Case report: Restoration of 2 Astra Tech implant fixtures utilising custom Atlantis Abutments and transverse screw retained 3M ESPE Lava metal free zirconia crowns

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Cemented and screw-retained implant prostheses both present distinct advantages and limitations. The major difference between the two strategies is that a screw-retained prosthesis can be removed by the clinician, while a cemented restoration is not intended to be retrieved. Each can be the best option, depending on the objectives of the prosthesis, the properties of the implant system and the philosophy of the practitioner.

Many studies have discussed the merits of screw retained vs cement retained implant restorations.[1-3] However, the one major advantage of a screw retained implant restoration is that of retrievability. The ability to remove the restoration allows any biological and technical failures that may occur during the lifespan of the restoration to be addressed. This includes removal of the restoration to retighten loosened abutment screws, replace failed or fractured components, or even to perform routine periodontal and implant hygiene.

In addition, screw retained systems provide a great variety of transmucosal and prosthetic components, working well in clinical situations where there is limited occlusal space; require no removal of sub-gingival cement and cause no negative sequalae when the cement is not removed. This is particularly important if the transmucosal to

Figure 1.

Figure 2.

Figure 3. A view of a cross-pin screw retained implant supported ceramo-metal crown (Image reproduced with permission from the Australian Dental Journal).[4]

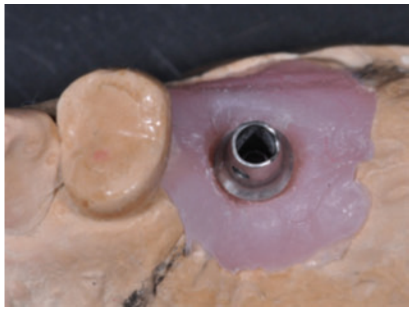


Figure 4.

Figure 5.

Figure 6.

Figure 7.

Figure 8.

implant junction is greater than 3-4mm subgingivally. The utilisation of a screw retained system, however, is not without its disadvantages.

Firstly, there is a problem of a lack of aesthetics at the screw access channel, particularly if the channel is cast in metal. The presence of the screw access opening in ceramo-metal restorations also weakens the porcelain around the opening and at the cusp tip rendering the porcelain susceptible to fracturing and chipping in those areas.

Figure 1 shows chipping and fracturing of the porcelain on the distal aspect of the transocclusal screw opening on the restoration on 45. The direct composite resin seal on 46 also shows uneven wear when compared to the surrounding porcelain surface. At the time of presentation, the transocclusal screw retained implant restorations on 45 and 46 have been in function for the past 5 years.

Figure 2, in comparison, shows the 36 on the contra-lateral side in the same patient with minimal changes from base line since the time of delivery. The 36 was restored with a cross pinned screw retained implant restoration. At the time of presentation, all three implants in the 36, 44 and 45 sites were placed and restored at the same time and have been in function for the past 5 years.

The centric contact at a screw access opening, which is often in the centric fossa and may occupy 50%-60% of the inter-cuspal occlusal contact, is usually developed by the use of direct restorative composite to "seal" the transocclusal screw access. This in turn has the potential to establish unstable occlusal contacts with the opposing dentition due to the wear of the composite restorative material.

One option that is commonly used to retain the benefits of screw retained restorations and concurrently eliminate the disadvantage associated with the transocclusal screw access is by cross-pinning the prosthesis to the implant abutment. The technique of cross-pinning uses a transverse screw to attach the restoration to an implant abutment when access for the abutment screw would compromise the aesthetics and/or structural integrity of the prosthesis.

This technique traditionally requires the final restoration to be completed as a full metal or as a ceramo-metal prosthesis where a rim of metal is placed around the head of the cross-pin screw to avoid ceramic contact (Figure 3). This is to allow the tapping of the coping to house the transverse screw channel.

Figures 4-8 demonstrate the components commonly utilised in the provision of a ceramo-metal transverse screw retained prosthesis.

The possibility now exists to allow the final restoration to be fabricated utilising metal free Zirconia based systems.

The following case report presents an alternative of utilising metal free Zirconia based prostheses (3M™ ESPE™ Lava™) which are attached to custom milled abutments (Astra Tech Atlantis™) by the utilisation of transverse screws (cross-pinning technique).

Figure 9. Healing caps in situ following confirmation of osseointegration.

