

# Digital Denture

## Case Study

Comfort, and predictability through combined digital and traditional techniques.

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The uptake in the use of intraoral scanners has been staggering. In March of 2020 we estimated 16% of the cases arriving at the lab came from intraoral scanners. In March of 2023 over 60% of the cases arriving at the lab came from intraoral scanners.

Dentists and patients are enjoying the convenience and comfort of intraoral scanners. There seems to be less talk about the benefits to analysis and diagnosis. This case study shows techniques available to dentists with scanners that ultimately benefit the patient and makes the dentist's workflow more predictable.

The patient is a 78-year-old male with a history of cardiac issues. He received a heart transplant in 2000 and has since suffered a heart attack in his replacement heart. His medications have taken a toll on his body, and he now attends dialysis appointments to assist his kidneys.

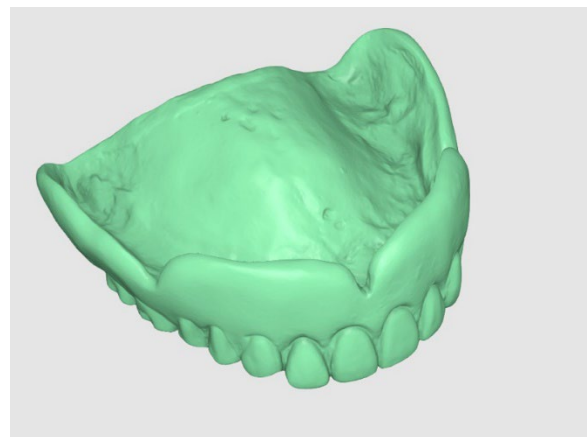
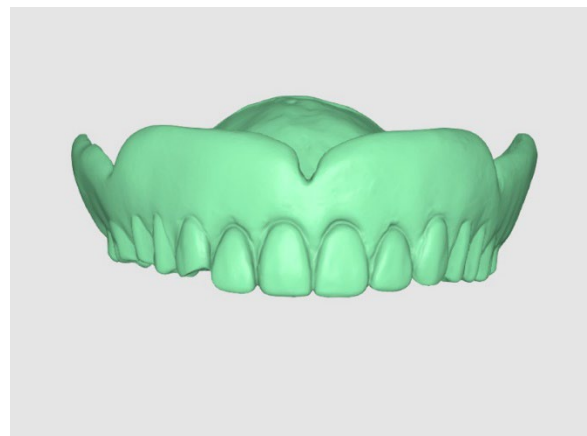
He presented with a complete upper denture and a lower partial denture on a metal framework. The lower partial denture has had modifications to add teeth as teeth were extracted. It is now loose and uncomfortable. He is happy with his current upper denture.

Although the remaining lower teeth are not in ideal condition, the choice was made to avoid surgical treatments and limit treatment to a new lower denture only.

## The Upper Denture

The upper denture was recorded as an opposing occlusion. The critical areas of the upper denture are the occlusal surfaces (for occlusal contact) and the buccal surfaces (for bite registration). I made the decision to scan the entire upper denture.

Digital techniques are more efficient and cost effective than physical impressions. It is better to have a comprehensive record and not need it than to need a more complete scan and not have it. Having a complete 360° Scan serves as a digital back-up record of the denture which could be used to create a copy denture in the future if such a need were to arise.

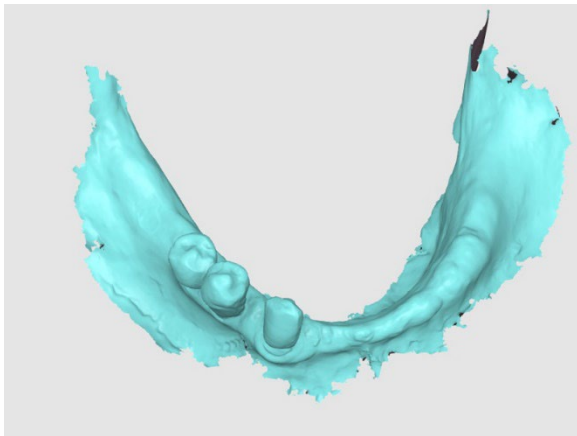


## The Lower Arch

The lower arch was mostly edentulous. Three remaining teeth were all in the fourth quadrant, and the 4-3 had very poor prognosis due to abfraction on the facial side.

