DigiSplint - the CAD/CAM splint

By Terry Whitty

"Intraoral scans are now becoming more common... and whereas these digital impressions are popular in restorative dentistry, they are equally suited to splint making..."

Oral splints come in a plethora of designs and are amongst the most popular non-surgical means by which dentists treat pain in the jaw muscles and TMJ, often known as temporomandibular disorders (TMD). They are also used for bruxism, clenching and repositioning the mandible. In orthodontic specialties, splints are often used as a device to assist in permanent bite opening and also to stop brackets being dislodged. Splints are also great at reducing damage to veneers and other dental restorations.

Figure 1. Standard "flat plane" splint traditionally made.

Despite the extensive use of oral splints in the treatment of TMD, bruxism, etc their mechanisms of action remain controversial and the jury is still out on a definitive scientific explanation of their effect. The good news is that if the various hypotheses that have been proposed to explain their apparent efficacy (i.e., true therapeutic value) are inconsistent, then results of anecdotal evidence from patients would appear to keep the treatment success relatively high. Even if treatment is not completely explained, they can still be used effectively for many cases.

Traditionally, splints are made from hard acrylic using the "pack and press" method or the newer, advanced "low residual monomer" self-curing acrylics. Acetyl resins and polyolefin are gaining popularity too, as are materials such PEEK (Polyether Ether Ketone). Thermoforming is another popular method of fabricating splints as it allows various materials to be used such as polycarbonate and polyurethanes. Other materials that are popular include ethyl methacrylate and some composites.

Figure 2. The lower teeth are often slightly indexed.

Figure 3. Traditionally made Sved-type splint for allowing posterior eruption.

Figure 4. Traditionally made Lower Anterior Repositioning Splint.

Figure 5. Traditionally made Gelb Splint.

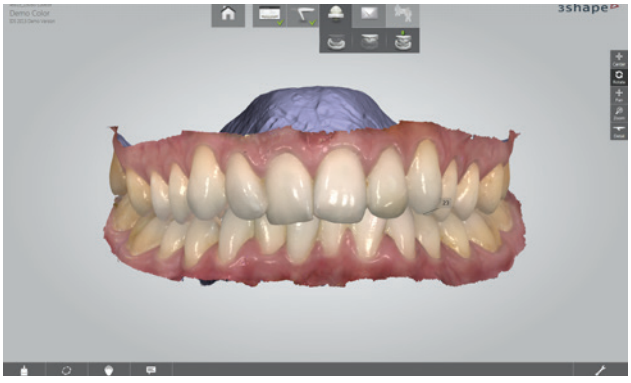

Figure 6. Intraoral scan from a 3Shape Trios Scanner in colour!

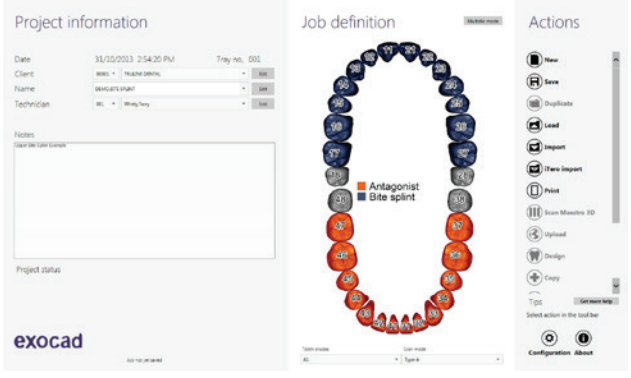

Figure 7. Setting up a job in exocad is very simple, just like a conventional lab form.

Regardless of the process used to manufacture the splint, the main clinical objective is ease of fit and durability. Considering that the splint is mainly tooth borne and covers all of the maxillary or mandibular teeth, it is reasonable to assume that an accurate impression with impeccable cross arch accuracy is mandatory.

Unfortunately, this is often easier said than done. Alginates are fine to use for the impression, however, these need to be treated with care and the impression should be poured up as soon as possible. From experience, polyvinyl siloxanes give the best result, however it's always important to use the correct trays and follow the manufacturers instructions.

