

Occlusion indicators: A review

Ramakrishna Rajan Babu, Sanjna Vibhu Nayar

Department of Prosthodontics, Meenakshiammal Dental College, Chennai, Tamil Nadu, India

For correspondence

Dr. Sanjna Nayar, A-3/12 SAF Games Village, Koyambedu, Chennai, Tamil Nadu, India. E-mail: sanjna101@yahoo.com

Any prosthesis replacing missing teeth aims towards establishing an occlusal contact that is harmonious with the position of the condyles and the musculature of the mandible. A premature occlusal contact may disrupt this harmony that may lead to conditions such as trauma from occlusion, periodontal disease, bruxism and temporomandibular joint dysfunction. In order to locate these interferences and to refine the occlusal contacts, indicators such as waxes, articulating papers, foil, film, silk strips and newer materials such as the T-Scan and virtual dental patient are available. Their sensitivity, marking ability and method of usage vary based on their characteristics, oral environment and the interpretation of the clinicians regarding the markings. Hence, 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.

Key words: Occlusal interference, qualitative indicators, quantitative indicators, T-Scan

INTRODUCTION

Occlusal contacts occur when the maxillary and the mandibular dentition touch each other.^[1] Near contacts are those areas that range from a contact to a gap of 0.5 mm between the occluding surfaces, while noncontacts are those areas wherein there is a 0.5-2 mm separation of the teeth.^[2]

An "occlusal interference" is any tooth contact that inhibits the remaining occluding surfaces from achieving stable and harmonious contacts.^[3] Any occlusal interference as small as 15 μ can trigger an untoward response and hence must be eliminated. Occlusal interferences can induce tooth pain or mobility, although data does not indicate that they are the cause of chronic jaw dysfunction problems.^[4,5]

The true occlusal contact time simultaneity by definition implies that a time of 0 s elapses between the first and the last occlusal contact,^[6] i.e., all the occluding surfaces should meet at the same instant during the mandibular closure. Occlusal therapy aims at achieving this simultaneous occlusal contact relationship.

The selection of the appropriate occlusal indicator for this purpose enables the dentist to work with precision and provides valuable information on occlusion for its refinement. Clinically, this is significant since the markings of most commonly used occlusion indicators are thought to be accurate by many practitioners, although they lack the qualitative ability. Studies have shown that when the qualitative indicators are used, the sequence of occlusal contacts cannot be determined and hence a false marking may be

perceived by the dentist as an occlusal interference. Hence, many a time, restorations are placed in infra-occlusion predilected by the pseudo contacts that were registered using these indicators.

OCCLUSION INDICATORS - TYPES

The occlusion indicators can be broadly divided as qualitative and quantitative indicators, the principal difference being that the quantitative indicators are capable of measuring the tooth contact events.

Qualitative indicators

- Articulating paper
- Articulating silk
- Articulating film
- Metallic shim stock film
- High spot indicator

Quantitative indicators

- T-Scan occlusal analysis system
- Virtual dental patient

QUALITATIVE INDICATORS

Qualitative indicators are the most commonly used materials for registering the occlusion owing to their lower cost and their ease of application.

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With these materials, only the localization of the occlusal contact points is possible. The disadvantage is that the sequence or the density of the occlusal contacts cannot be determined, although an opinion can be derived from the density of the contacts according to the darkness of the marks. Further, these materials lack the quantitative time and force descriptive capacity and are incapable of measuring tooth contact events.

Articulating paper: Articulating papers are the most frequently used qualitative indicators to locate the occlusal contacts intraorally. They differ in terms of width, thickness and the type of the dye impregnated. They are hydrophobic in nature. Their basic constituents are a coloring agent and a bonding agent (e.g., Transculase-Bausch Articulating paper) between the two layers of the film. On occlusal contact, the coloring agent is expelled from the film and the bonding agent binds it on to the tooth surface. The characteristic marking is observed as a central area that is devoid of the colorant and surrounded by a peripheral rim of the dye. This region is called "target" or "iris" owing to their appearance, and it denotes the exact contact point. The density of these markings does not denote the force of the contact; instead, heavier contact tends to spread the mark peripheral to the actual location of the occlusal contact. Only the central portion in heavy contact areas indicates the interference requiring correction.

In practice, there is a tendency to use cost-effective materials such as carbon papers. These are made up of hydrophobic waxes that tend to smudge the tooth surface and fail to mark the contact spots clearly. Articulating papers, despite being the most commonly used occlusion indicators, have the following inadequacies. They are easily ruined by saliva and hence require usage in a dry field. Their thickness of 40 μ is well above the thickness perception level of the patient and their relatively inflexible base material leads to the formation of a large number of pseudocontact markings.