Figures 10 and 11. Examples of shade taking procedure.

Figure 12. Healthy and non-inflamed gingival architecture following removal of the healing caps.

Figure 13 and 14. Implant pick up (or impression coping) inserted to allow for a fixture level impression utilising an open tray technique.

Case report

The patient presented for the restoration of the upper left second premolar 25 and upper left first molar 26 following successful osseointegration of the Astra Tech fixtures in the respective sites. Both teeth had previously been extracted due to a combination of endodontic and prosthetic failures which rendered both teeth unrestorable.

Extraction of the teeth was followed by the routine diagnostic workup for restoration of the edentulous segment with implant retained restorations. The implant fixtures were placed and subsequently restored utilising a delayed loading protocol.

Figure 9 shows the healing caps in situ following confirmation of osseointegration of the Astra Tech implant fixtures.

Following confirmation of osseointegration of the implant fixtures, the patient presented nine weeks post implant placement for the restorative phase of treatment.

The healing abutments had been used in combination with a removable temporization, in the form of a sectional removable Valplast denture.

Shade selection

Providing the appropriate shade images for communication with your laboratory and dental technician is such an important factor to achieve better colour matching. There are a few things to consider:

- The photos should be taken prior to any intra-oral procedures to minimise any shifts in colour or shade due to dehydration that can occur during and following the impression taking procedure and/or 2 weeks following completion of bleaching or 48 hours after temps have been placed.
- The position of the shade tab should be in the edge to edge position against the matching teeth.
- Including extra shade tabs with different hue/chroma can help determine correct colour selection.
- The indication of the shade tab (what colour) should be included within the photograph. In Figure 10, only the A2 shade guide is visible so Figure 11 is ideal.
- Avoid light reflection as much as possible. Figure 11 shows a lot of reflection on the shade tab that makes selecting the colour difficult. Figure 10 shows the correct amount of light reflection. This can be achieved by tilting or twisting the position of the shade tab slightly.

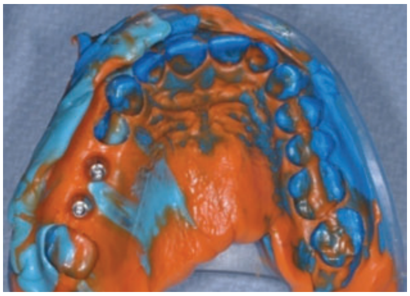
Including the gum shade guide makes the background (the property of the shade tab) and the matching dentition similar which helps selecting the correct hue around the cervical third.

The healing cap was removed and the internal configuration of the implant rinsed thoroughly to remove any residual blood or tissue material.

It is the author's opinion that impressions taken at the implant level can offer several advantages:

- The quality of prosthetic planning and treatment can be enhanced;
- Implant angulations can be compensated for at an early stage;
- Individual anatomic designs can be performed through abutment selection and preparation or through customised casting or milling of the abutment.

An open tray impression technique was selected for the impression procedure. Figures 13 and 14 illustrate the implant pick up (or impression coping) inserted to allow for a fixture level impression utilising an open tray technique.



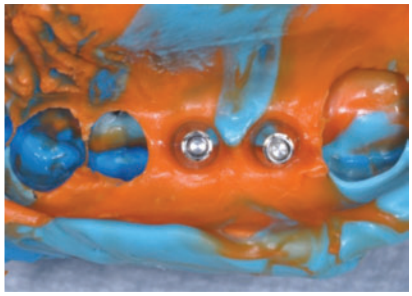


Figure 15 and 16. Completed fixture level impressions.

Figure 17. Fabricated working model with gum replica.

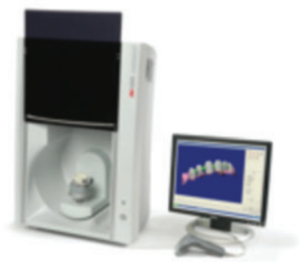
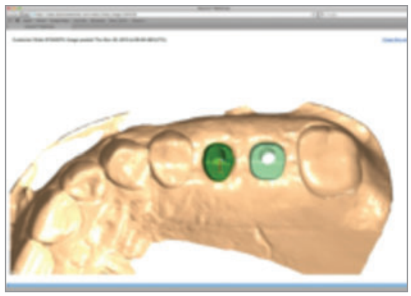
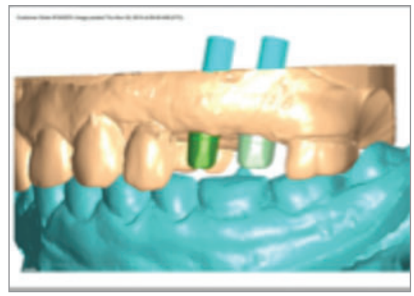


Figure 18. Lava Scan ST.





