



OCCLUSAL INDICATORS – A REVIEW OF QUALITATIVE AND QUANTITATIVE METHODS

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Abstract

To establish a diagnosis of occlusal pathology, it is essential to have objective knowledge of the patients' mandibular dynamics and to develop a method that enables the dentist to analyze. Having established the importance of balanced and harmonious occlusion, it is important for dentists to perform routine analysis of dental occlusion and check contact between the maxillary and mandibular arches. It is important to understand the patterns of tooth contact, properties of materials, and methods used to record these tooth contacts for an accurate examination of occlusion in prosthodontic treatment. The various occlusal indicators analyze these occlusal interactions and facilitate the making of beneficial occlusal adjustments during dental procedures. Both qualitative and quantitative methods are used for the evaluation of occlusal relationships. Therefore a thorough knowledge of the different occlusion indicators available in dentistry, their usage, interpretation of their markings, and their limitations is very important.

Index Terms- occlusal contact, occlusal interference, occlusal equilibrium, T Scan

Introduction

Occlusion is defined as "the static relationship between the incising or masticating surfaces of the maxillary or mandibular teeth or tooth analogues".^{1,2} For ideal occlusion, it is required to observe the simultaneous, bilateral, and homogeneous contact between the maxillary and mandibular teeth without any interferences or premature contact.³ Understanding the patterns of teeth static and dynamic contact is required to achieve an accurate examination of occlusion in prosthodontic and restorative treatment and further to avoid occlusal discrepancy.^{4,5} The presence of occlusal discrepancy may not be readily apparent when clinically examining; therefore, further occlusal analysis is required. Occlusal indicators play an important role in finding out occlusal problems.⁶ Those areas that range from a contact to a gap of 0.5 mm between the occluding surfaces are recognized as near contacts; whereas, non-contacts are those areas with 0.5-2 mm space between the teeth.⁷

Premature occlusal contacts in prostheses or dental restorations may lead to devastating alterations in the craniomandibular system. Articulating papers were traditionally used to identify any occlusal interferences. Occlusal indicators are made from paper, wafers, ribbon, foils, silks, silicon, irreversible hydrocolloid material, sprays, and indicating waxes etc. Recently computer analyzing systems have been used.

Diagnosing occlusal discrepancies play a vital role in the planning and following the delivery of predictable functional and aesthetic restorations.⁶ In addition, to maintain the dental, periodontal, articular, and muscular health, it is essential to detect adequate static and functional dynamic occlusion.⁸

Review

The occlusion indicators could be classified into qualitative and quantitative indicators. The principal difference being that the quantitative indicators are capable of measuring the tooth contact events. These indicators are considered as the most commonly occlusal registration materials as a result of their relatively lower initial cost and their application simplicity.^{9, 10}

Articulating papers

Articulating papers are used to detect high spots, the width, and thickness and dye type of the articulating paper so it leaves a mark of either a point or a surface. [Figure 1] The color coating of many articulating papers consists of waxes, oils and pigments, a hydrophobic mixture which repels saliva. High spots can be detected easily as dark marks and contacts as light marks. Articulating paper come in strips and horse shoe shaped sheets (Bausch articulating paper Inc., Nashua, NH, USA). When grinding selectively it should be noted that only dark colored spots should be ground. The major disadvantages of articulating papers have been that they can be easily ruined by saliva, are thick, and they have a relatively inflexible base material; all of these factors result in a greater number of pseudo contact markings.^{11, 12} Few manufacturers have produced articulating films with an additional emulsifier (Bausch articulating paper Inc., Nashua, NH, USA) which gives these films certain bonding properties on moist occlusal surfaces. They have added special bonding agent- transculase (Bausch articulating paper Inc, Nashua, NH, USA), or wetting agents like lecithin to articulating paper coating.¹¹ The first test is made with blue articulating paper (200u). Spots are immediately evident. The bonding agent, transculase, is also transferred as a fine coating. The next step is to take a thin film (preferably red, 8u) because of its intensity and contrast with blue.



Figure 1 Articulating paper

Silk Strips

Some researchers have stated that silk strips are the best material for indicating occlusal contacts. Articulating silk is made from high quality natural silk (Bausch articulating silk, 80 microns, Bausch articulating paper Inc, Nashua, NH, USA). Natural silk consists of so-called fibrils, a tube-shaped protein structure which, because of its composition, has an extremely high color reservoir capacity. This silk is highly tear-resistant and, because of its low thickness and good flexibility, adapts perfectly to cusps and fossae. The marking of silk is extremely precise. Because of their texture, soft indicator materials do not produce pseudo contact markings. However, silk strips can lose their marking abilities when their stain components are dried, and they also can be ruined by saliva.¹³

Foils

These are the thinnest indicator materials. They give more accurate readings than paper and silk. However, under reduced pressure and on glossy surfaces, their marking capacity is less evident. This means that greater pressure must be applied for the clinical use of foils.¹³