Digital bite records can often be more stable than traditional bite records. A single point of contact at the teeth is effectively a tripod record due to the patient's temporomandibular joints establishing bilateral posterior records.

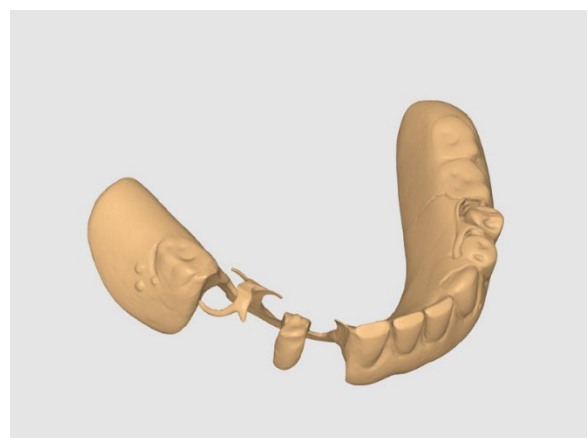
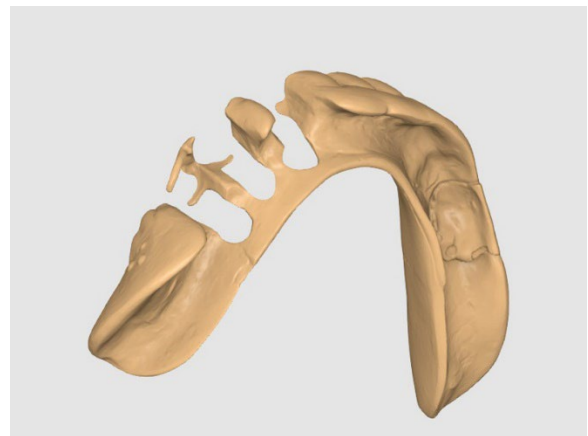
A bite record against a natural dentition may have been predictable, but due to the nature of the opposing complete denture, the decision was made to use the existing lower denture to assist in recording the bite.



## The Existing Partial

The existing partial denture was not comfortable and not stable. There was no intention of replicating the existing partial, however there is often an advantage to fully recording the partial denture. Lingual extensions are often difficult to capture digitally, and a record of existing flanges can be helpful in treatment planning and guiding the case.

The existing partial denture was scanned 360° to fully record the existing condition.

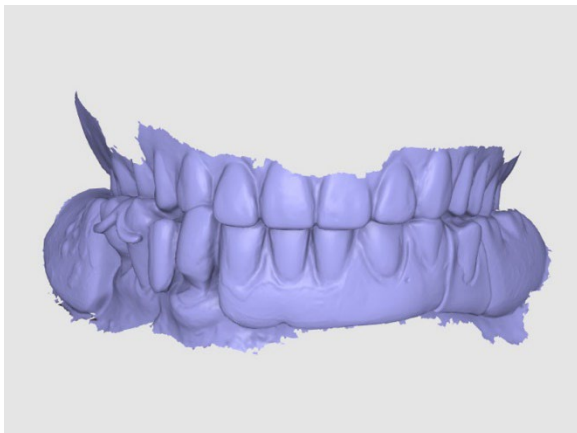
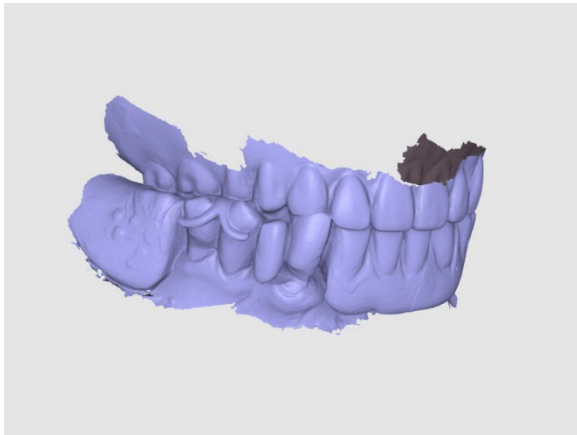


## The Bite Registration

The scanned complete upper denture and the scanned lower partial denture were inserted back into the patient's mouth for the bite registration. The patient was instructed to bite firmly while the bite record was scanned.