Figures 19-20. Atlantis Abutment web order design stage.

Seating the implant pick-up

The appropriate implant pick up (or impression coping) was selected and seated securely into the implant.

Care is taken to ensure that the internal hex is correctly engaged before tightening the implant guide pin with a hex screwdriver using light finger force.

A Directed Flow Impression Tray (3M ESPE) was prepared with perforations on the occlusal surfaces of the tray to allow the implant impression pick-up to penetrate the tray without any interferences. The prepared penetrations are then covered with wax, which is penetrated by the implant coping when the impression procedure is undertaken.

Taking the impression

A Polyvinyl Siloxane (PVS) impression material was selected for the fixture level master impression. Kerr's Take 1 Advanced Light Body Wash (low viscosity) and Medium/Monophase (medium viscosity) was syringed around the implant pick up and the impression tray was filled with Kerr's® Take 1™ Advanced Heavy Body Tray (heavy viscosity) material with a thin overlying wash of the light body wash material.

The rationale for the utilisation of the PVS material of differing viscosity is to acquire an accurate reproduction of the soft tissue and adjacent teeth contours afforded by the greater flow of the low viscosity wash material. The heavy and medium viscosity material ensures adequate rigidity within the impression material to minimise or eliminate any potential movement of the impression coping during impression removal and when the implant analog is fitted and models are poured in the laboratory.

Any potential movement or dislodgement of the impression copings can also be further minimised by linking the copings with a pattern resin material such as Duralay (Reliance) or Pattern Resin (GC), a technique which was not employed in this case.

The tray is then seated ensuring the Guide Pin of the impression coping is penetrated with wax. Figures 15 and 16 show the completed fixture level impressions stabilising the guide pins and accurately capturing the details of the existing maxillary dentition.

Removing the impression

Once the impression material has set, the Guide Pin is loosened and completely disengaged from the implant before removing the impression. The impression is then checked for correct and stable retention of the implant pick up.

The implant fixtures were then copiously irrigated and a gel of 0.12% Chlorhexidine (Curasept, Curaden Swiss) placed into the implant housing before the healing caps were repositioned and hand tightened.

The appointment was then completed with the impression of the opposing dentition and the registration of all necessary bite records.

The master fixture level impression, the opposing impression, the bite records along with the lab prescription and digital images were then sent to the ceramist to allow the laboratory phase of the treatment to be completed.

Laboratory Procedure

Atlantis Abutment

Atlantis abutments are CAD/CAM custom abutments with two piece components that are individually designed from the final anticipated or proposed shape of the implant retained restoration (i.e. the final shape of the tooth).

The design process which is accomplished utilising the unique Atlantis VAD™ (Virtual Abutment Design) software, allows the Atlantis abutment to be digitally designed with the ideal bucco-lingual, mesio-distal and inciso-cervical dimensions based on the surrounding dentition and opposing occlusion (Figures 19 and 20). It's compatible with Lava Scan ST so any accredited Lava Design Centre is capable of scanning the abutment (Figure 18).

Figure 21. Completed Atlantis GoldHue Titanium Abutment.

Figure 22. Completed GoldHue on Model.

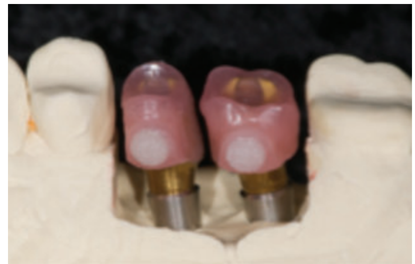


Figure 23. Support wax-up with collar for screw channel.

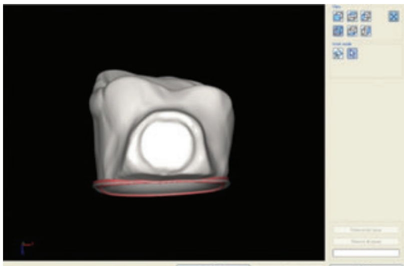


Figure 24. Lava Zirconia scanning stage.