Articulating film

The Artifol articulating film (Bausch Inc.) has only a thickness of 8 μ , which is much less than the thickness perception level of the patient. [Figure2] It is made up of an emulsion with a thickness of 6 μ , which is hydrophobic and contained inside a polyester film. It must be used with special holders in a dry environment. It is universally applicable, both intraorally and on lab models.⁹



Figure 2 Articulatting film

High Spot Indicator

It is a liquid contact color (Arti-spot, Bausch articulating paper Inc, Nashua, NH, USA) which is applied to the test surface with a brush. [Figure3] The solvent evaporates in seconds, leaving a thin film (3u thick). Every contact destroys skin color exactly at the point of contact. The base material then shines through and high spots can easily be detected. It can also be used to test for high spots on highly polished occlusal surfaces such as gold or ceramic. The food dye contained in the solvent is completely safe. The layer can easily be removed after use with hot water or alcohol.⁹



Figure 3 High Spot Indicator

Metallic Shim Stock Film/Mylar Paper Strip

The shim stock film is color-coded on one side and has a metallic surface on the other side. It is generally indicated for the occlusal splint therapy in the laboratory for the accurate identification of the contacts on both soft and hard splints.⁹ Metallic polyester shim stock-film contains colour coating and metallic 12-micron thick film. It has been recognized as a technique, which produces more accurate and reliable results as compared to the conventional shim stock films and articulating paper.¹⁴

Occlusal Sprays

These are universal color indicator to test occlusal contacts. They are easy to administer (Arti-Spray, Bausch articulating paper Inc, Nashua, NH, USA) and leaves a thin colored film which can easily be removed with water, leaving no trace of residues. They are applied at a distance of 3-5 cm onto the occlusal surface. When testing occlusion all contact points will be immediately visible. These are available in colors: red, blue, green and white.¹³

Quantitative occlusal analysis techniques have been developed to overcome the limitations of qualitative assessment, such as subjective interpretation. Occlusion Sonography, T-Scan system & photoocclusion are the most commonly known quantitative systems.

Occlusion Sonography

“Dental Sound Checker” was produced in Japan in the mid-1980s by Watt. Its production took place to evaluate occlusal contact sound patterns during closure to detect the possible occlusal disturbance.¹⁵ Kifune et al.¹⁶ calculated the duration of the occlusal sound in a subject before and after occlusal adjustment. A large amplitude, the long sound would be made by a forceful slow closure, and a soft rapid closure would make short low amplitude sound. Therefore, recorded documents of occlusal sound were of limited value unless the patients were trained to close their teeth with constant force and speed.

T-Scan

T-scan is one of the newest and developing systems for quantitative occlusal analysis, which was introduced by Maness.^{17,18} [figure 4] Later, in the mid-1980s, Tekscan developed T-Scan®, which was the first-ever grid-based sensor technology, particularly designed for occlusal analysis.^{19,20} Furthermore, it can quantify any occlusal surface engagement. This analysis can be played back or forth by 0.01s or if in turbo mode by 0.03s increments, which can never be visualized by our eyes or any other method, which is currently available.^{21,22} The T-Scan computerized system can effectively locate the premature contacts, high contact points, areas of excessive occlusal load, and non-uniform load concentration.^{9,18} T-Scan’s recording sensor consistently reproduces 256 levels of varying occlusal force, so it can provide the accurate precision of force and time required

for diagnostic along with the controls which must be established during treatment.²³ It also analyses the collected data, with the amount of load and time contact relationships, which is displayed by colour contour images. The T-SCAN III system has been considered to be a very precise system to assess and analyze both the dental occlusion and articulation.^{24, 25}

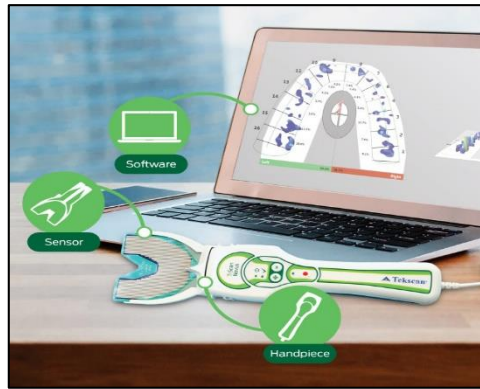


Figure 4 T -Scan System

Photo-Occlusion

In a photo occlusion system, a thin photoplastic film layer is placed on the occlusal surface of the teeth; patient then is asked to occlude on the film layer for 10 to 20 seconds. The film layer is removed from the mouth and inspected under a polariscopic light.¹³ this technique is reported to be “difficult to apply”. Light contact is seen as yellow, orange or red colour and shows 40% of light penetration. In medium contact the colour patterns are blue centered within the light coloured pattern and the percentage of penetration is 40-48%. In heavy contact the color pattern is yellow and orange within the blue center and the percentage of penetration is 48 to 60%.²⁶

Conclusion

Every material has its own limitations in some way. Compared to conventional occlusal indicators, the T-Scan system clearly has more clinical utility in diagnosing and treating cases of temporomandibular disorders when caused due to occlusal disturbances. The choice to use any of the above mentioned materials depends upon the clinical situation, availability, clinician’s choice, expertise, economics and comfort.

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