Articulating silk: It is made up of a micronized color pigment, embedded in a wax-oil emulsion. Since it has a soft texture, pseudomarkings are not produced during the use and it is effective when used intraorally. However, it loses its marking ability when stain components are dried and can be ruined by saliva. Hence, its storage in a cool, closed environment is essential. 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 as ten times.

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. 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.

Metallic shim stock film: The shim stock film has a metallic surface on one side and the other side is colour coded. 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.

High spot indicator: This is supplied in the liquid form and is indicated for use in the laboratory to check the proximal contacts of crowns, inlays, onlays, telescopic crowns and clasps. The liquid is applied with a brush on the proximal surface of the coping and it forms a film with a thickness of 3 μ . The dye is then seated in the cast, and on removal, the proximal contact area is delineated as an area of show through in the base material of the crown.

The two-phase occlusion indicator method: In this method, the sequential use of the articulating paper and the articulating film highlights the actual interference areas accurately and clearly. The articulating paper is initially used to mark the contacts represented as a clear central region surrounded by a peripheral rim of the dye. In the next step, the articulating foil of a contrasting colour is used to mark the contact spots in the center of the contact areas highlighted by the articulating paper markings previously. It is the central areas marked by the articulating foil that are the actual interferences and are to be eliminated.

SELECTION OF THE QUALITATIVE INDICATORS

The parameters to be considered in selecting these qualitative indicators are below the thickness perception level of most patients.^[7] This will enable the verification of centric occlusion mounting on a hinge articulator, the occlusal accuracy of wax-ups and the occlusal



Figure 1: Tekscan recording handle with sensor placed intraorally

contact of newly restored teeth and establish the contact of unrestored teeth.^[8] It also serves to locate the working and balancing interferences.

- Thickness - The disadvantage of a thick occlusal registration strip, i.e., the one that the patient can perceive between the teeth is that it can indicate the tooth contact between the opposing teeth, even when no contact exists when the thickness of the registration strip is greater than the space between the teeth.^[9] Moreover, excessive thickness can induce a proprioceptive response that in turn can cause the jaw to be deflected.
- Plastic deformation - Occlusal registration strips that have plastic deformation will stretch before they tear, thereby enabling the dentist to tug at the strip and to evaluate the occlusal contact.^[10]
- Tensile strength - Thinner strips would tear before they served their purpose, but those having the property of plastic deformation will stretch prior to tearing.
- Marking ability - On occlusal contact, the coloring agent should bond to the tooth. The occlusal registration strip should be thin, plastic and non-smearing on the tooth surface. Articulating foils have the greatest marking sensitivity values, followed by the articulating paper. It has been found that the marking ability of all qualitative recording media is negatively affected by the presence of saliva, and hence, the teeth should be dried prior to the use of the registration strips.

QUANTITATIVE INDICATORS

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 recording, analyzing and viewing the data. The T-Scan identifies the time magnitude and the distribution of the occlusal contacts.

This device is indicated in any situation where the bilateral simultaneous occlusal contact is necessary.

- Complete dentures
- Fixed or removable partial dentures
- Complete arch reconstruction solely using implants
- Complete arch reconstruction involving FPD
- Natural tooth occlusal equilibration
- Disclusion time reduction
- Occlusal splints
- Mandibular repositioning devices.

Recording technique - The recording handle with the sensor and arch support is placed between the maxillary central incisors of the patient [Figure 1]. The recording is initiated by pressing the button on the recording handle. The patient is asked to close the mouth till complete intercuspation is reached, without making any excursive movements.

Data interpretation - The data recorded is shown as a force movie [Figures 2 and 3] in which the center

