International Journal of Research and Reports in Dentistry

3(2): 24-29, 2020; Article no.IJRRD.58152

Consistency and Repeatability of Digitized Occlusal Records

Philip L. Millstein[1], Carlos E. Sabrosa[2*], Sergio Florencio[3] and Karen Geber[4]

[1]Department of Graduate Prosthodontics, Harvard School of Dental Medicine, Biomaterials, 188 Longwood Avenue, Boston, MA 02115, USA.
[2]IASERJ Hospital, University of the State of Rio de Janeiro, Rio de Janeiro, Brazil.
[3]Private Practice, California, USA.
[4]Private Practice, Rio de Janeiro, Brazil.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Fatih Oznurhan, Cumhuriyet University, Turkey.
(2) Dr. M. Jaya Nagendra Krishna, Kamineni Institute of Dental Sciences, India.
(3) Dr. Roberta Gasparro, University of Naples Federico II, Italy.
Reviewers:
(1) Ahmed Abdulrahman Abbas, Thammasat University, Thailand.
(2) Akanksha Bhatt, Babu Banrasi Das College of Dental Sciences, Babu Banarasi Das University, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/58152

Clinical Practice Article

Received 20 April 2020
Accepted 27 June 2020
Published 08 July 2020

ABSTRACT

New technology yields an instant occlusal impression for recording occlusal and near occlusal contacts and excursive movements in a closed position. Occlusal contact areas can be recorded in a material rather than on a tooth, allowing the information to be scanned and digitized for immediate viewing and subsequent examination.

Keywords: Occlusion; instant impression; polysiloxane; image analysis; hard-copy.

1. INTRODUCTION

Presently, the conventional systems used to evaluate an occlusion require materials such as waxes, ribbons, films, or the T-Scan occlusal analysis system [1-4]. These materials and systems are each limited by their form or application. Research in the literature has not uncovered recordings of dynamic occlusion with excursions that are preserved in electronic form

**Corresponding author: Email: cesabrosa@sabrosa.com.br, cesabrosa@gmail.com;*

or hard copy. Permanent occlusal records, like radiographs, are important for comparison over time and identification [5]. A record of dynamic occlusion would enhance the clinician's ability to diagnose and treat occlusal disharmonies and related factors.

Occlusion is recorded intraorally by using contact marking media that remain on the teeth momentarily. Upon viewing, the marks are often washed away and their context about occlusal contact is lost [6]. Near-occlusal contacts — those that are close but not touching—are not recorded but may give the dentist perspective of occlusal dynamics. Wax can be used but, because of its crystalline properties, it does not flow readily to record the occlusion on contact [1]. T-Scan makes a hard copy of force points of occluding cusps but does not record the dynamic relation of cusps to fossae [4].

A novel means for recording the occlusion uses a non-polymerizing polysiloxane compound to impress contact and non-contact areas [7]. Occlusal contact areas are recorded in the impression material and not on the teeth. To be time-efficient, the recordings can be made instantly and with little resistance to closure. Non-cross linked (single component) linear polysiloxanes, having a molecular weight of 400,000 to 500,000 Daltons and a viscosity of 10 to 12 million centistokes, can be used for occlusal measurement and recording systems, particularly those using light transmission through the material as a measure of occlusal position. As a reference, the viscosity of water at room temperature is about 1 centistoke. A small fraction of opaque filler such as titanium dioxide or calcium carbonate is added to the transparent impression material to provide enhanced contrast in subsequent evaluations. There is no catalyst. The occlusion can be impressed and read immediately with imaging software. A hard copy can be printed should the clinician desire it. This paper reviews this concept.

2. TECHNIQUE

The procedure involves making a reference grid and making an impression to record occlusal variations.

1. Set up a computer imaging workstation by connecting a calibrated direct current lightbox (Schott North America), grayscale digital camera (CFW-1308M; Scion Corporation), and computer with imaging analysis program (ImageJ software; National Institutes of Health). Position the camera at a fixed distance of eight inches above the lightbox and connect the camera to the computer (Fig. 1).

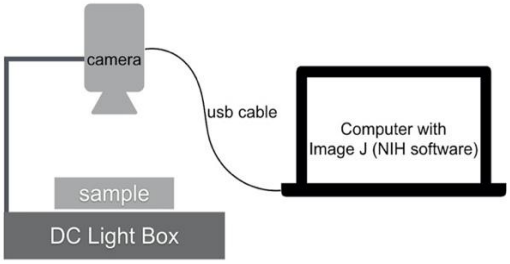

Fig. 1. Recording and measuring station

2. Make a circular grid for calibration purposes. Place a small amount of impression material on the lower flat plate of a grid press. Engage the upper plate with matching a sphere of three-eighths of an inch in diameter. Close the press until point contact of the sphere and flat plate is made.
3. Photograph the circular grid. Use the camera to capture the light transmitted through the grid so that the light projected can be translated into a grayscale value and in turn assigned a thickness value.
4. Assign geometric reference grayscale values to the circular grid. Assign an actual thickness value associated with the optical transmission—i.e., the picture elements or pixel based on a range of 0 to 256 grayscale values. Calculate the thickness of the gap at a given location created by the grid sphere of known values as it makes point contact with the flat surface of the press (Fig. 2).