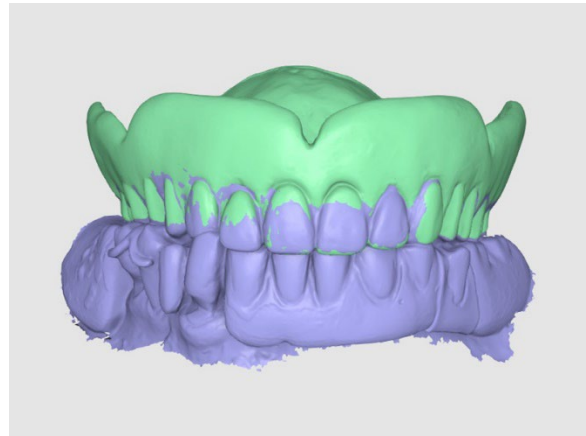
Digital bite records work by recognizing similar anatomy in multiple scans and stitching them. It is critical, therefore, to capture large zones of common areas between the bite scans and the individual scans.

Some dentists have been trained to snap small buccal bite images. There are, however, tremendous advantages to recording large patterns of data. This scan captured the entire arch in the bite registration.

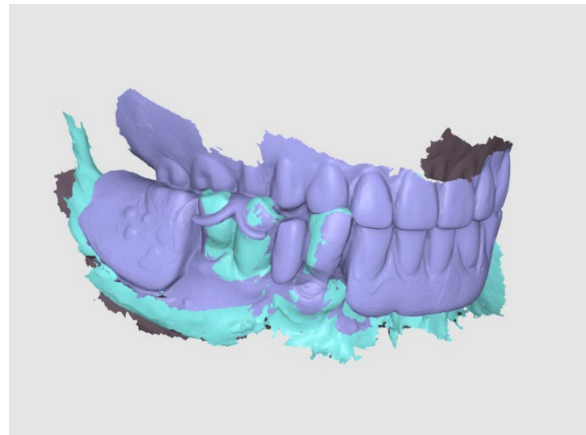


## Putting it together

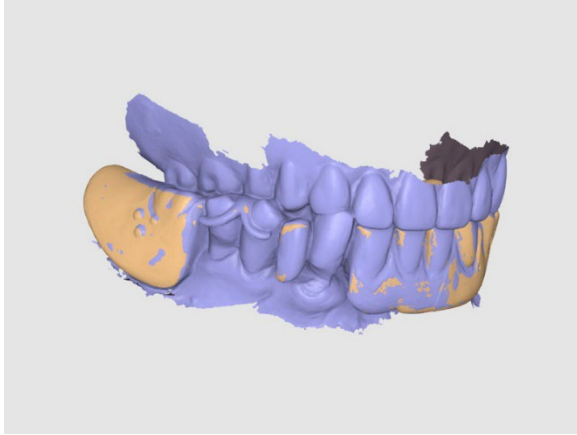
With enough data points, matching records becomes very easy. The purple image is the bite record. The green is the independent complete upper denture scan. Stitching software recognizes the common areas between the upper denture and the visible parts of the upper denture in the scan and aligns the denture to the bite.



The lower arch is the turquoise image. Like the upper technique, the teeth and attached gingiva from the partially edentulous scan were stitched into matching areas of the bite scan.

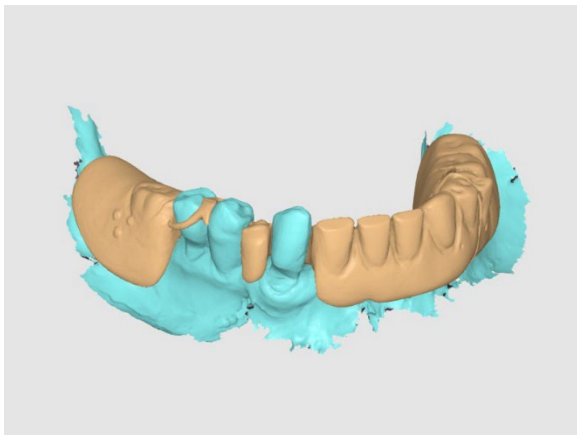


Finally, the scan of the lower partial was stitched to the bite scan.

