Clinical Occlusal References in Prosthetic Procedures

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INTRODUCTION

Too often prosthetic procedures refer to theories and technics. However theories and technics are only means to reach the purposes and not ends by themselves. The functioning mouth is and must remain the only reference. "Nature to be commanded must be obeyed" (F. Bacon). Applying a prosthetic philosophy does not lead necessarily to success. Each patient needs his own personal solution. Precise observation of the functioning stomatognathic apparatus teaches us more than theories, although theories can point out what should be observed.

What kind of references the practitioner should look for?

First it must be determined that the relative position of the mandible to the cranium does not show any pathologic symptoms.

Second, the relationship between the maxillary and the mandibular arches should be considered under the two following aspects:

STATIC RELATIONSHIP

This relationship, commonly called intercuspidation which would be better named occlusion*, is used during mastication and deglutition.

During chewing, the mean duration of interarch contact is about 194 milliseconds.1 Swallowing supposes the mandibular arch to be fastened to the maxillary arch to serve as a fixed part to allow for contraction of the hyoidian and pharyngian muscles. The mean duration of the interarch contact is about 694 milliseconds,1 that is 3.5 times the duration of the same contacts during chewing. It must be also kept in mind that swallowing occurs from 1500 to 2000 times per 24 hours, twice more time during the awake period.

* occlusion: from ob + claudere to shut, close (Webster's Third New International Dictionary, 1966).
than during sleep. The importance of occlusal relationship during
deglutition cannot be denied.

1) Locks of occlusion
There are two kinds of lock of occlusion*: the maxillo-mandibular
and the mandibulo-maxillary locks.2

(1) Maxillo-mandibular locks of occlusion are developed by the
relationship of the mesio-lingual cusps of the upper molars with
the opposite central fossae of the lower molars (Fig. 1).

(2) Mandibulo-maxillary locks of occlusion are developed by the
relationship of the disto-buccal cusps of the lower molars with the
central fossae of the upper molars (Fig. 2).

These relationships are for us the real cusp-to-fossa relationship.
The more the pairs of maxillo-mandibular and mandibulo-maxillary
locks of occlusion exist, the more stable the interarch relationship is.

2) Starting from this point, all the other centric cusps can have
two different kinds of relationship.
(1) Cusp-to-triangular fossae. On the upper arch, the disto-lingual
cusps of the molars and the lingual cusps of the premolars are, in
the reference position, contacting with the distal triangular fossae
of the lower opposite teeth (Fig. 3).

On the lower arch, the mesio-buccal cusps of the molars and the
buccal cusps of the premolar contact the mesial triangular fossae

* the term "lock" is probably excessive, but it has not be found a better one.
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Fig. 3. Except the mesio-lingual cusps of the upper molars, all the maxillary lingual cusps are in a cusp to triangular fossae relationship.

Fig. 4. Except the disto-buccal cusps of the lower molars, all the mandibular buccal cusps are in a cusp to triangular fossae relationship.

Fig. 5. Except the mesio-lingual cusps of the upper molars, all the maxillary lingual cusps are in a cusp to embrasure relationship.

Fig. 6. Except the disto-buccal cusps of the lower molars, all the mandibular buccal cusps are in a cusp to embrasure relationship.

of the upper opposite teeth (Fig. 4). This type of relationship is less than 15% of natural dentitions. It is a one to one tooth relationship.3,4

(2) Cusp-to-embasure relationship. The cusps that are not involved in the locks of occlusion are contacting the peripheral ridges of the two opposite marginal ridges (Fig. 5, 6). It is a one to two teeth relationship and represents about 85% of natural cases.5,6

Very often, this type of relationship has been condemned because of the risk of food impaction into the gingival embrasure (Fig. 7). But why is it that this type of relationship works in 85% of the natural cases without food impactions? It seems that all the
Fig. 7. Classical representation of food impaction in a cusp to embrasure relationship.

Fig. 8. According to M. de Stefanis’ slide. Stress is transmitted through the concerned tooth, first directly to the supporting tissues, second, through the proximal contact zone to the immediate adjacent tooth. Into those last dental units, stress is again divided and transmitted to the supporting tissues and to the next adjacent tooth.

