns were screwed into place (Fig. 27) and the screw channels sealed using an aesthetic composite filling material. The zirconium oxide supported IPS e.max CAD-on bridges were seated using a self-curing resin cement (SpeedCEM Plus, Ivoclar Vivadent).

Discussion

All-ceramic materials are sometimes described as too risky for the prosthetic rehabilitation of patients with bruxism. Even today, bruxism is often mentioned as a contraindication. This is certainly true as far as conventional ceramic materials with a high brittleness are concerned. When it comes to these materials, the failure rates at high loads (parafuntions) should be critically assessed. However, advances in material engineering and adhesive technology have led to considerable progress. In the view of the writer, modern ceramic materials and concepts can be suitable for restorations in patients with bruxism – provided that they are processed in accordance with the clinical indication.

Overview of the data for the materials used in this report

IPS e.max CAD-on: Clinical data of up to three years of clinical wear are available for the CAD-on technique. The mean observation period was 21 months for bridges and 36 months for crowns. Two studies examined 29 three-unit bridges [Watzke et al., 2010, Blatz et al., 2012] No failures have been reported to date. Another study including 50 bridges was initiated in 2010 [Baier et al., 2012]. Still another study [Beuer et al., 2012] was also initiated in 2012. In addition, a prospective study carried out at the University of Pennsylvania by von Blatz et al. evaluated the performance of what are termed as composite bridges manufactured using the CAD-on technique. Twenty-five patients received a three-unit CAD-on bridge. After six months of service, all restorations were rated as ‘very good’ or ‘good’.

IPS e.max Press: Data of up to ten years are available for lithium disilicate restorations made using the press technique. A survival rate of 97% after a mean observation period of 7.6 years has been established on the basis of 642 restorations (crowns) – five external clinical studies [Blatz et al., 2012; Gehrt et al., 2012, Dental Advisor 2012] and an internal Ivoclar Vivadent study. Failures (1.5 %) were attributable to fractures (16 %), endodontic complements.
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Treatment of a patient with bruxism by all-ceramic restorations

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Fig. 30A-B: Occlusal view of the restorations in the upper and lower jaw

Fig. 31 A relaxed and happy patient after completion of the treatment

Conclusion

In the clinical case described in this report, the treatment goal was achieved and the functional and aesthetic expectations of the patients were fully met. All-ceramic restorations were employed for the rehabilitation of the dentition that had been severely damaged by bruxism. If we take a retrospective view, the importance of thorough diagnostics, careful treatment planning and a step-by-step pre-prosthetic treatment phase becomes evident. Consistent adherence to the treatment plan is equally important. Only after the planned vertical dimension is achieved with the help of long-term temporaries should the permanent prosthetic restoration phase be begun. When selecting the materials for the prosthetic restoration, the high functional loads to which the dentition of a bruxer is exposed should be considered and, ideally, monolithic structures should be preferred. If these points are taken into consideration, long-term stability of the bite and, if appropriate materials are used, high aesthetics can be achieved.

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