

# OCCLUSAL INDICATORS – CHASING BLUE MARKS? : A REVIEW

Shayan Nazir Mir,<sup>1</sup> Ashish Choudhary,<sup>2</sup> Jagadeesh HG<sup>3</sup>

Post Graduate Student,<sup>1</sup> Professor,<sup>2</sup> Professor & Head,<sup>3</sup>

1-3 Department of Prosthodontics, Crown & Bridge, School of Dental Sciences, Sharda University, Greater Noida

## Abstract

The long-term successful rehabilitation of a mouth with removable or fixed restorations is dependent upon the maintenance of occlusal harmony. Any restoration placed which causes disharmony in occlusion, the adaptive capacity of the system may exceed leading to malocclusion. Therefore, the restoration should be planned so that they do not cause effects that exceed the patient's threshold or adaptive tolerance. It has been suggested that premature contacts in lateral excursion on non-working side should be eliminated without the alteration of other intercuspation. The correct physiological recovery of the occlusion poses a major challenge for the operator and the technician. Therefore, an understanding of the synergy of the teeth in static and dynamic occlusion forms the basis of good dentistry. Occlusal indicator is a medium to aid in the detection of occlusal permeability in prosthetic restorations. It is used to mark or indicate the position of occlusal contacts. By understanding the design & differences between occlusal indicators, for the elimination of these interferences operator can make accurate & precise markings. A thorough knowledge of the various occlusion indicators available, their method of usage, interpretation of their markings and their limitations is essential prior to their usage. This will help in making accurate adjustments rather than "Just chasing the BLUE MARKS".

**Key Words:** - Occlusal indicators, Occlusal contact marks

## Introduction

Occlusal indicators are used to locate and define occlusal contacts. The accuracy of these indicators is essential for the establishment of occlusal harmony, "the ultimate goal of treatment".<sup>1</sup> Occlusal registration and corrections depends upon precise registrations. Very less information is present in the literature on the accuracy of these registrations. The patient's perception of occlusal thickness ranges from 12.5 to 100 micro meter. The thickness of an occlusal registration strip should be below the patient's perception.<sup>2</sup> A supra-contact should be removed below the threshold of appreciation, and generally, it does not matter if the mark is overshoot. "Patients have occlusal sense; articulators have not".<sup>3</sup> Thick occlusal registration strip or one that a patient can perceive between the teeth has two major disadvantages.<sup>1</sup>: It can indicate tooth contact between opposing teeth when no tooth contact exists. It can introduce a proprioceptive response that in turn can cause the jaw to be deflected.<sup>2</sup> During an occlusal examination, the accurate measurement of tooth contacts can provide valuable information for diagnostic, treatment or prognostic purposes. Occlusal indicators differ not only in their marking characteristics but also in material properties such as thickness, plasticity and tensile strength. Hence the relevance of concerns relating to occlusal indicators affecting tooth contact measurement is likely to vary with indicator design.<sup>4</sup>

### Occlusal Adjustments

Occlusal adjustment refers to selective re-contouring and grinding of teeth in order to remove prematurities.

### Indications

1. Evidence of trauma from occlusion, by changes in the periodontium
2. Symptoms of TMJ dysfunction and habit neurosis (Bruxism)
3. Excessive tooth mobility

4. Excessive tooth wear
5. Need for extensive restorative work
6. Prerestorative treatment

The aim of occlusal adjustments is to allow maximal intercuspation of teeth in centric relation, by removing centric pre-maturities, in addition to removing any eccentric interference. By such a procedure, the adaptive arc of closure is replaced by the skeletal arc, and the patient is allowed to close in centric relation without deflective occlusal contacts. In other words, the patient's occlusion is adjusted in such a manner so that his habitual closure would coincide with his centric closure. Occlusal adjustments are made by selective reshaping or grinding of the marginal ridge angles, cusp heights, and angles of triangle and oblique ridges. It is very important in the process of occlusal adjustments to maintain the rounded contours and not to create flat surfaces.

## Discussion

### Occlusal Indicating Materials: Historical background

#### Carborundum Stripping technique (1970)

Waterproof carborundum (silicon carbide) abrasive paper was the material being used.

It maintains or improves the flatness of the posterior occlusal surfaces, requires less time, allows reduction of several teeth at one time or a portion of a single tooth. It is an economical method and readily available. One of the disadvantages is that when the teeth are in end-to-end as in working occlusion, reductions of both the buccal and lingual cusps will result.<sup>5</sup>

#### *Inter-occlusal Wax Record*

Wax has gained wide acceptance for interocclusal record transfer, however complete closure into wax is not easily achieved and rarely registers accurate incisal and occlusal forms of teeth.<sup>6,7</sup> It is easy to use and clinically flexible. But it has several disadvantages of being inaccurate, unstable

and inconsistent. Studies showed that waxes contain aluminium or copper particles that have flow rate of 2.5–22% at 37.5°C. These are susceptible to distortion upon removal from the mouth<sup>6</sup>. Enrich and Taicher (1981) recorded the occlusal contacts and these records were examined in front of a light screen. Each registration was placed on the diagnosed cast to visualize and verify the exact location of each contact (supracontact, contact and near contact).<sup>8</sup>

