

DENTAL TECHNIQUE

# A technique for verifying the accuracy of the virtual mounting of digital scans against the actual occlusal contacts



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The digital scans of dentate arches can be mounted using virtual interocclusal record to expedite the fabrication of dental prostheses.<sup>1-3</sup> This procedure allows dental practitioners to scan the dental arches and align them in a 3D manner using the computer software of the intraoral scanner. When the digital scans are mounted, the opposing teeth are matched against each other with the buccal views of the arches articulated in the maximal intercuspal position (MIP).<sup>4,5</sup>

The virtual mounting of digital scans eliminates conventional laboratory procedures of creating gypsum casts and enables the practitioner to evaluate the cross-sectional, palatal, and lingual views of the occlusal relations on the computer screen.<sup>1,6,7</sup> However, the virtual interocclusal record used to mount the digital scans may demonstrate a mismatch against the actual occlusal contacts of the teeth, creating occlusal inaccuracy (Fig. 1).<sup>6-8</sup>

This article describes a method of verifying the accuracy of a digital interocclusal record and of correcting the alignment of the digital scan to match the digital record against the actual interocclusal contacts. This method involves marking occlusal contacts on the teeth with colored articulating paper before making the digital scans. When the virtual images of the dental arches are mounted, the virtual interocclusal record is matched to the actual occlusal contact points to avoid occlusal errors in the fabrication of computer-aided design and

## ABSTRACT

The digital scans of dentate arches can be mounted from a virtual interocclusal record to expedite the fabrication of dental prostheses. However, the virtual mounting may develop an occlusal error when combined with less than ideally scanned data and an algorithm that matches poorly. This article describes a method of verifying the accuracy of virtual mounting against the actual occlusal contacts marked with colored articulating paper. (*J Prosthet Dent* 2019;121:729-32)

computer-aided manufacturing (CAD-CAM) dental prostheses.

## TECHNIQUE

1. Isolate and dry the maxillary and mandibular dentition using gauze and an air syringe (Taurus Sante; Shinhung).
2. Place colored articulating paper (AccuFilm II; Parkell) between the occlusal aspects of the maxillary and mandibular teeth and guide the mandible to close and mark the occlusal contacts in the MIP. Mark contacts in the lateral and protrusive excursions with articulating paper (AccuFilm II; Parkell) of a different color (Fig. 2).
3. Make digital scans of the maxillary and mandibular dental arches demonstrating occlusal contacts using an intraoral scanner (Trios 3 Color; 3Shape A/S). Capture the buccal surfaces of the teeth and articulate the virtual images of the dental arches in the MIP with the anatomic landmarks of ridges and grooves matching against each other (Fig. 3).
4. Rotate the virtual models to demonstrate the occlusal contacts marked in MIP. Note the occlusal

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**Figure 1.** Conventional digital scans of maxillary and mandibular dental arches. Note digital interocclusal record without demonstrating clear occlusal contacts. A, Maxilla. B, Mandible. C, Occlusal view of scan data.



**Figure 2.** Actual occlusal contacts marked with colored articulating paper in maximal intercuspal position. A, Maxilla. B, Mandible.



**Figure 3.** Maxillary and mandibular digital scans demonstrating actual occlusal contacts and virtual mounting in maximal intercuspal position as reference to buccal surfaces. A, Maxilla. B, Mandible. C, Virtual interocclusal record.

