




Use of CAD/CAM Technology for Recording and Fabricating Neutral-Zone Dentures


م.د. علي نعمه احمد حسين
فرع التعويضات الاصطناعية

Introduction:


**Computer-aided design /
computer-aided manufacturing
(CAD/CAM) technology have been
used in dentistry since the early
1980s.**




Andersson envisioned the use of titanium for crown fabrication and pioneered the CAD/ CAM fabrication process, which resulted in cementation of the first CAM fabricated titanium crown in 1982.




**Mörmann developed a prototype
CAD/CAM system in 1983 and
placed the first chairside fabricated
ceramic restoration in 1985.**




Since that time, CAD/CAM technology has been used for the fabrication of intracoronaral and extra- coronal crowns, fixed partial dentures, and implant prostheses.




Recently, CAD/CAM technology has been applied to the fabrication of complete dentures.



By milling complete denture bases from prepolymerized pucks of acrylic resin, the polymerization shrinkage inherent in the traditional methods of fabrication is eliminated.




The digital milling process also provides a precise and a reproducible record of the prosthesis design, permitting the fabrication of a duplicate or replacement denture without having to obtain clinical records again.




The digital process of fabricating complete dentures involves scanning conventional complete denture records.

It is also possible to scan the neutral zone record and the esthetic blueprint (maxillary occlusal rim with the clinically set anterior prosthetic teeth) along with the definitive impression and the interocclusal record, to locate prosthetic teeth positions and to determine the contour and form of the cameo surface of the denture.




The CAD/ CAM software can also be used for printing record bases and wax trial dentures using stereolithography.



Several techniques that can be used to incorporate the neutral zone into the CAD/CAM fabrication of complete dentures are described below.

Registering the Neutral Zone during Impression Making




The neutral zone record can be registered at the time of making definitive impressions, using VPS impression material, and then it can be incorporated in the CAD/ CAM fabrication of complete dentures.

Technique:

1) A conventional clinical impression is made of the edentulous ridges using VPS impression material in special edentulous impression trays.







Note that caution should be exercised to ensure that the thickness of the underlying tray and impression is not excessive, or else registration of the neutral zone will be distorted.

2) Excess impression material that extends onto the occlusal surface of the impression tray is trimmed away with a scalpel blade ensuring that a minimum of 5 mm of the recorded borders is retained.


3) The occlusal surface is coated with a suitable VPS adhesive and medium-viscosity VPS impression material is applied and extended occlusally and posteriorly up to the level of the center of the retromolar pad .




**Limiting the extension to this height
(center of the retromolar pad)
permits recording of the neutral
zone without having to use an
excess amount of VPS material.**



4) The impression is accurately seated in the mouth and the patient is asked to swallow three times consecutively while pressing the lips together and then maintaining the lip and tongue positions until the completion of the polymerization of the impression material.

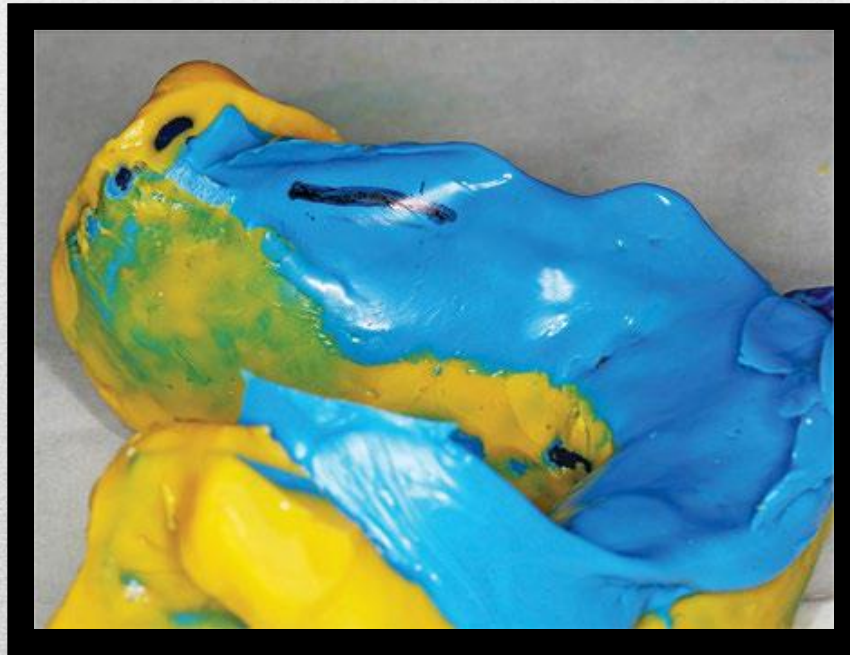


Swallowing causes contraction of the lip, cheek, and tongue muscles, with the lateral borders of the tongue producing a depression in the lingual surface of the impression material.