By using the grid, the relationship between transmitted light and thickness is established) [8].

5. Convert grayscale values to color representations. Translate the shades of gray in the image by intervals that cover all 256 values (Fig. 3). Assign each interval of grayscale values an arbitrary color.
6. Make an impression. Fill a triple tray (Premier Dental Products) with the non-polymerizing polysiloxane impression material (SE-30 silicone gum rubber; Momentive Performance Materials). Insert the tray in the patient's mouth, have the patient follow your commands, and remove

the impression tray immediately. Because of its properties the material does not stick to the teeth.

7. Photograph the impression. Place the impression on the lightbox, capture the image, and transfer the data to the image analysis program as done with the grid (Fig. 4). The light source should be perpendicular to the occlusal surface otherwise the contacts may be distorted. A direct current light source is used and the intensity is adjusted to the light transmission through the impression material as determined by the grid.
8. This procedure demonstrates the reliability of the technique (Fig. 5).

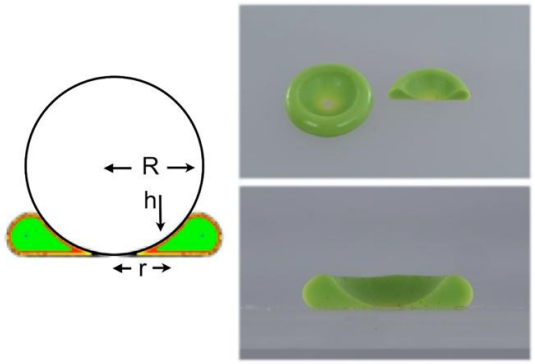

Fig. 2. Grid and sphere in contact with gap at base (The thickness, h, of the grid at a distance, r, from the point of contact is given by the formula (h = R - $\sqrt{R^2 - r^2}$) where R is the actual radius of the sphere, three-eighths of an inch)

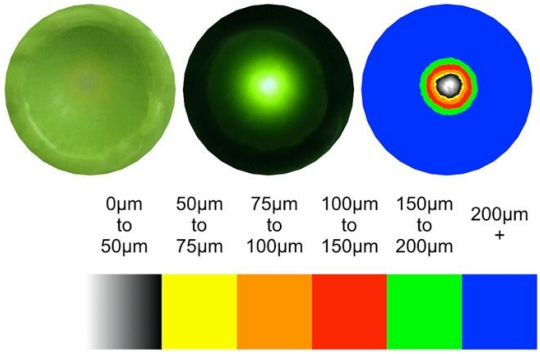

Fig. 3. Color representation of optical density

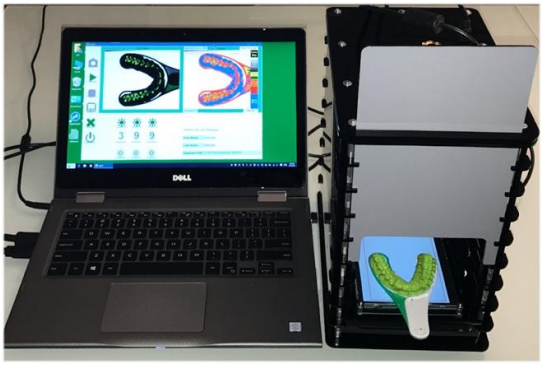

Fig. 4. Chair-side workstation containing impression

9. Record the occlusion. Use the same process to convert the grayscale image to color. A series of 3 photographs of the same patient verifies the repeatability of the technique (Fig. 6).

3. DISCUSSION

The polysiloxane material is physiologically inert. It offers little resistance to closure and closely follows the contours of the teeth. The material is non-adhesive and easily removable from the teeth without distortion after an impression is made. Silicone impression material which is between a gel and liquid state and of a specific molecular weight is ideal for making an instant and accurate impression of an occlusal position within 10 to 15 seconds. Excursive movements can be accurately recorded in seconds, and the image is then immediately processed (Figs. 7 & 8) [9].