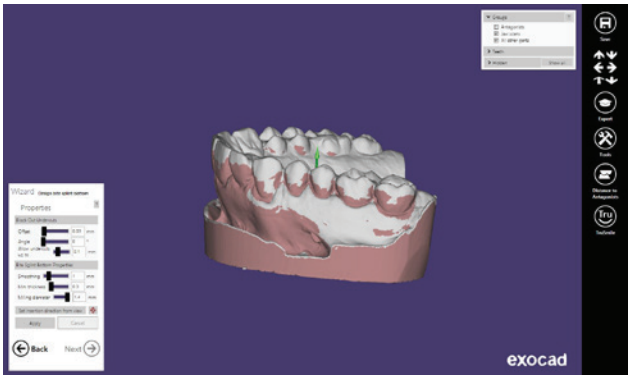

Figure 8. After importing the scan, the survey tool allows you to survey, block-out undercuts and utilise desirable undercuts.

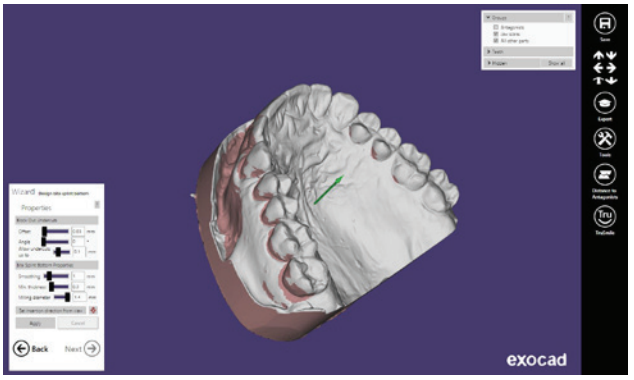

Figure 9. exocad survey tool.

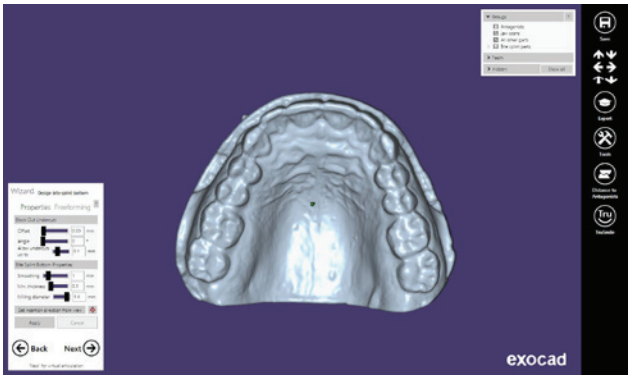

Figure 10. The offset feature is handy to make your splints fit snugly but not too tight!

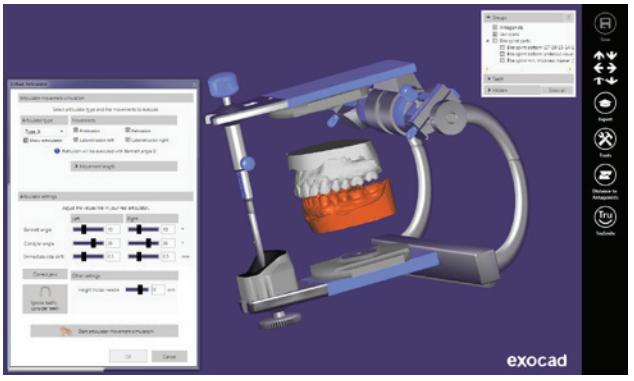

Figure 11. Mounting on a virtual articulator.

Figure 12. Various articulator types are available.

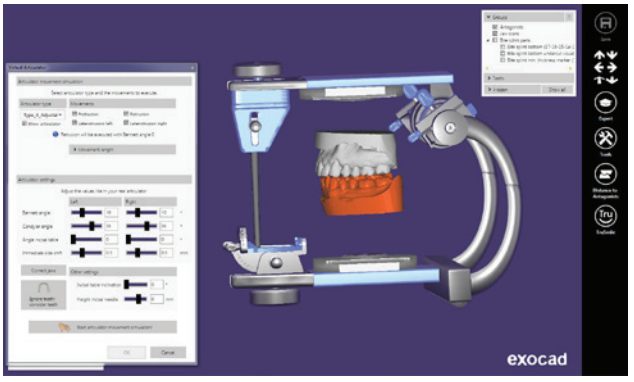

Figure 13. The software will record the articulator movements exactly and reproduce these movements during the design phase.