Many authors have suggested placing the occlusal plane at the same level as the lateral border of the tongue.

Thus the occlusal extent of the lingual depression can be used as a guide to determine the level of the occlusal plane.



5) A scalpel blade is used to slice through the polymerized impression material horizontally up to the occlusal level of the lingual depression, and the neutral zone is identified and the record is developed by further sculpting of the VPS material.






6) The impression is scanned to record both the intaglio surface and the occlusal surface (neutral zone record).




A virtual cast (with defined neutral zone) is generated in the software.

The opposing arch impression and the interocclusal records are also scanned.






The occlusal extent of the lingual depression marked with a black line, generally denoting the height of the occlusal plane.



A mold of teeth is selected and incorporated into the virtual neutral zone in the software.



After establishing the desired occlusion of the prosthetic teeth in the software, trial dentures are milled using the desired shade of tooth-colored resin.


After trial placement and making final revisions, the definitive dentures are milled using either a monolithic denture design where the teeth and base are one unit or by bonding the manufacturer's prosthetic teeth into recesses milled in the denture base.




Registering the Neutral Zone during Maxillo- Mandibular Records

**The process of registering the
neutral zone during
maxillo-mandibular records
appointment using modeling plastic
impression compound.**


Technique:




1) The mandibular record base with a modeling plastic impression compound occlusion rim is immersed in a warm water bath set at a temperature of 140 °F and uniformly softened.



It is removed from the water bath and quickly placed in the patient's mouth carefully, avoiding distortion.



2) The patient is given a glass of warm water and is instructed to swallow, then sip more warm water and swallow again.



The sipping and swallowing procedures are repeated several times to mold the compound through the action of the cheek and lip muscles moving inward, and the muscles of the tongue moving outward.

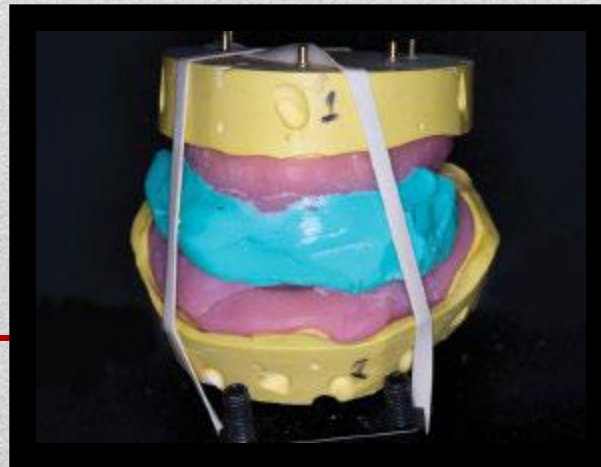
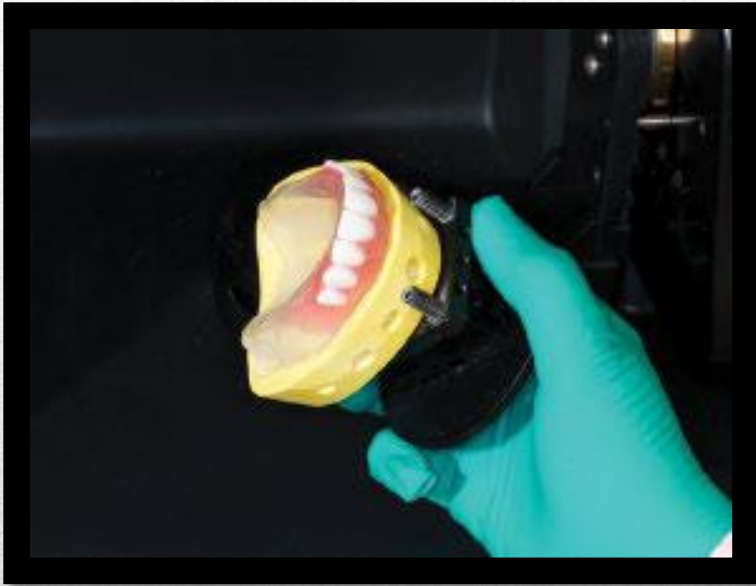
3) Once cooled and solidified, the neutral zone record is removed from the mouth, its accuracy is verified, and the excess material is trimmed using a sharp blade.



