State-of-the-Art Dental Machining Demonstrated by Sescoi and Partners

Sescoi, DentalWings, Agie Charmilles and Seco recently came together to run a free seminar demonstrating the latest advances in dental machining. More than a hundred participants, including delegates from many of France’s dental companies and prosthetic manufacturers attended the seminar hosted by the ENSAM School (Ecole Nationale Superieure d’Arts et Metiers) based in Cluny, France.

Sescoi works regularly with ENSAM’s major R&D Centre, and the latter’s support for the seminar is a significant endorsement of the state-of-the-art technology presented. Delegates were able to follow every stage of prosthetics manufacturing, starting with scanning and manipulating a model in DentalWings software, and automatic programming of the high speed toolpath in WorkNC Dental automation. CAM system followed up 5-axis machining of the prosthetic frameworks on a Mikron HSM 400U using Seco tooling.

By using the techniques proposed in the seminar, the machining of a dental framework in difficult to machine materials such as cobalt, titanium or zirconia can be completed in a few minutes, making it possible to produce between 150 and 260 parts per day while maintaining full traceability.

Sescoi developed WorkNC Dental in close collaboration with dental technicians, adapting its ‘One Button’ CAM software to suit the needs of dental laboratories. Intelligent technology within the system selects tools and cutting strategies that have been specially adapted to high speed 5-axis machining, while considering the kinematics and limits of the machine tool to automatically produce highly accurate implants with an extremely fine surface finish. Further information and machining videos can be viewed on the Sescoi site.

Sescoi is also the software partner in the ambitious ‘Pro-dentie’ dental prosthesis ‘open manufacturing’ project. This 56-month, French government-funded project is lead by the French UNPPD (Union Nationale des Prothesistes Dentaires) and AFNFT, an association that promotes common standards in data exchange.

Lab link with new system

A Hi-TECH link between an expanding dental supplier and dental practices across the UK and Ireland has been created by Sheffield IT specialist Richlyn Systems.

Richlyn was called in by Crown & Bridge to help it meet the needs of a growing number of private and NHS practices by providing a new website and web-based order processing, accounting and logistics systems.

“An increasing number of UK dental practices are realising the benefits of our products in terms of both quality and cost,” said Crown & Bridge managing director Marcus Rickard.

“An effective website is critical to our growth and Richlyn have provided a superb bespoke solution – there is nothing else like it on the market!”

Marcus added: “We have received great feedback from dentists, practice managers and the financial directors of our corporate group members, who have found that our system enables to keep better control of their laboratory bills.”

“In addition to running our own administration, the website allows our dentist clients’ to view prices and products, track orders, product passports and print statements.”

In the future, the site (www.crownandbridge.co.uk) will also allow the company's clients to order direct online, sending scanned dental impressions rather than the traditional moulds. The Crown & Bridge package marks a further expansion into the UK dental sector for Richlyn.

The company has also developed a tailor-made website solution which is being used by practices in Sheffield, Leeds, Manchester, Nottingham, Wakefield and Mansfield.

“More dentists are seeking to market their practices effectively as they enter the private sector and they realise that a stylish, informative website is essential,” commented Richlyn director Rick Cusimano.

“Where required, we can also provide bespoke software solutions, tailored to a client's individual needs – as was the case with Crown & Bridge.”

New GDC Council confirmed

The Appointments Commission has confirmed the names of the members it has appointed to the restructured Council of the General Dental Council (GDC), which took office in October.

The GDC works to protect patients and promote confidence in dental professionals by:
• registering qualified professionals
• setting high standards of dental practice and behaviour
• quality-assuring dental education
• making sure dentists and DCPs keep up to date
• helping patients make a complaint about a dentist or dental care professional.

GDC chief executive and registrar Duncan Rudkin said: “The General Dental Council is moving into a new era and I look forward to working with the new-ly appointed Council.”

In making the structural changes, the Council was keen to ensure the GDC of the future could continue to command the confidence of the profession whilst fulfilling its public protection role.
All-ceramic restorations

Dr Stephen Ball presents a clinical case showing the replacement of aesthetically failing bonded porcelain crown and bridgework with all-ceramic restorations

ABSTRACT

As we face increasing demands from our patients for highly conservative restorations that are true reproductions of natural tooth structure, traditional porcelain bonded to metal systems have competition from newer all-ceramic materials. These materials combine natural aesthetics with adequate compressive and flexural strengths to allow their use in bridgework and also in posterior areas of the mouth. This article will showcase a clinical application of the Ivoclar Vivadent IPS e.max system to replace aesthetically failing anterior bonded porcelain crown and bridgework.