*Novel Photo-Occlusion & Color Marking Technique (1986)*  
The NPT was based on photo-occlusion technique.<sup>9</sup> Coltene paste was applied to the maxillary surface of the memory wafer. The wafer was then examined under the polariscope and the location and intensity of occlusal contacts were analyzed. Color patterns less than 10 micrometer apart (under the x10 magnification of the polariscope) were counted as a single contact.<sup>10</sup>

CONTACT	COLOR	PENETRATION
Light Contact	Yellow , Orange, Red	40 % light penetration
Medium Contact	Blue Center within the light-colored pattern	40 % - 48% penetration
Heavy Contact	Yellow & Orange within the Blue Center	48% - 60% penetration

*T-Scan (1987)*

A computerized system (T-Scan System, Tekscan, Inc., Boston, Mass.) is used for analyzing occlusion. The device enables the dentist to interpret occlusal contact information quantitatively, using time as the primary diagnostic variable.<sup>11</sup> It is composed of a sensor, handle and cable, system unit, and software. This Microsoft compliant system can record a given contact sequence in 0.01-s increments.<sup>12</sup> The T-Scan instrument was designed to examine and record occlusal contacts by computer analysis of information from a pressure sensitive film. The T-Scan system is purported by the manufacturer to digitally record both the location and timing of tooth contacts. The tooth contact information is presented by demonstrating 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.<sup>13</sup> The advantage of this instrument over silk marking ribbon is that it not only records contacts but also analyze the timing and force of each contact. In addition, the T-scan may yield potential clinical value in diagnosis and the monitoring of occlusal diseases.<sup>14</sup> The T-Scan showed that the variability between subjects is significantly greater than variability within subjects which shows the reliability of the values

obtained by the T-scan being able to differentiate between individuals.<sup>15</sup>

*Virtual Dental Patient (2002)*

Virtual technologies in dentistry is used to provide better education and training by simulating complex contexts and enhancing procedures that are traditionally limited, such as work with mechanical articulator.<sup>16</sup> This is a recently introduced concept wherein the three-dimensional dental patient is assembled from the data scanned from the casts of a patient’s dentition. This provides quantitative information that would aid in the assessment of his chewing function and in identifying the occlusal interferences.<sup>12</sup> Valid occlusal contacts can be calculated from aligned virtual casts. The preferred method of calculating contacts uses virtual casts aligned with virtual interocclusal records.<sup>17</sup>

*Transparent Acetate Sheet*

Davies et al. (2005) described a clinical method termed the occlusal sketch technique as a means of recording occlusal contacts. The occlusal sketch consisted of a transparent acetate sheet with outline representation of the occlusal aspects of the teeth. The use of acetate in this manner facilitated viewing of the marked occlusal contacts from both sides. The static and dynamic occlusal contacts were marked. To define locations of occlusal contacts, the contact anatomic regions were traced onto each occlusal sketch after completing the occlusal record for each subject. The occlusal sketches were overlaid by a 1-mm<sup>2</sup> 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 appears to be a simple way of recording the occlusion of patients and, subsequently, incorporating these into the dental records. Furthermore, this technique was quick, inexpensive, and easy to perform.<sup>13</sup>

*High Spot Indicator*

It is a contact color (Bausch Arti-Spot Highspot-Indicator) for testing the accurate fit of crowns, inlays, onlays, telescoping crowns and clasps. It can be applied with a brush. The solvent evaporates in seconds, leaving a thin film of 3µ thick. Every contact destroys the color skin exactly at the point of contact.<sup>12</sup> The base material then shines clearly through and high spots can be easily detected. It can also be used to test high spots on highly polished occlusal surfaces such as gold or ceramic. The food dye contained in the solvent is completely safe and can easily be removed after use with hot water or alcohol.

*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 bridge or crown.<sup>18</sup> When testing occlusion or trial seating the bridge or crown, all contact points will be immediately visible. It can be used for proximal contacts when trial seating crowns and bridges.

**OTHER OCCLUSAL INDICATORS** <sup>7,1,2,4</sup>

INDICATORS	THICKNESS	PLASTIC DEFORMATION	SENSITIVITY	CONTACT NO. (Wet/Dry)	SEMG ACTIVITY
Articulating Paper	19-200 micrometer	Inflexible / Brittle , Compresses & Fragments	Reduced with increased strokes, lower than foils	Ruined by saliva	Signifiacntly alter SEMG activity with increased thickness
Silk	60-80 micrometer	Highly Tear Resistant	Reduced with increased strokes	Marking is highly precise, Ruined by saliva, Marking ability is reduced when stain components are dried.	Does not affect SEMG activity
Film	8 Microns	Below Patient Perception	Reduced with increased strokes	Affected by wet/ dry condition	Does not affect SEMG activity
Foil	Thinnest Indicator Material		Highest	Accurate than paper & silk, Affected by wet / dry condition	
T-Scan	< 60 micrometer	Deforms Elastically	Reduced when used more than once	Not Affected by wet/ dry condition	Significantly affect SEMG activity

