

OCCLUSAL INDICATORS: KEY FOR THE EQUILIBRATION OF FUNCTIONAL OCCLUSION

*Lisa Vincent, **Kavitha Janardanan, ***Harsha Kumar K, ****R. Ravichandran

* Postgraduate Student, ** Associate Professor, *** Vice Principal, Professor and Head of the Department, **** Professor, Department of Prosthodontics and Crown & Bridge, Govt. Dental College, Thiruvananthapuram, Kerala - 695 011. Corresponding Author: Dr. Lisa Vincent, Email: Lisavincent158@Gmail.com

<https://doi.org/10.55231/jpid.2024.v08.i01.07>

Abstract

In dentistry, accurate means of recording occlusal contacts is important. It is necessary to understand occlusion and errors produced during recording occlusal contacts. Occlusal interferences of just a few microns can result in myalgia and temporomandibular dysfunction. The aim of any restorative treatment is to establish occlusion that is in harmony with the stomatognathic system. Occlusal indicators are used to locate and define occlusal contacts in prosthetic restorations. Over the years various occlusion testing materials have been used to assess any occlusal interferences. For obtaining a proper occlusion it is important to understand the properties of materials and methods to record occlusal contacts. This review article overviews the various materials and methods that have been used as occlusal indicators.

Keywords: Occlusal indicator, occlusal contacts, occlusal interference

Introduction

The activities of chewing, swallowing and speaking greatly depends both on intra arch and inter arch tooth position.¹ The occlusal contacts undergo constant changes with every tooth restoration, extraction and prosthetic care. Conventional concepts of traumatic occlusal interferences involve a single anterior or posterior tooth, which is the "supracontact" during maximum intercuspitation or excursive jaw movement. Severe irritation can be triggered by an occlusal interference of only few microns. The patient will not bite on the new prosthesis in order to avoid any unpleasant sensation. The new bite of convenience can be obtained by moving his lower jaw into a physiologically unsound position that results in irregular muscle activity. This leads to temporomandibular joint pain and myalgia. Occlusal indicators are used to locate and define occlusal contacts.² Over the years various materials and methods have been used to detect

high spots. Occlusal indicators differ not only in their marking characteristics but also in material properties such as thickness, tensile strength and plasticity. The aim of occlusal adjustments is to provide maximal intercuspation of teeth in centric relation, by removing centric pre-maturities and any eccentric interference.³ It has been a real challenge for achieving occlusal markings over some restorations such as gold, metal alloys, ceramics and on moist occlusal surfaces. For the correct assessment of occlusion in prosthodontic treatment, it is important to understand the patterns of tooth contact, properties of materials and methods used to record these tooth contacts.²

Classification of occlusal indicators

Occlusal indicators are classified as qualitative and quantitative indicators.

Qualitative/non-digital/conventional indicators

- ♦ Articulating paper
- ♦ Articulating film
- ♦ Articulating silk strips
- ♦ High spot indicator
- ♦ Gnatho-film
- ♦ Articulating wax
- ♦ Foil
- ♦ Metallic shim stock
- ♦ Silicon putty material
- ♦ Dental floss with a pressure sensitive material
- ♦ Fleximeter strips
- ♦ The two-phase occlusion indicator method

Quantitative/digital indicators

- ♦ T-Scan
- ♦ Occlusense
- ♦ Photo occlusion
- ♦ Virtual dental patient

The location and number of tooth contacts are determined by qualitative indicators whereas quantitative indicators determine the time, sequence and force characteristics of tooth contacts.

Qualitative indicators

Articulating paper:

Articulating papers are the most commonly used qualitative indicators. They vary in terms of thickness, width and the type of the dye impregnated. They consist of a coloring agent and a bonding agent (transculase) between the two layers of the film. The coloring agent is expelled from the film on occlusal contact and the bonding agent binds it on to the tooth surface. The marking obtained consists of a central area that is devoid of the colorant and surrounded by a peripheral rim of the dye. This region is the 'target' and it denotes the exact contact point. It is also called as 'iris' because of its appearance. The density of these markings does not represent the force of the contact; instead, heavier contact tends to spread the mark peripheral to the actual location of the occlusal contact. The central portion in heavy contact areas indicates the interference that needs correction. They should be used in a dry field as it can be ruined by saliva easily. They can make pseudocontact markings because of their relatively inflexible base material.⁴

Bite intensity detecting articulating paper

This was invented and patented by August Kokal in 1976. It comprises of an upper paper and lower paper or mesh layer and many ink granules which are interposed between the two. Each ink granule is surrounded by a membrane with variable thickness that ruptures at different biting pressures. For example green ink granules have thin membrane which is designed to be rupturable at biting pressure of 300-500 psi, red ink granules at 500-700 psi, blue at biting pressure

of 700-1000 psi. This articulating paper would mark the teeth with different colours which gives the operator a clear picture of the different points of occlusion with the different biting pressures.⁴