During the initial cosmetic consultation appointment, this 48-year-old male patient’s chief complaint was the poor appearance of his existing anterior crown and bridgework. (Figures 1, 2, 5 and 4.) Although the restorations were approximately 12 years old and clinically satisfactory in terms of marginal fit and periapical health, they were aesthetically poor due to:

1. Unnatural opaque shade
2. Lack of interdental papilla between central incisors – “Black triangle”
3. Poor adaptation to ideal smile line.

The probable reason for the opaque appearance was under-preparation of the tooth structure leading to inadequate clearance for a satisfactory porcelain thickness. After a long discussion with the patient, he was adamant that he did not want any metal in the new restorations and he was also keen to avoid any further tooth reduction.

Appropriate informed consent was obtained and the decision was made to replace the anterior restorations with an all-ceramic alternative – in this case IPS e.max. The UR1 is a single unit crown and UL1 is a retainer for a cantilevered pontic replacing UL2.

Introduction

Preparing for treatment

After numbing the patient thoroughly and taking a pre-operative impression of the upper arch, the old restorations were cut off and the preparations refined to proper requirements for this type of restoration, namely:

1. 1.5mm to 2mm incisal reduction
2. 1.0mm to 1.5mm labial reduction
3. 1.5mm occlusal clearance in intercuspal position (ICP) and lateral excursions
4. 1.0mm reduction at gingival margin
5. Shoulder margin
6. Rounded internal line angles. (Figure 5.)

Fortunately following removal of the old restorations, there was a well-proportioned ovate pontic site at the U1/L2 region already. The red appearance here was not due to the presence of inflammation but rather that of hypokeratinised tissue.

Final preparations were completed, tissue retracted, and final master impressions made with an addition cured silicone impression material (Take1 – Kerr). Care was taken to provide the laboratory with an accurate impression with detailed crisp marginal definition. A silicone bite registration was made over the preparations only at ICP.

To assist with accurate shade determination, photos were taken with two shade tabs thought to be closest to the correct shade in the frame and these were sent to Dr. Stephen Ball.

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the laboratory along with the impressions. The shade in this case, despite having been improved by home whitening, was rather challenging as the patient had suffered from tetracycline staining. (Figure 6.)

Custom-fit temporary restorations were fabricated from a dual cured bis-acryl composite temporary crown and bridge material (Quicktemp2 – Schottlander) using the upper preoperative impression as a template and these were then cemented with a non-eugenol containing temporary cement. Homecare instructions were given and the patient was seen two weeks later for the fitting appointment.

Approval before cementation
Following removal of the temporary restorations, the preparations were cleaned with a slurry of pumice and water with a prophylaxis brush in a slow speed hand-piece. The restorations were then tried in and assessed for marginal fit, shade and occlusion. The patient was then asked to look at the restorations in-situ and approve them before cementation. Following approval from the patient, the restorations were cleaned internally with alcohol soaked cotton wool pledgets, dried with oil-free compressed air and silanated (MonobondS – Ivoclar Vivadent) as per manufacturers instructions.

The emergence profile and gingival condition associated with the new restorations was highly satisfactory. The incisal edges also follow the curve of incisive cover in a much more aesthetically pleasing way. Unfortunately, it was not possible to completely eradicate the black triangle effect between the central incisors. If we examine the peri-apical radiograph taken following cementation, we can see that due to loss of alveolar crest height caused by previous periodontal disease, the distance from the bone level to the contact point is approximately 6.5mm. The maximum distance between the alveolar crest level and contact point between adjacent natural teeth to guarantee 1.00 per cent papilla infill is 5.0mm (Tarnow 1992), (Figure 11.)

Fortunately in this case the patient has a low lip line, which means that this problem is relatively unnoticeable on a full smile and the patient was extremely pleased with the appearance and function of his new restorations.