Figure 25. Oversized kit for Lava Milling Centre (Bredent from Binder Dental).

Figure 26. Completed Lava Zirconia copings.

The final abutment is then precision machined (Figure 21). For this case an Atlantis GoldHue™ Titanium Abutment is selected which has a lifetime warranty and enables the desired aesthetic outcome. Using custom designed abutments instead of stock abutments offers several advantages:

- The possibility to create an optimal emergence profile of the abutment supporting long-term aesthetics both for the soft tissue and the final restoration.
- The abutment design provides optimal support and retention for the final restoration and at the same time, reduces costs for expensive framework material such as gold alloys. Atlantis Abutments are available in the following materials; titanium, gold-shaded (GoldHue) titanium (tin coated) and zirconia.
- In screw retained restorations, the margin or the interface of the final restoration and abutment can be placed at a hygienically maintainable level. This may be an advantage in reducing or eliminating the risk of chronic gingival inflammation which has been attributed to the presence of a microgap beneath the gingival level, left by the use of screw retained systems. (Keller 1998, Lindhe 1998).
- In cement retained restorations, margins can be placed at a level where there is an easy and safe removal of excessive cement, eliminating peri-implantitis caused by remaining cement.

Fabrication of Lava Zirconia with screw channel

Considering the longevity of restorations, well supported coping design is essential. Double scanning is a must in most cases, especially in the posterior region. Functional cusps and marginal ridges are where the most support is necessary as that is where the occlusion is and prevents potential chipping of veneering porcelain.

An accredited 3M ESPE Lava Milling Centre creates the screw channel in the zirconia coping at green stage using the bur (Figure 25). In order to make an indication, where to put a whole through, a collar needs to be created prior to scanning in wax and communicated with the milling centre (Figure 23). It is ideal to have any force/pressure exerted by the conical head of the screw to be on the zirconia framework, not the veneering porcelain. The depth of the collar is determined based on the position of the abutment, final position of the restorations and the length of the screws. A spru wax (3-4mm in diameter) can be used to create the base of the screw channel. In this case a pressed spru is used to make a defined circle for better indication (Figure 24) so the milling centre can put a hole through exactly in the middle of the circle, which is the centre of the zirconia collar. Figure 25 shows the completed Lava zirconia copings with screw channel.

Cross pinning technique

Figure 27 shows a 'must have tool' in order to process the cross pinning technique. To create a thread within the titanium abutment to secure the screw there are a few steps to go through.[5]

Step 1: Set the handpiece speed at 8,000 rpm. Take Bur #33000660 and make a dimple in the position where you want to drill (Figure 28).

Step 2: Apply the special Bredent Milling and Drilling Oil (Figure 29). With Bur #3300063 drill a hole where you have made the dimple (Figure 30). It is important that the drilling path aims towards the centre of the abutment to avoid creating an oval shaped hole, which would end up cutting a thread on two faces only.

Step 3: Blow out the hole with air, clean the area of metal filings, etc.

Step 4: Use a generous amount of oil during this stage. Insert the tapping tool marked M1.4V #33000671 into the holder and place a drop of oil into the hole and a drop onto the tap. Holding the instrument with two fingers only, tap the hole gently. In a clockwise motion, screw the tap in 180°. Then stop and unwind it 90°. Add a drip of oil and tap in a clockwise direction again another 180°. Unwind 90° then tap another 180° and so on until you are through. Marking a dot on every 90° is advised so that the position can be easily determined. Unwind the tap (Figure 31), then steam clean the metal filings.

Figure 27. Drilling and Tapping Kit (Bredent, Binder Dental).

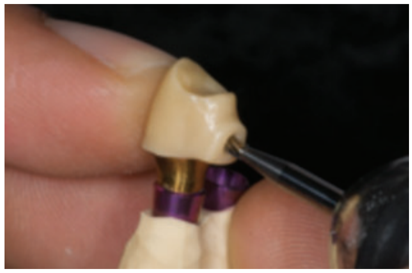


Figure 28. Making a dimple on the abutment, Bur #33000660

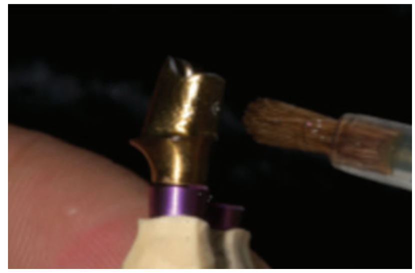


Figure 29. Applying Bredent Miling and Drilling Oil.