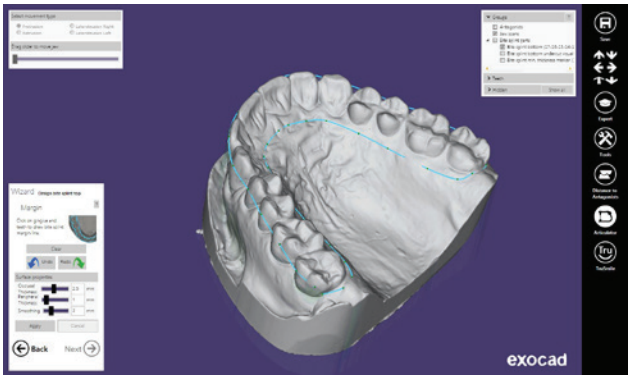

Figure 14. Freeform outlining for the splint design. Here I am using a basic common splint design but any design is possible.

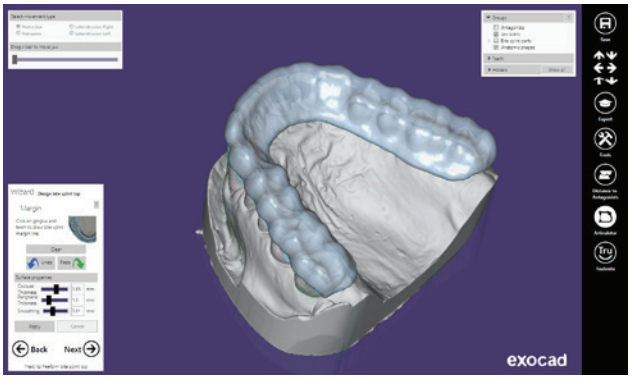

Figure 15. The software instantly creates the basic splint design. You can adjust thickness to suit.

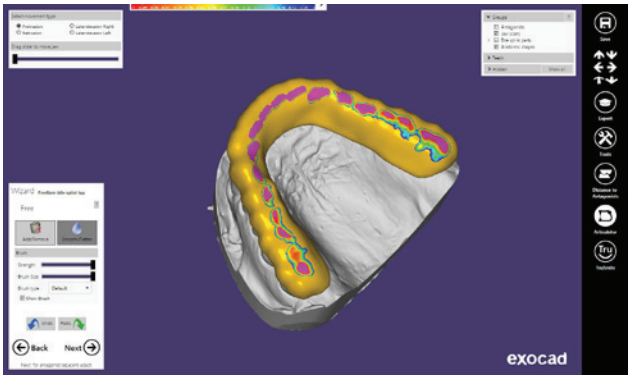

Figure 16. You can then freeform the design, add, remove, smooth, etc.

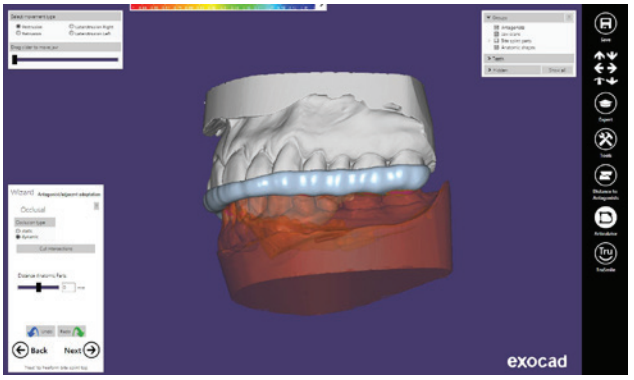

Figure 17. Check design with antagonist.

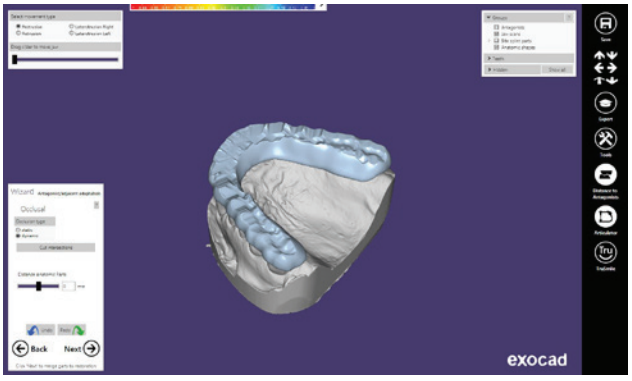

Figure 18. Visualisation of bite planes from articulator movements.