**Topics for discussion**
Significant developments in all-ceramic materials have created great opportunities for the fabrication of lifelike restorations that provide reliable, long-term results. In 2005 Ivoclar Vivadent introduced IPS e.max lithium disilicate glass ceramic, a material that provides optimal aesthetics, yet has the strength to enable conventional or adhesive cementation. IPS e.max lithium disilicate has a needle-like crystal structure that offers excellent strength and durability as well as outstanding optical properties. IPS e.max lithium disilicate can be traditionally pressed or contemporarily processed via CAD/CAM technology. Due to its strength and versatility, the material can be utilised for the following applications:

- Anterior/posterior crowns
- Inlays/onlays
- Veneers
- Thin veneers
- Telescopic crowns
- Implant restorations
- Anterior three-unit bridgework up to the second premolar (press only)

Glass ceramics are categorised according to their chemical composition and/or application. The IPS e.max lithium disilicate is composed of quartz, lithium oxide, phosphorus oxide, alumina, potassium oxide, and other components. These powders are combined to produce a glass melt. Once the proper viscosity is achieved, similar to that of honey, the glass melt is poured into a separate steel mould of the proper shape. The material is then left to cool in the mould until it reaches a temperature that no deformations occur.

This process produces minimal pores or internal defects due to the glass flow process and provides for easy quality con-
trol due to the translucent nature of the glass. The blocks or ingots are produced in one batch depending on the shade and size of the materials. Overall, this composition yields a highly thermal shock-resistant glass ceramic due to the low thermal expansion that results when it is manufactured. The glass ingots or blocks are then processed using the lost-wax hot pressing techniques (IPS e.max Press) or CAD/CAM milling procedures (IPS e.max CAD).

The restorations shown here were fabricated using the press technique with IPS e.max Press ingots.

The pressable lithium disilicate is produced according to a bulk casting production method, which involves a continuous manufacturing process based on glass technology (melting, cooling, simultaneous nucleation of two different crystals, and growth of crystals) that is constantly optimized in order to prevent the formation of defects. The microstructure of the pressable lithium disilicate material consists of approximately 70 per cent volume of needle-like lithium disilicate crystals that are crystallised in a glassy matrix. These crystals measure approximately three µm to six µm in length.

The basic physical properties for IPS e.max Press are displayed in Table 1.

This means that a restoration fabricated to full contour using the pressing technique delivers 400MPa of strength throughout creating a monolithic structure. Overall, these materials demonstrate specific advantages including higher edge strength vs. traditional glass ceramic materials (i.e., can be finished thinner without chipping). Additionally, the low viscosity of heated ingots enables pressing to very thin dimension (i.e., enabling minimal prep or no-prep veneers) and creation of the chameleon effect, due to their higher translucency.

**Conclusion**

There are several clinical advantages to the use of all ceramic systems compared with porcelain bonded to metal alternatives. These are:

- Less tooth reduction required and thus lower level of pulpal insult during tooth preparation,
- Improved aesthetics due to the lack of opaque porcelain needed to mask out metal substructures,
- Chemical bonding capabilities between porcelain and enamel/dentine substrates,
- Improved biocompatibility to allow their use in patients with metal allergies.

From a clinical standpoint, the restorations demonstrate excellent aesthetics, are easy to cement using standard procedures and materials, and are durable enough to provide an excellent and conservative alternative to metal-ceramic restorations.

Thanks to Mr Andrew Taylor of Pacor Dental Ceramics for his excellent technical work in this case.

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**Table 1**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Flexural strength [biaxial] [MPa]</td>
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</tr>
<tr>
<td>Fracture toughness [MPa m0.5]</td>
<td>2.75</td>
</tr>
<tr>
<td>Modulus of elasticity [GPa]</td>
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</tr>
<tr>
<td>Vickers hardness [MPa]</td>
<td>5800</td>
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<tr>
<td>Chemical solubility [µg/cm2]</td>
<td>40</td>
</tr>
<tr>
<td>Press temperature [°C]</td>
<td>915–920</td>
</tr>
</tbody>
</table>

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**About the author**

Mr Stephen D Ball BDS is a general dental practitioner with a special interest in cosmetic dentistry and aesthetic restorative dentistry. To contact him, call 01709 364404, visit www.pdental.co.uk or email pdfaltd@gmail.com.

