Mastering the art of dental technology

By Marc Chalupsky, DTI

SINGAPORE/BAD BOCKLET, Germany: Singapore and Germany are about 10,000 km apart. As Singaporean dental technicians and dealers discovered at this year’s International Dental Exhibition and Meeting (IDEM), the world’s most comprehensive range of dental laboratory products can be found at DT&SHOP, located in the town of Bad Bocklet about 200 km north-west of Nuremberg. Owing to the company’s latest inventory and delivery systems, orders arrive in Singapore and other Asia Pacific countries within three working days. DT&SHOP has big plans for this thriving dental technology market.

According to a recent Transparency Market Research report, the Asia-Pacific dental laboratory market is projected to expand at a substantial rate in the next five years. Driven by rising dental tourism and a growth in the number of dental laboratories, the domestic sector will also see an increase in export demand, particularly regarding bridges and implants. Local dealers, according to DT&SHOP, will soon provide a convenient solution: “We will work closely with these smaller and medium-sized dealers in the region by giving them access to the company’s product and delivery system,” said Dr Nicolas Rohde, head of the Digital and International Division. “This will also include advanced marketing, and educational support. The new digital possibilities allow us to work with partners and clients anywhere and anytime.” With a 96 per cent product availability, eco-friendly packaging and competent customer service, the company has proved itself to be a reliable partner for local dealers.

This year, DT&SHOP took the next step towards securing a major position in the Asia-Pacific market, by exhibiting at IDEM Singapore 2016. With a 50 m² booth, the company showcased its wide range of dental laboratory products from leading manufacturers. As a dental practitioner himself, DT&SHOP also presented the new FINOCAM A5 free-axis milling unit and the FINOSCAN RELATION high-quality optical 3D scanner. "Most dental technicians at IDEM were impressed by our FINO CAD/CAM solutions. In fact, our FINO brand covers most of the dental laboratory needs, including orthodontic boxes, partial denture alloys, duplicating and addition-curing silicons, core-modelling wax, relining units, porcelain brushes and much more,” explained Roer. “I think that we have quite successfully mastered the art of offering the complete range of dental technology.”

Artists and dental technicians share a talent for colour, aesthetics and technical complexity. It therefore comes as no surprise that DT&SHOP’s corridors are filled with masterpieces, inspirational and vivid artworks from around the world. Roer has had a passion for art for most of her life. Her latest acquisition, a set of paintings from Canada, is awaiting a suitable space in one of the company’s new course and laboratory rooms.

In 2010, she travelled to Vietnam, to purchase several paintings from local artists. The Asia-Pacific region and Vietnam in particular are known for their lively art scene. “Art has always been very important to me,” said Roer. “Our visitors do not rush through the aisles of the building. They stop and see the beautiful work by artists about 10,000 kilometres apart.”

Materials and systems for all ceramic CAD/CAM restorations

By Drs. Christian Brenes, Ibrahim Duqum & Gustavo Mendonza, USA

Dental crowns have been used for decades to restore compromised, heavily restored teeth, and for aesthetic improvements. New Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) materials and systems have been developed and evolved in the last decade for fabrication of all-ceramic restorations. Dental CAD/CAM technology is gaining popularity because of its benefits in terms of time consuming, materials savings, standardisation of the fabrication process, and predictability of the restorations.

The number of steps required for the fabrication of a restoration is less compared to traditional methods (Fig. 1). Another benefit of CAD/CAM dentistry includes the use of new materials and data acquisition, which represents a non-destructive method of saving impressions, restorations...
Lithium disilicate

Lithium disilicate is composed of quartz, lithium disilicate, phosphor oxide, alumina, potassium oxide and other components. According to Saint-Jean (2014) the crystallization of lithium disilicate is heterogeneous and can be achieved through a two or three stage process depending if the ceramic is intended to be used as a mill block (e-max CAD) or as a press ingot (e-max press). Lithium disilicate blocks (Fig. 3) are partially sintered and relatively soft; they are easier to mill and form to the desired restoration compared to fully sintered blocks; after this process the material is usually heated to 890 °C for 20 to 30 minutes to precipitate the final phase. This crystallisation step is usually associated with a 0.2 percent shrinkage accounted for the designing software[19]. Nowadays, blocks of lithium disilicate are available for both in-office and in-laboratory fabrication of all-ceramic restorations, monolithic blocks require lambing or staining to achieve good esthetic results[8]. Different in vitro studies that evaluate the marginal accuracy of milled lithium disilicate reveal that these restorations could be as accurate as 56 to 65 microns.[10]