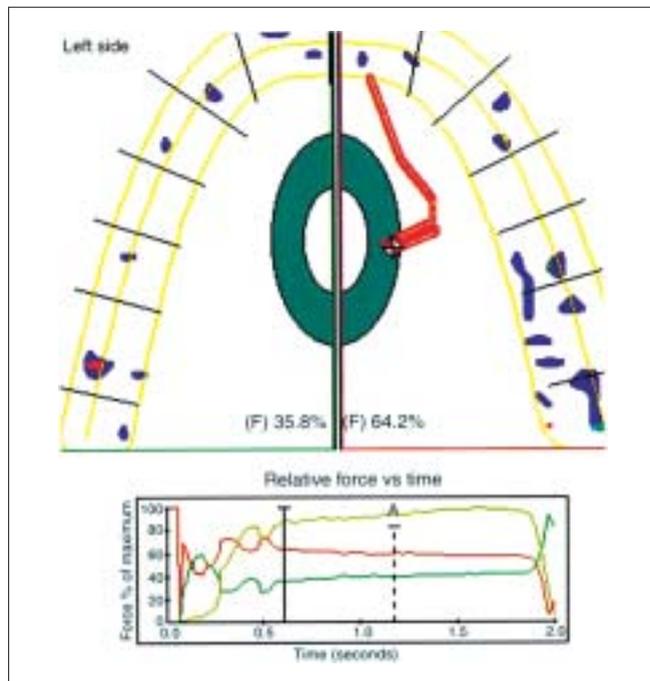


Figure 2: Data recorded shown as force movie with centre of force trajectory

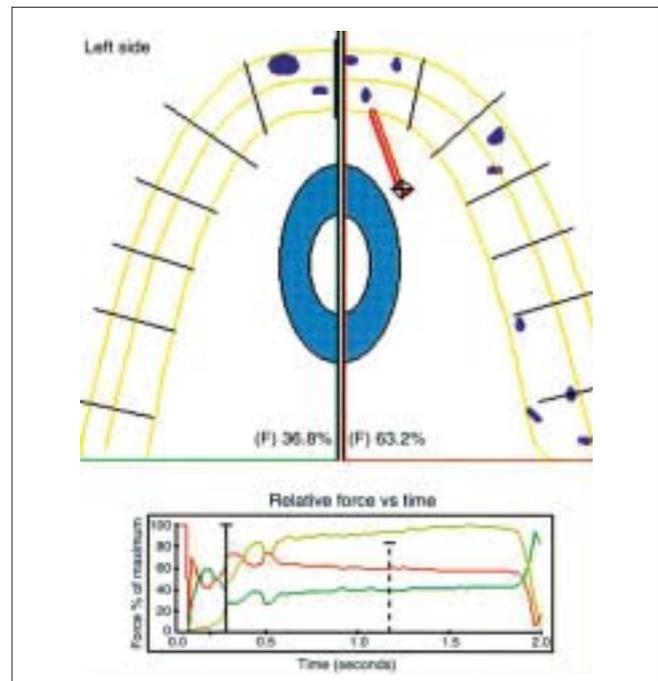


Figure 3: Force movie initially shows a right-sided contact

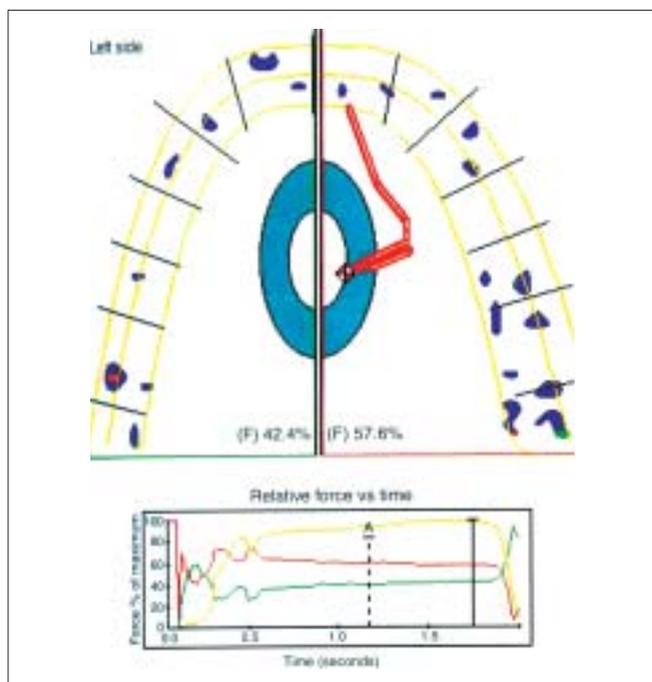


Figure 4: Leftward movement of the trajectory due to contact of tooth 26 at 0.469 s. At 0.699 s, the left side completes the contact, which is 0.311 s after the right side completes the contact. Since the force trajectory shows that there is a right-sided premature contact, significant occlusal correction is required on the right side