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Abstract
CAD/CAM technology has had a considerable impact in dentistry in the past years and will continue to expand in the years to come. While initially CAD/CAM technology was commonly associated with zirconia-based restorations, modern systems offer an extensive range of materials and solutions for both natural teeth and implants. The benefit is not only limited to a more cost-efficient manufacture of dental restorations in the laboratory, but the benefit for both the patient and the practitioner from the technology. A selection of eminent advantages from a laboratory and clinical perspective is provided below.

The laboratory perspective
CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing) technology has revolutionised dental laboratory techniques and protocols significantly. Advantages related to material and manufacturing processes will promote the continuous adoption of CAD/CAM systems over conventional casting techniques as the technology offers several benefits compared to conventional framework fabrication. This is not an unfavourable development, but provides true benefits for the dental laboratory, the practitioner and above all, the patient. The benefits of the technology and the new NobelProcera system from a laboratory perspective are obvious. Cost-efficient and time saving workflows with only one CAD/CAM system in the dental laboratory, high-quality products with unrivalled precision and free-virtual design options, and centralised production. And there are many benefits to the laboratory.

Cost-efficient workflows
In the competitive market of dentistry, cost efficiency is a very important aspect of a CAD/CAM system. There are several aspects that should be considered. One is the versatility a system offers. As implant dentistry is currently offered in most dental practices, a CAD/CAM system must allow a broader application than simply the fabrication of conventional crowns and bridges. Customised implant abutments, multi-unit screw-retained implant superstructures and a broad variety of removable solutions on implants is a mandatory requirement.

Product design and material selection
A wide range of materials can be selected and manufactured with CAD/CAM technology today. While zirconia-based restorations have often exclusively been associated with CAD/CAM technology, advanced systems such as the NobelProcera system offer a broad range of materials rang-
ing from aluminum and zirconia based oxide ceramics, titanium, acrylics and non-precious alloys (Figs.1-3).

Important aspects to consider include long-term stability in the oral cavity, biocompatibility, and post-processing options (for example, the type of veneering material). A true and unique benefit of the system is the anatomic tooth library, which does not only eliminate the need for a wax up in partial edentulous situations, but allows for automatic and homogenous framework reduction to allow for a uniform layer of veneering material. This mere “click-on-a-button” results in a reduction of clinical complications such as chipping of the veneering material in zirconia-based restorations, and the potential for fracture due to continuous control of adequate framework dimension (Fig.4).

Centralised production
Another aspect of cost effectiveness and safety is the feasibility of centralised manufacturing of products. Centralised milling clearly outclasses in-house systems: all workflows are permanently monitored, industrialised fabrication guarantees consistent quality, materials can be ordered as needed for any particular situation which eliminates the need for stock components, and time and money consuming adjustments, updates, or repairs do not accumulate (Fig.5). From a cost savings perspectives the fact that all metal frameworks are delivered highly polished and “ready-to-use” adds to the true benefits of centralised manufacturing (Fig.6). The additional five-year warranty on all products cannot be met by conventional fabrication techniques. The warranty ensures that if complications occur during clinical function, a new product can be ordered free of charge. Here again the uniqueness of virtual planning comes into play, as all data is always available even after years and merely require a click on a button to reorder.

The clinical perspective
From a clinical perspective CAD/

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Fig.1: The new NobelProcera system scanner. The application of the conoscopic holography principle ensures high-precision data acquisition of different materials (such as gypsum, impression materials, etc.) without prior surface coating and due to the colinearity of the laser beam deep concavities (e.g. impression scanning) digitised.

Fig.2a:

Fig.2b:

Fig.2: Coloured zirconia frameworks for both conventional frameworks (a: NobelProcera Bridge Shaded Zirconia) and screw-retained implant restorations (b: NobelProcera Implant Bridge Shaded Zirconia) allow for maximum esthetics and strength of a restoration. The benefit of industrial shading is a homogenous pigments distribution resulting in reliable strength values and colour.

Fig.2a:

Fig.2b:

Fig.3: Patients’ demands and clinical situations require the availability of different material options on different implant systems. Whether a titanium framework (here: NobelProcera Implant Bridge titanium on AstraTech implants) is used as a temporary or definitive solution, depend on the preferences of the clinician and the request by the patient. As all products are delivered highly polished and ready for veneering, time consuming adjustments are eliminated.