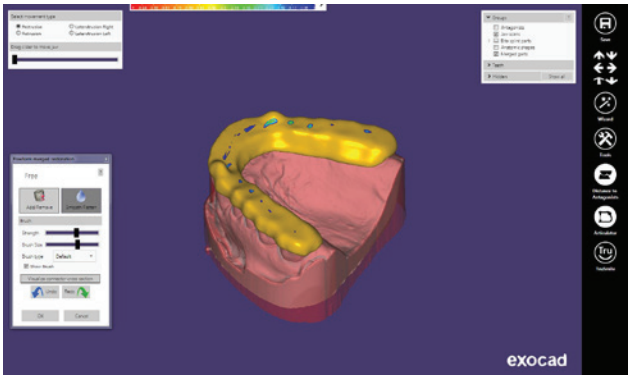

Figure 19. Smoothing and adding guide planes.

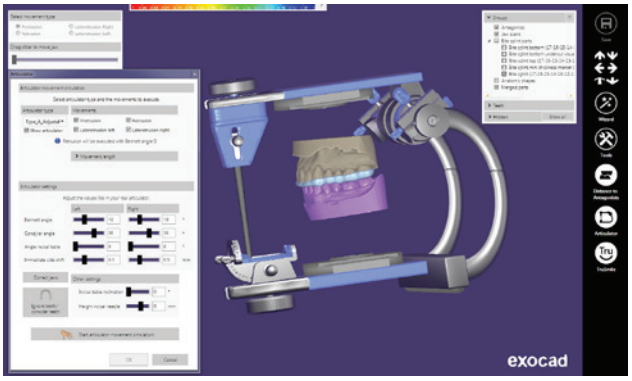

Figure 20. Repositioning finished splint on Virtual Articulator.

Figure 21. Finished CAD splint.

Intraoral scans (i.e. digital impressions) are now becoming more common and are an alternative to conventional impression taking. Whereas digital impressions are popular in restorative dentistry, they are equally suited to splint making. Digital impression taking systems give immediate feedback as to the integrity of the scan (i.e. impression) and this helps in creating a higher level of precision and accuracy than traditional means.

If an intraoral scanner is used, then you ill need a CAD package to take that digital information and design the splint.

Well-known German 3D software company, exocad™, has launched a new Bite Splint module which adds to their full featured dental CAD suite of software. This easy to use CAD package is powerful and allows the design of any type of splint. It also incorporates the usual procedures such as surveying and blocking out, virtual articulation and excursive movement. Once you design your splint, you can then send it to your favorite milling machine or 3D printer if the appropriate material is available. Common materials for milling are PMMA and polycarbonate.

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Figures 1 to 26 document a sample workflow for the new DigiSplint™ available in High Density PMMA or Polycarbonate. Many designs are available.

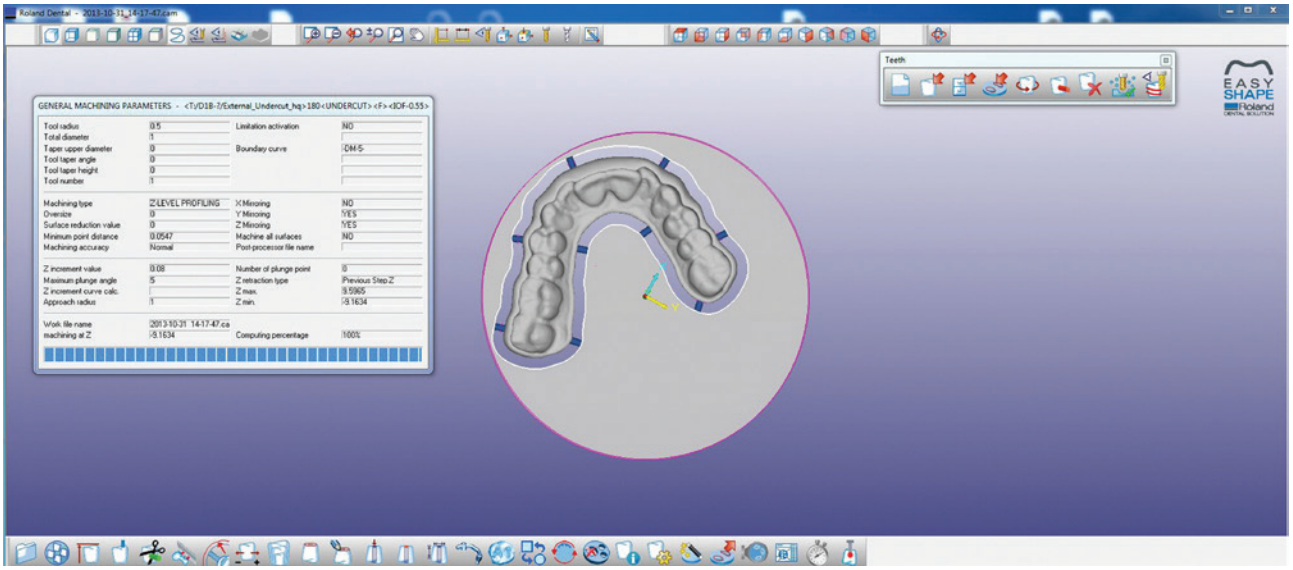

Figure 22. Transfer to CAM software for processing.