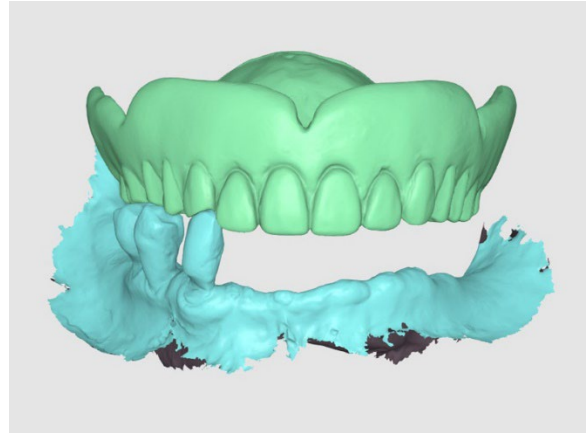


After aligning individual models, the software assigns 3D coordinates in space. That means the bite record has served its purpose. The complete upper denture, the existing lower partial denture and the lower partially edentulous ridge are now spatially related.

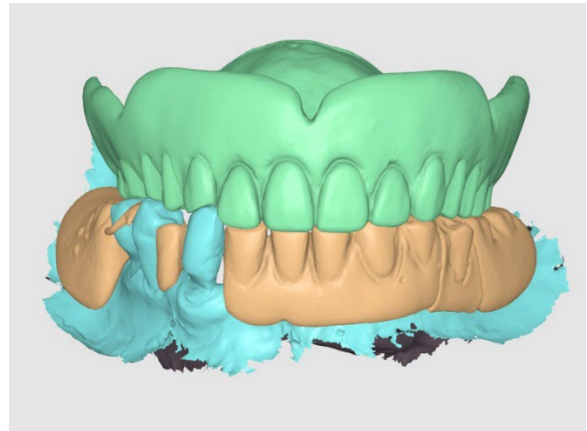
This image shows the full 360° partial denture scan virtually seated on the partially edentulous ridge.



The full 360° complete upper denture is virtually occluded with the partially edentulous ridge.



The complete upper denture, the lower partial denture and the lower partially edentulous ridge are all visible together in relation to each other.



At first glance, it may seem there is a record missing. There was no scan with the partial denture in place. This would normally be a recommended scan. In this case, the patient's existing partial was unstable. An open mouth scan would have resulted in inaccurate records as the patient's lips and tongue moved the denture. The occluding bite scan recorded the partially edentulous arch and the partial denture relationship more accurately. Both partial denture and ridge were digitally stitched using the bite scan.

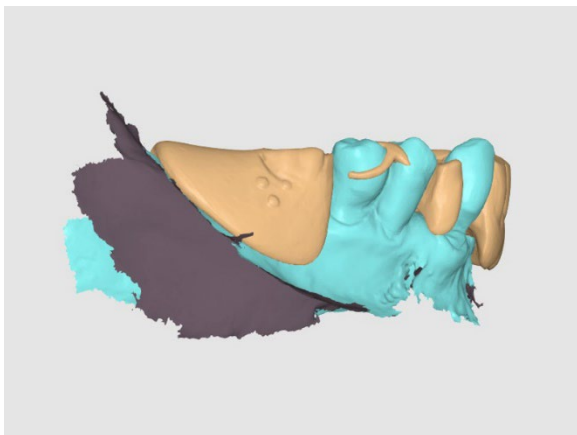
## The Treatment Plan

Upon digital review of the case, it is clear that this presentation more closely resembles a complete lower denture than a lower partial denture. The remaining teeth can not be counted on to support a metal framework and the patient is not able to have the remaining lower teeth extracted at this time.