According to the manufacturer specifications, the design guidelines for lithium disilicate are produced by design in the designing software; but in full all-ceramic crowns the milled margins must be reduced to 100 microns. During the crystallisation process, the ceramic is converted from a lithium metastable crystal phase to lithium disilicate. Some commercial types of ceramics are Empress CAD (focurl Vivadent) and IPS e.max. The first one is a leucite based glass ceramic with a composition similar to Empress ceramic; IPS e-max, was introduced in 2006 as a material with a flexural strength of 560 to 600 MPa (two to three times stronger than glass ceramics), the blocks are blue in the partially crystallized state it achieve the final shade after it is submitted to the firing process in a potential oven for an additional 10 minutes to complete the crystallisation; the final result is a ceramic with a fine grain size of approximately 1.5 μm and 70 percent crystal volume incorporated in a glass matrix[20]. In 2014, Vivadent released Suprinity, the first ceramic reinforced with zirconia that could follow it after the milling process; this micro defects or surface flaws could potentially affect the marginal integrity of the restoration during the milling process and also requires more time and intensive milling process - this micro defects or surface flaws can affect the final strength of the final restoration and could potentially affect the marginal integrity of the restoration.

One of the most interesting properties of zirconia is transformation toughening, Kelly (2008) describes it as: A phenomenon that happens when a fracture takes place by the extension of an already existing crack in the material structure, with the tetragonal grain structure changing into the monoclinic phase it has a high mechanical strength that makes it a suitable material for all-ceramic crowns but the additional heat that increases the energy that opposes the crack propagation[4].

Zirconia restorations can be fabricated from fully sintered zirconium oxide or partially sintered zirconium oxide blanks (green state). Propion of milling partially sintered zirconium oxide blanks claim that micro defects or surface flaws affect the fit, quality and accuracy of the restoration; these restorations could be as accurate as 56 to 65 microns.

Different manufacturers are using Zirconia as one of their main materials such as: Ceramill Zolid (Amann Girrbach), Planit (DENTSPLY, BruxAir (Gleiwed Laboratory), IPS Zirkaloc (focurl Vivadent), Zentron (Beher, Henty), InCoris ZI (Sierra Dental), VITA In-Ceram Y2 (Vivadent), among others. Companies have introduced materials that are in combination with Zirconia to improve its properties.

Table 1: Recommended dimensions for E-Max CAD by Ivoclar Vivadent.

<table>
<thead>
<tr>
<th>Material</th>
<th>Anterior</th>
<th>Premolar</th>
<th>Molar</th>
<th>Veneers</th>
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</thead>
<tbody>
<tr>
<td>Thickness</td>
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<td>1.5</td>
<td>1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Staining</td>
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<td>1.5</td>
<td>1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Technique</td>
<td>1.8</td>
<td>1.5</td>
<td>1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Layering</td>
<td>0.8</td>
<td>0.8</td>
<td>-</td>
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The development of dental CAD/ CAM systems occurred around the introduction of the Sophia system developed by Dr. Francois Durst. A few years after that event, Dr. Werner Mommern and the electrical engineer Marco Brandestini developed the Cerec-1 system in 1983, which was able to copy-mill in-office restorations. Since then, CAD/CAM systems occurred and expanded exponentially in the last decade [4].

Some of the main concerns from clinicians regarding all-ceramic CAD/CAM restorations and CAD/CAM systems in general are related to the gap parameter and the marginal fit of CAD/CAM restorations. Differences of 1–2 microns in the gap and marginal fit of CAD/CAM restorations are directly related to the gap parameters from the computer model and also related to the intrinsic properties of the CAD/CAM system [5].

Conclusion
This review of current and past literature regarding the evolution, characteristics, and marginal fit of milled CAD/CAM all-ceramic restorations and materials systems and shows that it is possible to fabricate restorations with the same marginal fit expected from conventional methods and within the range of clinically accepted restorations. When comparing both methods the advantage of using CAD/CAM technology is not to obtain the most precise level of fit, but rather to obtain a high level of reliability in a large number of restorations, especially when high productivity levels are expected. However, there are a limited number of clinical studies and the diversity of the results between systems and protocols does not allow us to give a definitive conclusion.

References

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