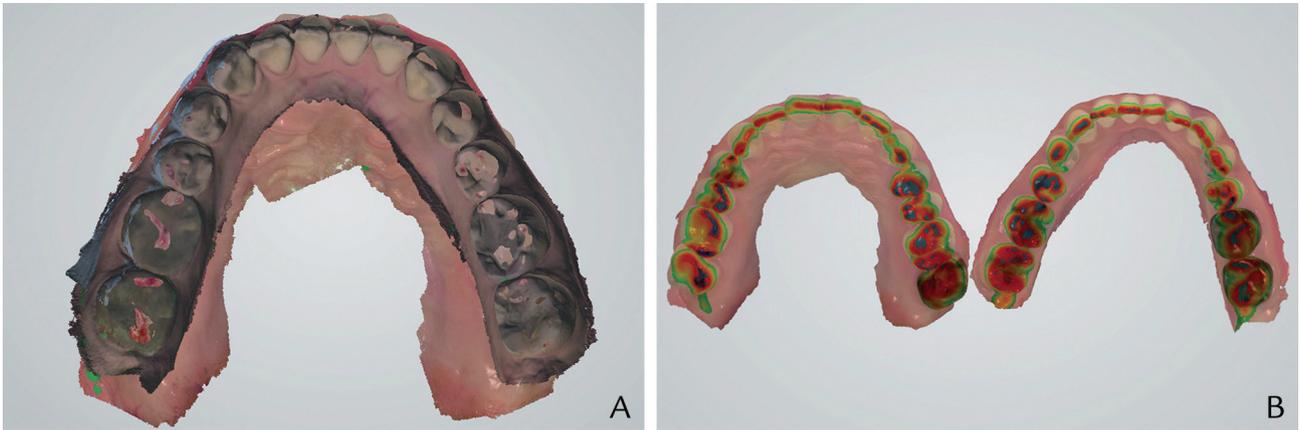
contacts displayed as areas of perforation driven by the antagonist of opposing dentition (Fig. 4A). Verify the occlusal contacts by applying the analysis mode and displaying a color map of different colors depicted as a function of the interocclusal distance (Fig. 4B). Transfer the acquired digital data to the dental CAD software (Dental system; 3Shape A/S) after verifying the occlusal contacts.

5. Correct the alignment of the scan data using the CAD software (Dental system) to match the digital interocclusal record against the occlusal contacts. Note the occlusal contacts displayed as areas of perforation (Fig. 5).

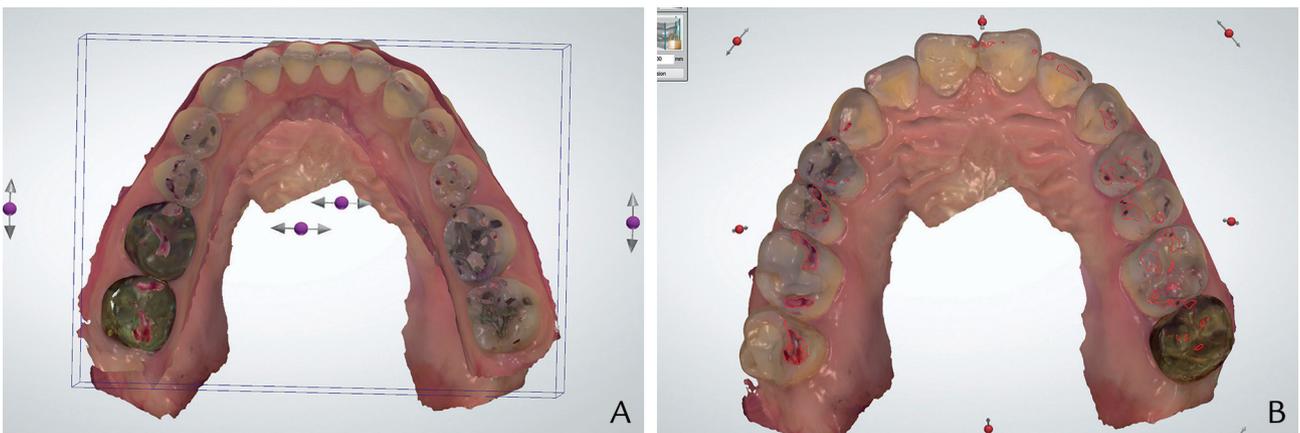
6. Simulate the excursive movements of the mandible on the virtual articulator and evaluate the accuracy of the virtual occlusal relations with reference to the marked contacts in the lateral and protrusive excursions (Fig. 6). Confirm the accuracy of the virtual mounting and proceed to design the CAD-CAM dental prosthesis.

## DISCUSSION

The interocclusal record should be accurate to ensure the accuracy of cast mounting and avoid occlusal errors in the dental prosthesis.<sup>2,3</sup> Although the centric relation



**Figure 4.** Occlusal view of scan data. A, Actual occlusal contacts as indicated by areas of perforation. B, Color map of virtual occlusal relations as indicated in *black* (occlusal contacts), *red* (close to antagonist), and *green* (far from antagonist). Accuracy of digital interocclusal record verified when perforated and *black* areas match.



**Figure 5.** Realignment of digital scan to match digital interocclusal record against occlusal contacts. A, Actual occlusal contacts as indicated by areas of perforation. B, Red circles indicate occlusal contacts.