Articulating silk strips

It is made up of a micronized color pigment, embedded in a wax-oil emulsion.⁵ Articulating silk strips are made from high quality natural silk. It consists of fibrils which are tube shaped protein structures and has high colour reservoir capacity. This silk is highly tear-resistant. It has soft texture and does not produce any pseudo markings. It is highly suitable for use on highly polished surfaces, particularly ceramic and gold in lab models, where one strip can be used as many times.⁴

Gail C Halperin et al. in their review on occlusal registration strips concluded that the occlusal registration should be less than 21 μm (micron meters) and should possess plastic deformation.⁶

Articulating foil

Articulating foils have a thickness which is around 8 μm and are known to produce more accurate readings than paper and silk. It has less marking ability under reduced pressure and glossy surfaces. Hence greater pressure must be applied for the clinical use of foils.⁴ The Artifol articulating film (Bausch Inc.) has thickness of just 8 μm , which is less than the thickness perception level of the patient. It must be used in a dry environment with special holders. It is universally applicable, both on lab models and intraorally.⁵ They are also manufactured with an additional emulsifier which gives them bonding properties on moist occlusal surfaces. This is achieved by adding special bonding agent transculase, or wetting agents like lecithin. On occlusal contact, the colouring agent is expelled from the film and

the bonding agent binds it on to the tooth surface.⁴

Metallic shim stock film

The shim stock film is colour coded on one side and has a metallic surface on other side. It is mainly indicated for use in the occlusal splint therapy in order to accurately mark the contacts on the soft splint in the laboratory.⁵

High spot indicator

This is in the liquid form. It is indicated to check the proximal contacts of crowns, telescopic crowns, inlays, onlays and clasps. The liquid is applied on the proximal surface of the coping and a film with a thickness of 3 μm was formed. The proximal contact area is delineated as an area of show through in the base material of the crown when dye is removed.⁵

Fleximeter strips

Fleximeter strips measures the height of the preparation. They are made of silicone rubber which can be sterilized to the temperature of 200°C. They are available in 3 different thickness: 1mm, 1.5 mm and 2 mm. Occlusal indicator paint can be applied onto these strips and can be used as a marking indicator.⁴

Gnatho-film

Gnatho-film is a soft and flexible occlusal film. It was developed by Bausch. It is Ultra thin, 16 μm polyethylene, with a colour coating of 6 μm , consisting of waxes with hydrophilic components. This unique film adapts perfectly to the individual conditions of the receptive occlusal surface and is extremely tear resistant. The flexibility of polyethylene helps in precise checking of the actual contact points. It is available in various colours like green, blue, red, black and in different sizes (20x60 mm or 70x100mm).⁴

Dental floss with a pressure sensitive material

Interproximal contacts are as important to the dentist as occlusal or biting contacts, during seating of crowns and bridges. Articulating floss impregnated with a pressure sensitive material may be used to mark tooth contacts interproximally between one tooth and an adjacent tooth.⁴

Silicon putty material

Silicone putty can be mixed and placed on the occlusal surface and interocclusal records are made. They are placed on the casts after trimming. The location of tooth supracontacts can be identified as perforations in the silicone putty records. The interocclusal record is then placed on the occlusal surface of the teeth or cast and a colour indicator is painted into the perforations of each record with a fine camel hair brush. This would produce markings which can be adjusted to eliminate them.⁴

The two-phase occlusion indicator method

In this method, the articulating paper and the articulating film are used sequentially. The articulating paper mark the contacts consisting of a clear central region which is surrounded by a peripheral rim of the dye. The articulating foil of a contrasting colour is used to mark the center of the contact areas highlighted by the articulating paper markings initially. The actual interferences are the central areas and are to be eliminated.⁴

Transparent Acetate Sheet

It was described by Davies et al. in 2005. It makes use of an occlusal sketch technique as a means of recording occlusal contacts. The occlusal sketch consist of a transparent acetate sheet that represents the occlusal aspects of the teeth. The use of acetate helps to assess the marked

occlusal contacts from both sides. The dynamic and static occlusal contacts were marked. To identify the locations of occlusal contacts, after completing the occlusal record for each subject, the contact anatomic regions were traced onto each occlusal sketch. The occlusal sketches were overlaid by a 1-mm two transparent grid to enable comparison between the 3 clinicians by comparing the x and y coordinates for each occlusal contact in a specific region. The occlusal sketch is a simple way of recording the occlusion of patients. Furthermore, this technique is quick, inexpensive, and easy to perform.⁷

Occlusal Sprays

It is a universal color indicator to test the occlusal contacts and accurate fit of crowns and bridges. It is easy to handle (Bausch Arti-Spray Occlusion-Spray) and leaves a thin colored film which can easily be removed with water, leaving no trace of residues. It is applied at a distance of 3-5 cm onto the occlusal surface or inside the crown or bridge. When testing occlusion or trial seating the bridge or crown, all contact points will be immediately visible. It can be used for adjusting proximal contacts when trial seating crowns and bridges.³