**Conclusion**

Occlusal indicators are classified as qualitative and quantitative indicators. Qualitative indicators include articulating paper, film, silk, high spot indicator, wax, foil, metallic shimstock film. Quantitative indicators include T-Scan, virtual dental patient. Qualitative indicators determine the location and number of tooth contacts whereas quantitative indicators determine the time and force characteristics of tooth contacts.<sup>12</sup> Different occlusal registration materials have been used since years for recording the occlusal contacts. Many new techniques have also been introduced. The selection and application of these techniques is situation based. Proper skill with which efficient result will be attained is what will make a difference rather than *chasing the blue marks*. Implants do not move on occlusal contact.<sup>19</sup> Recording occlusal contact of implants and vital teeth may require the use of a nonresistant indicator such as a thin articulating film.<sup>2</sup> The occlusal indicator should have some amount of plastic deformation before it tears, shreds away or before any deformation occurs. When used more than once, the articulating papers, foils, silk strips, and T-Scan system tested as occlusal indicators were associated with different rates of decrease in contact numbers. The success of the T-Scan system was negatively affected by repeated use of the sensors. Occlusal records obtained in wet and dry environments were significantly different. Every material has its own limitations in some-way, be it age-old materials like wax or impression materials or the latest technology of

T-Scan. The choice to use any one out of the above mentioned materials depends upon the clinical situation, clinician’s choice and expertise, economics and comfort.<sup>18</sup>

**References**

1. Saracoglu A, Ozpinar B. In vivo and in vitro evaluation of occlusal indicator sensitivity. J Prosthet Dent 2002;88(5):522-6.
2. Halperin GC, Halperin AR, Norling BK. Thickness, strength, and plastic deformation of occlusal registration strips. J Prosthet Dent. 1982;48(5):575-8.
3. Brill N, Schubeler S, Tryde G. Aspects of occlusal sense in natural and artificial teeth; J Prosthet Dent. 1962;12(1):123-128
4. Forrester SE, Presswood RG, Toy AC, Pain MT. Occlusal measurement method can affect SEMG activity during occlusion. J Oral Rehabil 2011;38(9):655-660.
5. Gronas DG. A carborundum stripping technique for the occlusal adjustment of cusplless teeth. J Prosthet Dent 1970;23(2):218-226
6. Millstein PL, Clark RE, Kronman JH. Determination of the accuracy of wax interocclusal registration Part II. J Prosthet Dent 1973;29(1):40-45.
7. Millstein P, Maya A. An evaluation of occlusal contact marking indicators- A descriptive quantitative method J Am Dent Assoc 2001;132(9):1280-1286.

8. Ehrlich J, Taicher S. Intercuspal contacts of the natural dentition in centric occlusion. *J Prosthet Dent.* 1981;45(4):419-21.
9. Dawson PE, Arcan M. Attaining harmonic occlusion through visualized strain analysis. *J Prosthet Dent* 1981;46(6):615-22.
10. Gazit E, Fitzig S, Lieberman MA. Reproducibility of occlusal marking techniques; *J Prosthet Dent.* 1986; 55(4):505-509.
11. Maness WL, Benjamin M, Podoloff R, Bobick A, Golden RF. Computerised occlusal analysis: A new technology. *Quintessence Int* 1987;18(4):287-292.
12. Babu RR, Nayar SV; Occlusion indicators: A review: *J Ind Prosthodont Soc* 2007;7(4):170-174.
13. 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;94(5):458-461.
14. Reza Moini M, Neff PA. Reproducibility of occlusal contacts utilizing a computerized instrument. *Quintessence Int.* 1991;22(5):357-360
15. Garrido Garcia VC, Garcia Cartagena A, Gonzalez Sequeros O. Evaluation of occlusal contacts in maximum intercuspation using the T-scan system; *J Oral Rehabil* 1997;24(12):899-903.
16. Gugwad RS, Basavakumar M, Abhijeet K, Arvind M, Sudhindra M, Ramesh C. Virtual Articulators in Prosthodontics: *Int J Dent Clin* 2011;3(4):39-41.
17. Delong R, Ko CC, Anderson GC, Hodges JS, Douglas WH. Comparing maximum intercuspal contacts of virtual dental patients and mounted dental casts. *J Prosthet Dent* 2002;88(6):622-30.
18. 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;5(1):e48-e53
19. Pesun IJ. Intrusion of teeth in the combination implant-to-natural tooth fixed partial denture; a review of the theories. *J Prosthodont* 1997;6(4):268-77.

### Corresponding Author

Dr. Shayan Nazir Mir,  
 Post Graduate Student  
 School of Dental Sciences,  
 Sharda University, Plot No. 32, 34, Knowledge Park-III,  
 Greater Noida, U.P.-201306  
 E-mail id: shayannazirmir@gmail.com