**Figure 6.** Simulation of excursive movements of mandible on virtual articulator to demonstrate occlusal relations. A, Left lateral excursion. B, Right lateral excursion. C, Protrusion. Note *red* color indicates occlusal contacts in maximal intercuspal position and *blue* in lateral excursions.

position serves as a reference for cast mounting, the MIP is commonly accepted for mounting the casts when the existing articulation is acceptable.<sup>4,5</sup> This is a positional relationship of the cusps articulating against the opposing fossae or grooves and is usually chosen in the restoration of a limited area of dentition. However, this

anatomic relationship often presents problems when combined with an unstable occlusion related to excessive occlusal wear, mutilated dentition, or neuromuscular disharmony of mastication.<sup>4,5</sup>

A CAD-CAM dental prosthesis may present deficient or hyperocclusion and require intraoral occlusal

adjustments.<sup>8</sup> Such occlusal errors may partly relate to a mismatch of the virtual interocclusal record against the actual occlusal contacts. An occlusal mismatch may be associated with deficient scan data, the type of intraoral scanner, and the length of the dental arch.<sup>2,8-10</sup>

The CAD software (Dental system) allows the scan data to realign, match, or alter the position, area, and distance of occlusal contacts in MIP. This procedure of realignment can be useful when the scanned data are less than ideal with the combination of a loss of occlusal anatomy or pathologic condition of the remaining dentition. With the color map, the accuracy of virtual occlusal relations can be verified against the actual occlusal contacts marked with articulating paper of different colors.

This method can reduce occlusal errors and the chair time needed for occlusal adjustments by allowing the dental practitioner to verify the accuracy of the digital interocclusal record before fabricating CAD-CAM dental prostheses. However, this method of verification is not suitable for all commercially available computer programs and is applicable only to color intraoral scanners. Although less than ideal, this method can be extended when the intraoral scanner is supported by a color scan.<sup>1</sup>

## SUMMARY

This article describes a method of verifying the accuracy of a digital interocclusal record against the actual occlusal contacts marked with articulating paper of different colors before making digital scans of the dental arches. This method can eliminate occlusal errors in the CAD-CAM design of dental prostheses resulting from a

mismatch of the virtual interocclusal record against the actual occlusal contacts.

## REFERENCES

1. Mangano F, Gandolfi A, Luongo G, Logozzo S. Intraoral scanners in dentistry: a review of the current literature. *BMC Oral Health* 2017;17:149.
2. Solaberrieta E, Arias A, Brizuela A, Garikano X, Pradies G. Determining the requirements, section quantity, and dimension of the virtual occlusal record. *J Prosthet Dent* 2016;115:52-6.
3. Solaberrieta E, Garmendia A, Brizuela A, Otegi JR, Pradies G, Szentpétery A. Intraoral digital impressions for virtual occlusal records: section quantity and dimensions. *Biomed Res Int* 2016;2016:7173824.
4. Christensen GJ. Is occlusion becoming more confusing? A plea for simplicity. *J Am Dent Assoc* 2004;135:767-8. 770.
5. Türp JC, Greene CS, Strub JR. Dental occlusion: a critical reflection on past, present and future concepts. *J Oral Rehabil* 2008;35:446-53.
6. Solaberrieta E, Mínguez R, Barrenebea L, Etxaniz O. Direct transfer of the position of digitized casts to a virtual articulator. *J Prosthet Dent* 2013;109:411-4.
7. Stavness IK, Hannam AG, Tobias DL, Zhang X. Simulation of dental collisions and occlusal dynamics in the virtual environment. *J Oral Rehabil* 2015;43:269-78.
8. Fasbinder DJ, Poticny DJ. Accuracy of occlusal contacts for crowns with chairside CAD/CAM techniques. *Int J Comput Dent* 2010;13:303-16.
9. Nedelcu RG, Persson ASK. Scanning accuracy and precision in 4 intraoral scanners: an in vitro comparison based on 3-dimensional analysis. *J Prosthet Dent* 2014;112:1461-71.
10. Ahlholm P, Sipilä K, Vallittu P, Jakonen M, Kotiranta U. Digital versus conventional impressions in fixed prosthodontics: a review. *J Prosthodont* 2018;27:35-41.

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