Quantitative indicators

Photo occlusion

A thin photoplastic film layer/ memory wafer is placed on the occlusal surface and the patient is asked to occlude on the wafer for 10 to 20 seconds. It is inspected under a polariscope light. The location and intensity of occlusal contacts are verified and the results are then transferred to a graphic occlusal scheme. Light contact is seen as yellow, orange or red colour and shows 40% of light penetration where as in medium contact the percentage of penetration is 40-48% and the colour patterns are blue centered within the light coloured pattern. In heavy contact the

color pattern is orange and yellow at the center and has 48 to 60% of penetration. E. Gazit et al. studied the reproducibility of the Novel photo occlusion (NPT) and color marking technique (CMT) by comparing two consecutive occlusal records and records made at 1-month intervals and concluded that the NPT is more reproducible than the CMT.⁸

T-Scan

The T-Scan occlusal analysis system (Tekscan) is a Microsoft compliant system that can record a given contact sequence in 0.01-s increments. It consists of a piezoelectric foil sensor, a sensor handle, both hardware and software for processing the data. The T-Scan assess the time magnitude and the distribution of the occlusal contacts. The T-Scan system digitally record the timing and location of tooth contacts. The tooth contact information is represented as moments of time in the sagittal axis and transverse axis of the occlusal plane. Time moments are defined as the sum of distances of the tooth contacts in millimeters from the 'x' or 'z' axis of the occlusal plane multiplied by their relative time value (1-sec) and divided by the sum of the onset times. The manufacturer purports that, when the time moments in these axes are analyzed, an occlusion can be uniquely described. The advantage of this instrument over silk marking ribbon is that it records contacts and helps to analyze the timing and force of each contact.⁵

Occlusense

Occlusense is a new digital occlusion product that was introduced in 2019. It is a wireless digital system handle and sensor that transmits the data to an iPad Application via a Wi-Fi connection. The patient's recordings are displayed on the App.⁹ It has a sensor with built-in articulating paper that marks the occlusal contacts on the teeth.¹⁰

Virtual Dental Patient (2002)

Virtual technologies in dentistry are used to provide better education and training by simulating complex contexts and enhancing procedures that are traditionally limited, such as work with mechanical articulator. This is a recently introduced concept where the casts of a patient's dentition is scanned to obtain the data of three-dimensional dental patient. This provides quantitative information to analyse the chewing function and interferences in occlusion. The aligned virtual casts helps to calculate occlusal contacts.⁵

Conclusion

Different occlusal registration materials have been used for recording the occlusal contacts since years. The occlusal indicator should have some amount of plastic deformation before it tears or before any deformation occurs. The articulating papers, foils, silk strips, and T-Scan system were associated with different rates of decrease in contact numbers on multiple uses. The repeated use of the sensors negatively affects the success of the T-Scan system. Occlusal contact numbers increased greatly when the teeth were dry. Every material has both advantages and limitations. The choice of occlusal indicators depends upon the clinical situation, clinician's choice and expertise, economics and comfort.

References

1. Debashish Panigrahi, Ashish Satpathy, Amit Patil, Gauresh Patel. Occlusion and occlusal indicating materials. *Int J Appl Dent Sci* 2015;1(4):23-26
2. Sharma A, Rahul GR, Poduval ST, Shetty K, Gupta B, Rajora V. History of materials used for recording static and dynamic occlusal contact marks: a literature review. *J Clin Exp Dent*. 2013 Feb;5(1):e48.
3. Shayan Nazir Mir, Ashish Choudhary, Jagadeesh HG. OCCLUSAL INDICATORS – CHASING BLUE MARKS? : A REVIEW. *TMU J. Dent* July – Sept 2014;1(3): 92-95
4. Pearl DEE, Joevitson DM, Sreelal DT, Chandramohan DG, Mohan DA, Hines DAJ. Marking the invisible – A review of the various occlusal indicators and techniques. *Int J Appl Dent Sci*.

- 2020;6(2):377–81.
5. Babu R, Nayar S. Occlusion indicators: A review. *J Indian Prosthodont Soc.* 2007;7(4):170.
 6. Halperin GC, Halperin AR, Norling BK. Thickness, strength, and plastic deformation of occlusal registration strips. *J Prosthet Dent.* 1982 Nov;48(5):575–8.
 7. Davies S, Al-Ani Z, Jeremiah H, Winston D, Smith P. Reliability of recording static and dynamic occlusal contact marks using transparent acetate sheet. *J Prosthet Dent.* 2005 Nov;94(5):458–61.
 8. Gazit E, Fitzig S, Lieberman MA. Reproducibility of occlusal marking techniques. *J Prosthet Dent.* 1986 Apr;55(4):505–9.
 9. Sutter B. Digital Occlusion Analyzers: A Product Review of T-Scan 10 and Occlusense. *Adv Dent Technol Tech.* 2019 Nov 20;1–31.
 10. Jauregi M, Amezua X, Iturrate M, Solaberrieta E. Improving the precision of recordings acquired with digital occlusal analyzers: A dental technique. *J Prosthet Dent.* 2024 Jul;132(1):37–41.