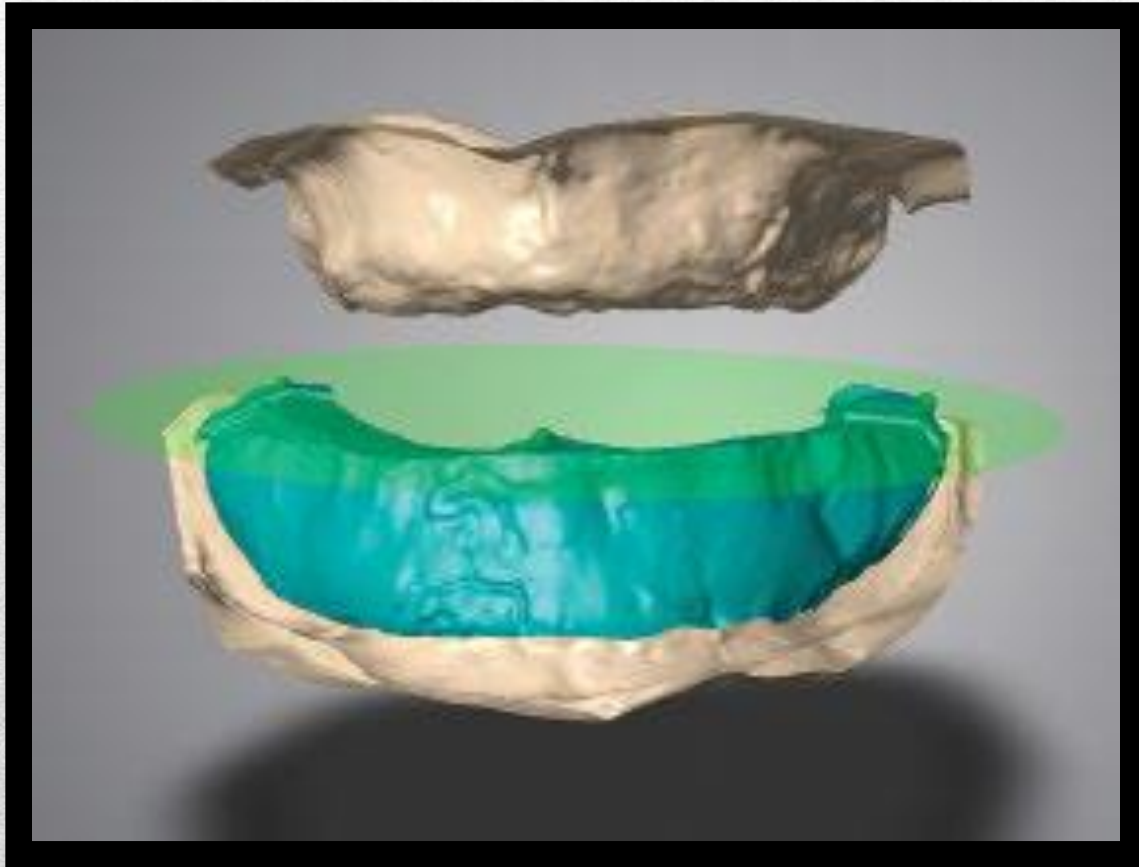
4) The neutral zone record is placed on the cast and it is scanned along with the cast.



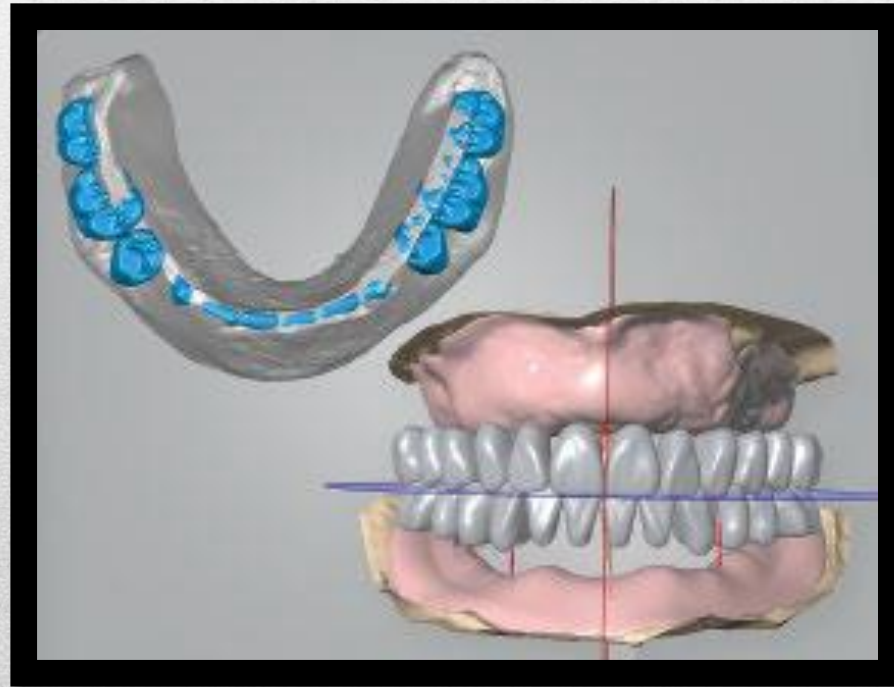
The esthetic blueprint (EBP) and the opposing cast with interocclusal record are also scanned.