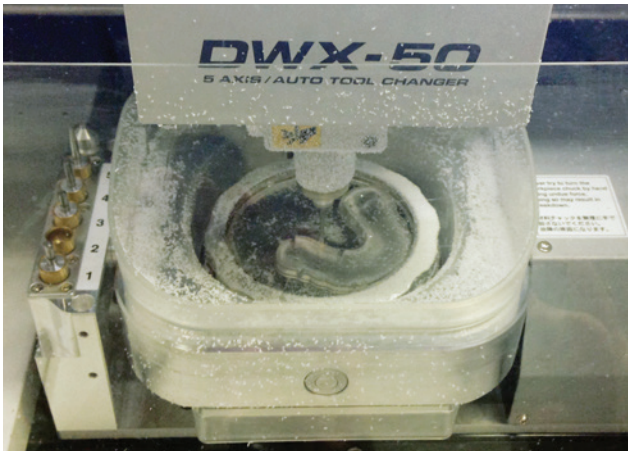

Figure 23. Milling splint using Roland DWX 50.

Figure 24. Milled splint in puck.

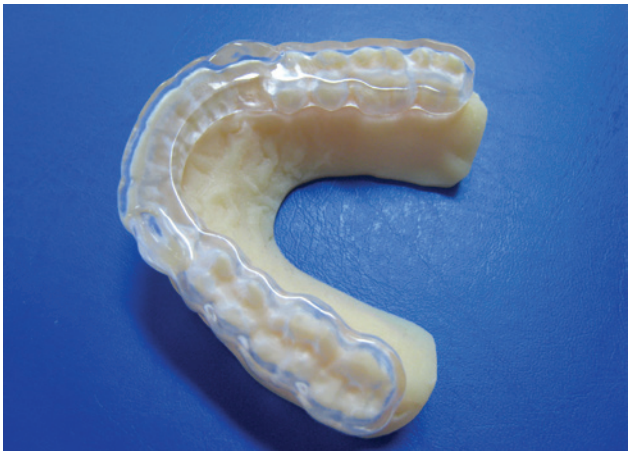

Figure 25. Finished splint.

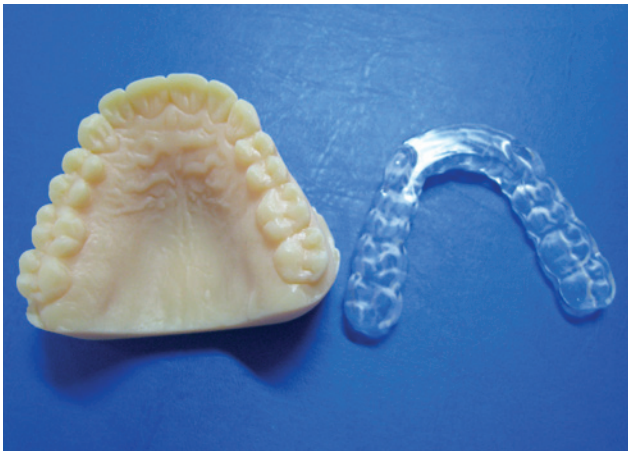

Figure 26. Splint with 3D printed model.

About the author

Terry Whitty lectures nationally and internationally on a variety of dental technology and material science subjects and runs a busy laboratory in Sydney's Eastern Suburbs, specialising in high tech dental manufacturing. Using the latest advances in intra- and extraoral scanning, CAD/CAM and 3D printing technologies, most specialties are covered including fixed and removable prosthetics, orthodontics and computer implant planning and guidance. He also specialises in the latest injection systems for traditional and CAD designed removable prosthetics and various associated dental appliances. His articles appear in various international journals.

For more info on DigiSplint, Exocad or this article, call Terry at Truline Dental on 1300-878-336 or see www.trulinedental.com.au.