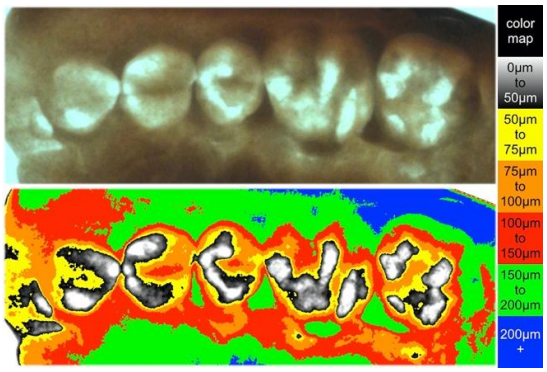

Fig. 5. Optical image converted to color representation

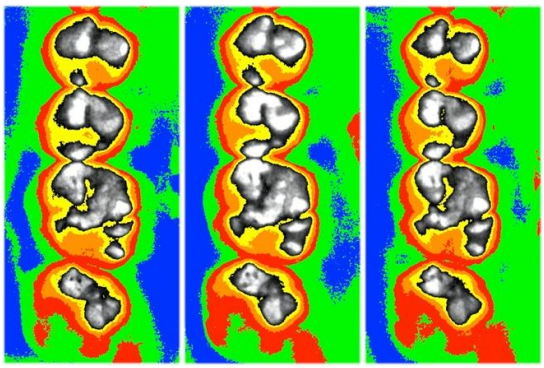

Fig. 6. Three quadrant impressions using same material

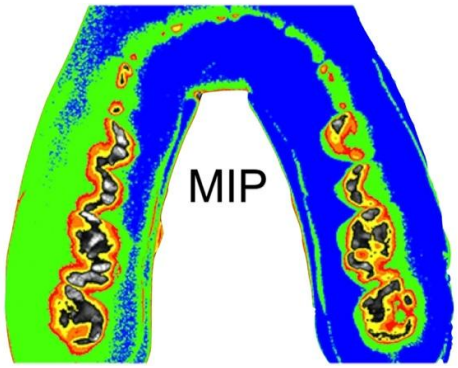

Fig. 7. Maximum intercuspation with reusable material

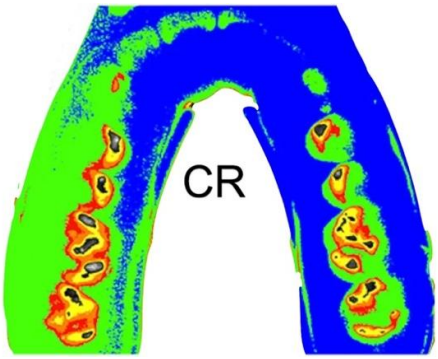

Fig. 8. Cenric relation with reusable material

With records of dynamic occlusion, measurements can differentiate variations in tooth compression [10,11]. One application is to align implant-supported restorations into an existing occlusion. Another is to make wear facets and areas of extreme occlusion more visible. Occlusal scans can be color coded to differentiate areas of contact, near contact, and distant contact.

This impression material does not set so it can be used over again on the same patient. It is quick to use and cost effective. The cost of the material is minimal, and it can be used multiple times on the same patient.

Routine clinical procedure can include making interocclusal records of various positions, that is, centric relation, maximal intercuspal position, protrusive and lateral eccentric positions. These recordings may be made instantly and permanently archived. They are valuable clinically because they provide a baseline for future reference. The information is meaningful to a clinician because it provides a full arch view of the occlusion which is not possible with articulating paper. Occlusal changes can be monitored over time. Compared to visual scanners which rely on a “best fit” computer – generated bite of the digital casts, this method relies on the patient’s temporomandibular joint which provides an accurate position for diagnosis and treatment planning. A patient’s occlusal health as determined by occlusal contacts can be assessed and treatment instituted if required.

4. CONCLUSIONS

An impression can be made instantaneously, and within a minute scanned and permanently recorded. The data in turn constitute a record keeping system with the following benefits:

- Occlusal records can be compared over time to view changes related to wear and uneven closure, leading to preventive measures.
- Pre- and post-delivery records can be used to ensure quality control from dentist to dental laboratory, minimizing errors and reducing cost.
- Occlusal analysis can be made and recorded and adjustments made to create more harmony
- and to balance the occlusion. The dentist must be knowledgeable to assess and make appropriate change.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, participant written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Millstein PL. An evaluation of occlusal indicator wax. J Prosthet Dent. 1985;53: 570-2.
2. Millstein PL, Maya A. An evaluation of occlusal contact marking indicators: A descriptive quantitative method. JADA. 2001;132:1280-6.
3. Millstein PL. An evaluation of occlusal contact marking indicators: A descriptive qualitative method. Quintessence Int. 1983;14:813-6.
4. Ayuso-Montero R, Mariano-Hernandez Y, et al. Reliability and validity of T-Scan and 3D intraoral scanning for measuring the occlusal contact area. Journal of Prosthodontics. 2020;29:19-25.
5. Rothwell BR. Bite marks in forensic dentistry: A review of legal, scientific issues. JADA. 1995;126:223-32.
6. Dixon D. Overview of articulation materials and methods for the prosthodontics patient. J Prosthet Dent. 2000;83:225-47.
7. Method and apparatus for occlusal position measurement and recording, Patent No. US 8,529,254 B2; 2013.
8. Millstein PL. A method to determine occlusal contact and noncontact areas: Preliminary report. J Prosthet Dent. 1984;52:106-10.
9. Abduo J, Tennant M. Impact of lateral occlusion schemes: A systematic review. J Prosthet Dent. 2015;114:193-204.
10. Iwaki Y, Wakabayashi N, Igarashi Y. Dimensional accuracy of optical bite registration in single and multiple unit restorations. Oper Dent. 2013;38:309-315.
11. Roque MA, Gallucci GO, Lee SJ. Occlusal pressure redistribution with single implant restorations. J Prosthodont. 2017;26:275-279.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/58152