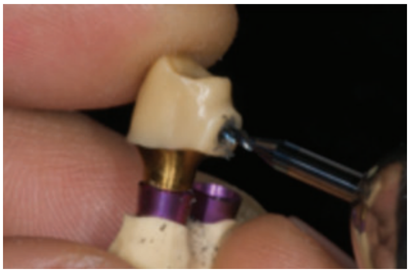


Figure 30. Creating a screw channel on the abutment with Bur #3300063.

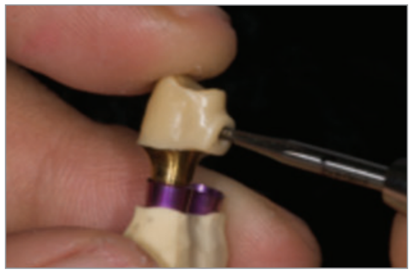


Figure 31. Tapping.

Figure 32. Completed Lava Zirconia copings with cross-pinning technique.

Figure 33. Completed restorations.

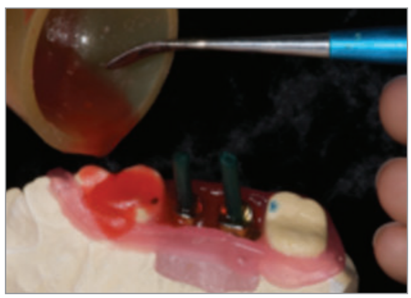


Figure 34. Blocking out the undercut and applying Pattern Resin (GC).

Figure 35. Completed Transfer Jig on the Model.

Fabrication of transfer jig and abutment installation

In general, dental implant abutments are designed to accommodate the final restorations in only one position, especially when the custom abutment is used. As internal hex is designed to accommodate abutments in several different positions, a laboratory fabricated transfer jig should be used to ensure correct seating and orientation of the abutments.

To fabricate the jig, the abutment has to be screwed onto the correct position using lab screws which have been secured on a solid model, not on a sectioned model. Then block out all the undercuts with denture wax placing a spru wax in the access hole of the abutment to allow the abutment screw to be screwed into the implant through the jig in the mouth. Apply a generous amount of Vaseline as a separator then apply a reasonable amount of non-shrinkable acrylic resin material such as Pattern Resin (GC) (Figure 34). Once it's set, trim up and polish using pumice in low speed. Figure 35 shows the completed transfer jig on the model.

The following components were then delivered back to the clinician for the completion of installation of the restorations:

- Custom milled Atlantis Abutments with the corresponding abutment screws;
- The finished LAVA Zirconia metal free crowns;
- The transverse screws;
- A transfer jig to facilitate the accurate transfer of the abutments from the model to the implants intra-orally.

Abutment installation

The customised Atlantis Abutments were seated using the transfer jig ensuring correct seating and orientation of the abutments. The abutments and screws were then inserted and manually tightened using a hex screw driver (Figure 36). The transfer jig was then removed and the correct positioning of the abutments were also confirmed visually by trying in the LAVA crowns individually and ensuring that the transverse screw channel on the crowns lined up with the tapped channel on the Atlantis Abutment.

The two LAVA crowns were then seated and tried in simultaneously and the routine process of checking the marginal integrity of the restoration, abutment interface and interproximal contacts carried out. The process was completed by checking the occlusion in both centric articulation and protrusive movements.

Final tightening

Once the verification and any necessary adjustments were completed, the abutments were tightened to the prescribed

Figure 36. Transfer Jig in the mouth.

Figure 37. Installed and torqued Atlantis Abutments from the occlusal view.

Figure 38. Installed Atlantis Abutments from the buccal view.

Figure 39. Inserted PTFE tape providing an easily removable 'seal', should retrieval of the abutment be necessary.

Figure 40. Bredent tip inserted on a Biomet-3i Contra Angle Torque Driver.