A three-dimensional electronic image is created of the interarch and neutral zone relationships.



Using collective data of the scanned images, denture teeth are digitally planned and positioned to lie within this established space using the planning software program.



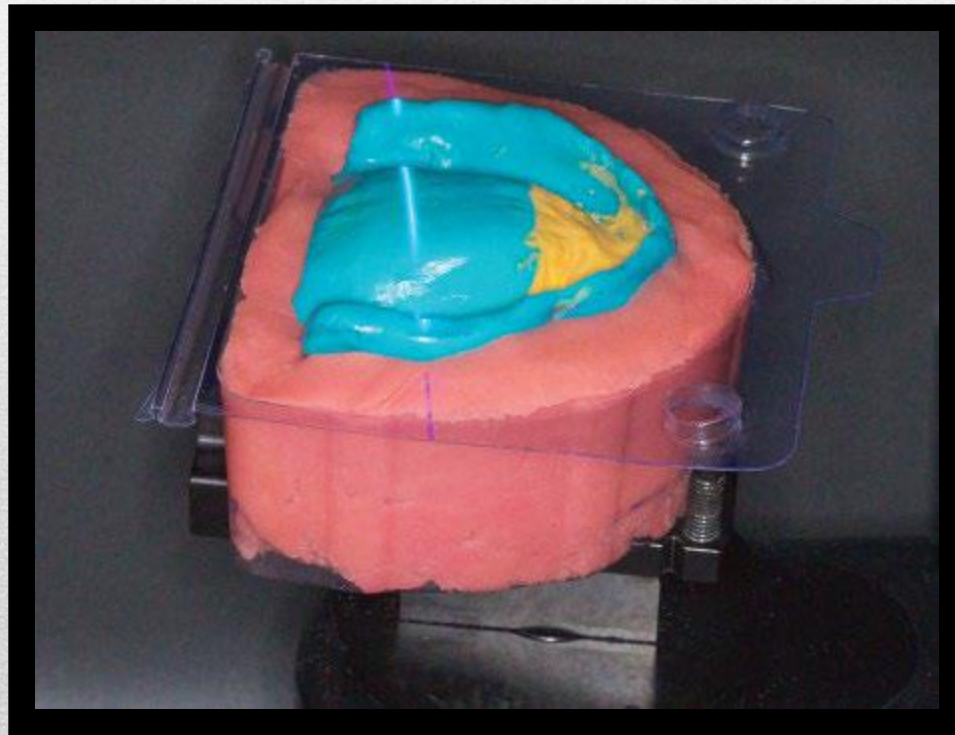
Registering the Neutral Zone during the Trial Placement




The neutral zone record can be registered at the trial placement appointment and then be incorporated in the CAD/CAM fabrication of complete dentures.

Technique:

1) Conventional complete denture impressions are made and beaded and boxed appropriately, ensuring that the desired amount of the impression borders are visible.







The boxed impression is then scanned and the scan data is used to print multiple record bases, using stereolithography.

2) A gothic arch tracing device, is attached to the printed record bases and maxillo-mandibular relationship records are registered.






3) An undercontoured wax occlusal rim is added to another printed maxillary record base. Shell teeth are waxed on the rim and their positions are verified clinically so as to achieve optimal esthetics.



4) The casts with the maxillo-mandibular records and the wax rim with the shell teeth (EBP) are scanned. The information obtained from the scanned data guides the digital arrangement of the prosthetic teeth.



Prosthetic teeth are digitally arranged in the software, and virtual trial dentures are generated and then printed using stereolithography.


5) The trial dentures are used for esthetic evaluation and also to record the neutral zone (termed cameo surface impression) using VPS impression material on the cameo surface of the printed trial denture.



6) The clinically verified printed trial dentures with cameo surface impressions are scanned and used to mill definitive dentures.




Summary:



The presented various methods of recording the neutral zone, scanning it, and using the resultant digital data for fabricating complete dentures.

And also described the process of using neutral-zone scan data for the fabrication of a stereolithographic trial denture.



Using the neutral zone as a guide for developing the contours of the polished surface of the mandibular denture and for determining the appropriate bucco-lingual positioning of prosthetic teeth not only aids in achieving retention and stability of the denture but also helps improve speech and patient comfort.

**Thank you for your kind
listening**