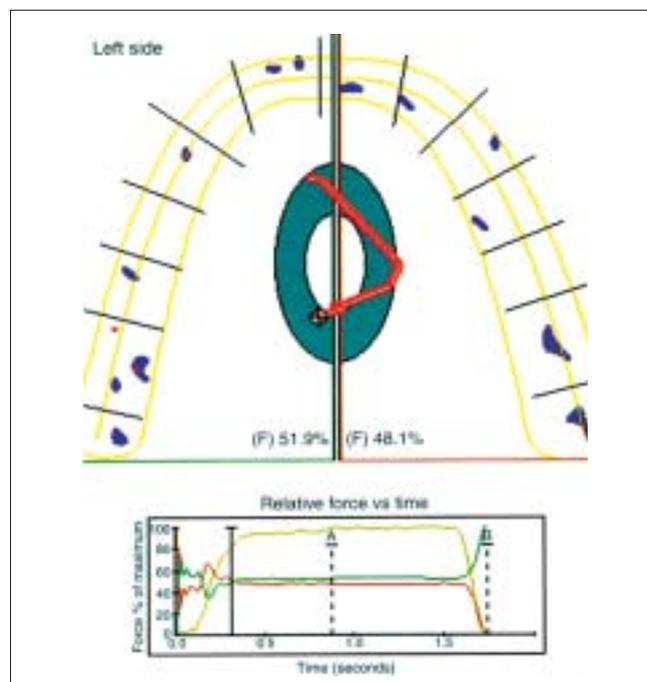


Figure 5: Occlusal correction is performed with articulating paper labeling using the T-Scan data as a reference for the sequence of the contacts. Force trajectory after two correction sequences shows a more uniform contact

of force trajectory shows the history of the path of the center of the force from the beginning of the force movie recording to the current displayed frame. The trajectory movement indicates where the force summation is directed when more of the teeth of the patient sequentially come into contact [Figure 4]. Thus, by gaining information on the earliest occlusal contact, it can be adjusted and simultaneous occlusal contact can be established [Figures 5 and 6]. The outcome of this occlusal therapy is that the patient can feel a more widespread contact sensation at the end, the reason being that the establishment of true and measurable bilateral simultaneous occlusal contacts is achievable using the T-Scan.^[8]

Virtual dental patient

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. Further, the sequential comparison of these occlusal contacts enables the dentist to identify the changes in the patient's occlusion as time elapses.^[10]

CONCLUSION

The various occlusal registration indicators available

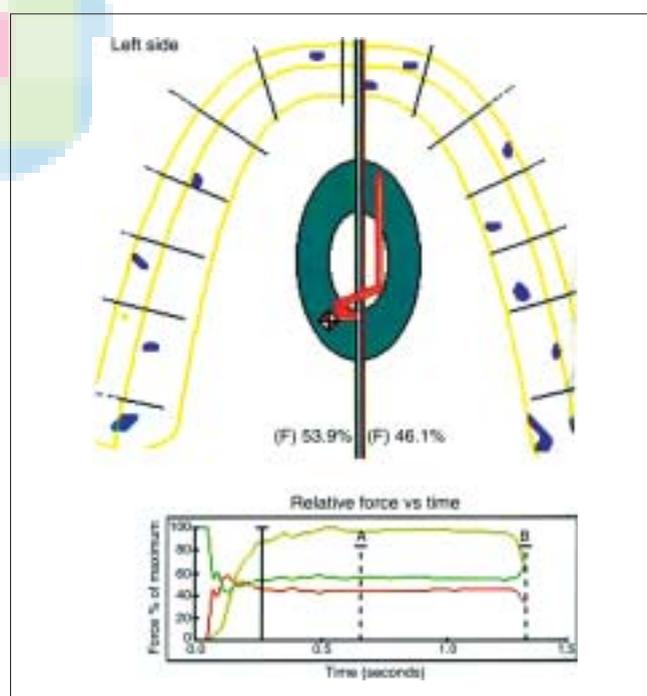


Figure 6: Nearly balanced occlusion is established after four correction sequences

have been discussed. Their characteristics and sensitivity delineate their usage in different situations.

1. Qualitative recording materials can establish the

location and number of contacts. These materials are primarily preferred because of their low cost and ease of application.

2. The marking ability of all qualitative recording media is negatively affected by the presence of saliva; hence, it is recommended that they be used only once when used intraorally and that the teeth be dried prior to testing.
3. The T-Scan system identifies the time and force characteristics of occlusal contacts, and hence, establishing true and measurable bilateral simultaneous occlusal contacts is a clinically attainable reality by using this system.

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