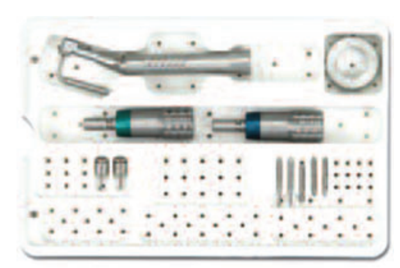


Figure 41. Biomet-3i Contra Angle Torque Driver Kit.

Figure 42. Completed restorations (immediate) from the palatal view demonstrating the transverse screw configuration.

Figure 43. Completed restorations (immediate) from the occlusal view.

torque using the hex screw driver and torque wrench. In this case, both the abutments were torqued to $25Ncm^2$ which is the indicated tightening torque by Astra Tech.

The abutment access is then closed using polytetrafluoroethylene (PTFE) tape to seal the screw access channel to protect the screw head of the abutment as described by Moraguez et al.[6] The tape will easily facilitate future screw access, and findings proved a lesser bacterial contamination manifested by bad smells (Figure 39).

In addition to the protocol described, a further seal of 3M ESPE Cavit™ was also placed once the PTFE tape was inserted and tamped down with a cotton pellet moistened with chlorhexidine solution (BISCO Cavity Cleanser™).

Installation of final crowns

The 3M ESPE Lava crowns were then seated and the transverse screw inserted into the palatal screw channels of the restorations. The transverse screw was then manually tightened with the Bredent Transverse Screw Driver Tip fitted to a Biomet-3i Contra Angle Torque Driver (Figure 40). The use of this mechanism allowed the tightening of the transverse screw to be done outside the confines of the oral cavity.

Blanching of the surrounding tissues was observed following immediate completion of the insertion process. However, the blanching resolved after a period of 5-10 minutes negating the need to either adjust the contours of the restorations or to incorporate a releasing incision to reduce the pressure exerted by the restorations on the surrounding soft tissues.

The final check and any adjustment of the occlusion were then carried out with the patient in an upright position. Once completed, all necessary hygiene and post insertion instructions were relayed to the patient before completing the restorative delivery appointment.

The final images demonstrate the integration of aesthetics and function of the transverse screw retained Lava Zirconia crowns (metal free) with the patient's dentition (Figures 42 and 43). The one month review also revealed resolution of any residual blanching of the surrounding soft tissues that was present immediately following the placement of the restorations and the development of ideal periodontal and soft tissue architecture and health.

In summary, the use of 3M ESPE Lava Zirconia metal free restorations retained to the implant abutment with the use of transverse screws (cross-pinning) provides a viable alternative to traditional ceramo-metal screw retained restorations, when retrievability and aesthetics are desired parameters for the success of the presenting case.

Acknowledgement

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About the authors

Dr Andrew Chio graduated from the University of Melbourne with first class honours in 1995. He currently maintains a private general practice in the Melbourne suburb of Carnegie where the emphasis is on rehabilitative and aesthetic dentistry in combination with general and preventive needs. He has completed numerous curriculums and CE programs from all fields of dentistry with strong influences from the philosophy and teaching from the Las Vegas Institute of Advanced Dental Education (LVI), Pascal Magne and Carl Misch.

Yugo Hatai is a Master Ceramist and recognised as one of Australia's most talented dental technicians. His ability to recreate a natural tooth with his artistic flair and his passion for creating beautiful smiles have changed many patient's lives and has earned the respect of leading clinicians across the globe. Yugo has published numerous articles nationally and internationally including articles in LVI Visions, the European Journal of Esthetic Dentistry and QZ (Quintessenz Zahntechnik). Yugo's lecturing began in 2008 presenting 3M ESPE Lava which was a great success as well as at the NZIDT National Conference. Yugo has the ability to satisfy the demands of leading clinicians in all areas of restorative work whilst always challenging new techniques and product selection, and in March 2010 Yugo was selected as the only Australian leader for the 3M ESPE Global Dental Technician Opinion Leader Group. Yugo established Smile By Yugo in 2008 to create a space to fit his vision to fuse Fashion and Art into dentistry in the complex area of aesthetic dentistry whilst making restorative work look as natural as possible. In 2011, following the successful growth of Smile by Yugo, he established School of Yugo, an innovative training facility organization and presents a Master Ceramist Course with 60 CPD. Yugo is a member of the American Academy of Cosmetic Dentistry (AACD) and has also completed numerous dentist and technician LVI courses being the most qualified LVI technician in Australia.

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