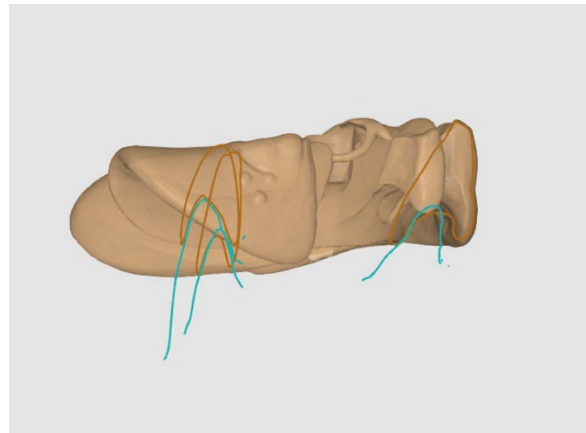
The patient opted for a lower gasket denture following the form of a complete lower denture and sealed around the remaining teeth with a gasket material.

## Analyzing the Existing Case

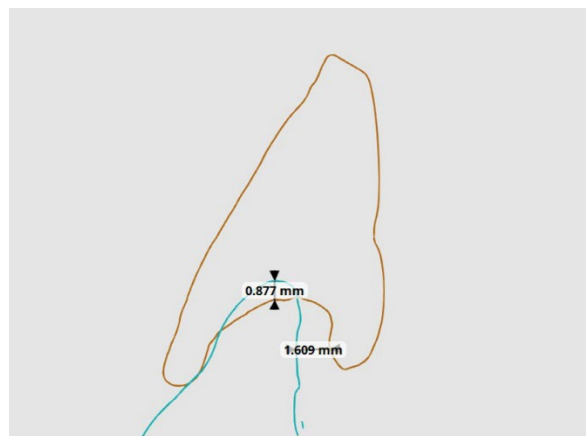
Aligned models allow the for rotation and manipulation of the records for optimal visualization. This lateral view would be difficult to accomplish intraorally and clearly shows a gap between the existing partial denture and the residual ridge in the lower anterior.



Digital analysis also permits the user to place cross sectional lines. This view shows the partial denture in relation to the midline cross section line through the denture and the same cross section line through the lower ridge (which has been made invisible for this view).



With both models turned off, only the cross-sectional view remains. The brown line is the outline of the existing partial denture, and the blue line is the outline of the ridge scan.



The cross section shows information that would be impossible to gather from a traditional impression. First, notice the gap at the facial edge. There is a 1.6mm gap between the existing partial denture and the current status of the ridge. This may be due to ridge

resorption, overzealous relief of intaglio acrylic or a combination of both.

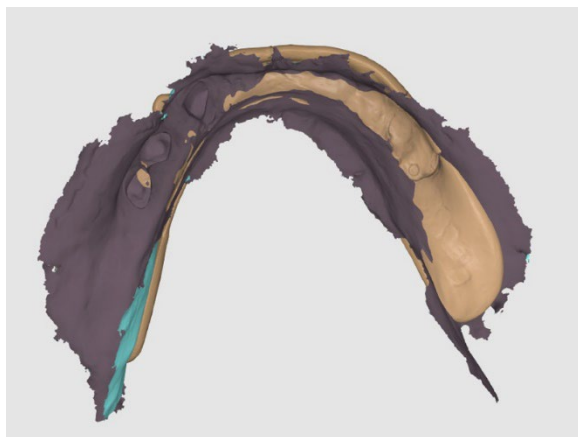
Also notice the relationship at the crest of the ridge. The scanned tissue sits higher than the intaglio of the denture. This indicates compressible or mobile tissue in this zone.

The discrepancy between the two scans does not indicate an error in record taking, but rather a dynamic intraoral situation that has been translated into a static record.

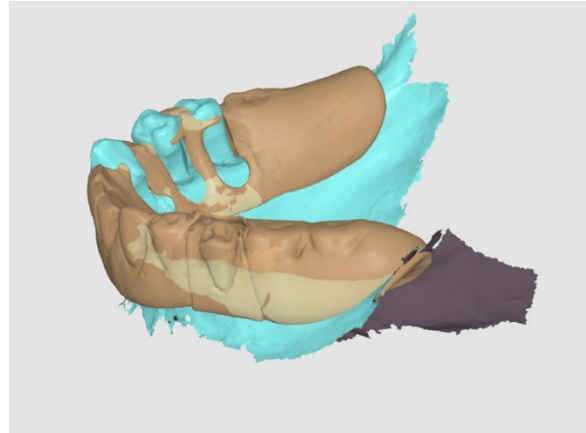
This cross section is a clear demonstration of why a partial denture can not be forced to fit on a stone model of a patient even though the partial denture fits the actual patient (and why a pick-up impression is 100% necessary for denture repairs).

## Tissue Compression and Mobile Tissue

This intaglio view of the seated denture reveals another inconsistency. Quadrant 4 is a view of tissue. The denture rightfully sits on the occlusal side of the tissue. Quadrant 3 is a view of the intaglio of the partial denture. It is seated below the surface of the tissue.



This posterior view of the denture aligned with the model shows the tissue surface in turquoise and the denture in brown. Notice the distal border of the denture is seated through the tissue surface.



This phenomenon speaks to tissue compression and mobile tissues. Impression materials in light, medium or heavy body naturally displace tissues. Scans are considered mucostatic records. They do not displace tissues and record them via a non-contact method.

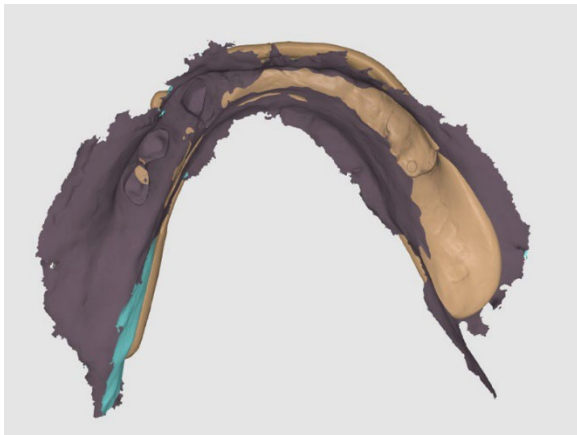
This would explain the discrepancy if the difference were solely due to tissue compression. Alternatively, there could be some recording of mobile tissue. The tissue at the buccal shelf was recorded using a slight buccal pulling border moulding during the scan. This may have resulted in mobile tissue being drawn off the buccal shelf. Likewise, the lingual tissue is unattached. If the patient's tongue was moving during the scan (and there's a 100% chance of that), the musculature may have drawn the tissue over the lingual ridge in a lingual direction.

The causes and clinical significance of the discrepancy is not clear at this stage. It was simply noted that this may be an area that requires adjustment.

## The Try-In

The purpose of a try-in with a digital workflow is to test-fit the case. The monobloc printed denture is dimensionally identical to the final. Issues of occlusion, rubs and tooth display can be evaluated and corrected before proceeding to the finished denture.

Immediately upon try-in, the patient noted a tight spot on the buccal shelf of the third quadrant. This was not a surprise. Some have said that working on a digital case is like doing the case as a virtual practice before delivering the actual case to the patient. The difference between an unloaded mucostatic impression and a loaded occluding impression was noted in the records. The exact area of pressure was predictable.



The buccal shelf, ridge crest and distal border of the try-in was liberally relieved. After confirming there was no pain with occlusal bite force, the try-in was coated with PVS tray adhesive and relined with medium body PVS.

The patient was instructed to occlude firmly and border mould by making “OOOO” and “EEEE” movements with his lips.



## The Final Denture

After adapting the modified record to the existing denture design, the final denture was milled with liberal space around the teeth in quadrant four.



The remaining teeth are not intended to add retention. The teeth were blocked out to the height of contour and a flexible gasket was processed to the contour line.



The result is a comfortable denture constructed over three short dental visits. Records capturing existing prosthesis, current intraoral conditions, and relationships in function allow a blending of information that would not be possible in traditional workflows.

Hallmark Dental Lab is the largest lab in Atlantic Canada and a leader in digital techniques and innovations.

Dr. Kirk Blanchard graduated Dalhousie Dental School in 1997 and Royal Roads University in 2015. He currently works at Hallmark Dental Lab improving workflows and efficiencies for dental offices.

Dan Watters works at Hallmark Dental Lab as a denture technician where he brings over 20 years of traditional denture experience to the digital denture protocol.

#### A Note on Digital Archiving:

This case captured a full three-dimensional record of the patient's existing upper denture. The digital design process also archives the newly designed lower denture. If the patient ever loses or breaks either prosthesis, new ones can be generated again with no additional appointments and no additional records.