Fig. 9A. Stress is well transmitted along the long axis of the mesial part of the tooth in a cusp to triangular fossa relationship.

Fig. 9B. In a cusp to embrasure relationship, stress transmission needs adjacent teeth to support the concerned dental units.
pictures explaining the inpropriety of such a relationship are incorrect. In fact, teeth work together. Each dental arch is a functional unit. When a tooth has to support a stress from food or occlusion, the adjacent teeth help by the acceptance of a part of the stress through the proximal contact zones (M. de Stefanis) (Fig. 8).7

Therefore, food impactions are the result of a wrong contour of the anatomy of the structures that surround the embrasures.

It appears that the reestablishment of a cusp-to-triangular fossa relationship, without any anatomical distortion (dysmorphia) allows for a better transmission of the stresses along the coronoradicular axis of the teeth and should, each time this is possible, improved (Fig. 9).

(3) Charles Stuart described the clinical situations where the relationship was a mixture combining cusp to triangular fossae and cusp-to-embrasure-relationships (Fig. 10).8 This relationship is acceptable if the locks of occlusion keep the stability of the intercuspatation and if the unity of each dental arch is maintained by the continuity of the interproximal contact zones.

THE KINEMATIC RELATIONSHIPS

The cycle of mastication begins with a vertical downward motion of the mandible. Then the mandible is directed laterally to the food and then comes back into intercuspatation. Interarch relationship is involved only in the last millimeters of the cycle (Fig. 11). The clinical mandibular movements on the patient as well as the tests with the articulator mounted models, are normally observed from centric occlusion to excentric positions. That is ex-
actly the reverse of the functional situation. The functional and tested mandibular movements on the articulator are supposed to be superimposable.⁹

1) The importance of neurologic controls
The mandibular motion is developed by muscular contractions that guide the mandible and the teeth. All of these movements are performed under the control of the central nervous system. Information is sent to the centers by proprioceptors of the T.M.J. and the oral mucosa. They transmit messages concerning the spatial mandibular position relative to the cranium as long as teeth are not contacting. During the terminal movement of the masticatory cycle, when the first contact occurs between two or more opposing teeth, periodontal proprioceptors inform and, for the principal part, control actively the closing mandibular mechanism through the regulation of muscular contraction. If it is kept in mind that interdental discrimination of thickness by periodontal proprioception decreases in value from the central incisor to the last posterior molar⁹,¹¹, it can be seen how important the so-called “anterior guidance” is in guiding the terminal mandibular movement into intercuspatation. In this aspect, the sensory capacity of the teeth can be considered as a protective pattern.¹²

2) When the closing mandibular movement is conducted by the incisors without any participation of the other teeth (incision), the kinematic relationship can be called anterior protection (Fig. 12). This occurs during function. In clinical procedures, it is tested in protrusion.

3) More often, the functional mandibular movement is a lateral protrusion. As pointed out by d’Amico¹³,¹⁴, the canine is the most important guide of this lateral guidance because of
In this situation of the sagittal static relationship between the canines, the registered marks occur on the lingual ridge of the upper canine and on the distal cusp ridge of the lower canine.

> its strategic position at the corner of the dental arch
> the particularly strong anatomy of its root and supporting alveolar bone
> its crown length which is the longest of all the teeth
> the high level of its proprioceptive capacity

In the lateral mandibular movement, the first contact between opposite teeth occurs normally on the lingual surface of the upper canine. The control of the occluding movement depends essentially on the quality of the gliding contact on this lingual surface. This assertion can be demonstrated by clinical observation. Patients who develop a unilateral mastication, chew only on the side where the lingual surface of the upper canine can easily be reached and used for the control of the occluding movement. In case of an important overjet or a cross bite at the level of the upper canine, mastication does function on the other side.

If no other tooth is associated with the canine, the functional kinematic relationship is called canine protection and the clinical tested motion is an immediate disclusion (Fig. 13). If an articulation recording device is placed between the teeth to register the gliding contacts, on the posterior teeth the centric position marks are the only registrations. On the canines, two types of registration depending on the relationship of the opposite canines in the sagittal plane can be found:

1. The gliding contact occurs between the lingual ridge of the upper canine and the distal cusp ridge of the lower canine (Fig. 14);

2. The gliding contact appears between the mesial ridge of the
Fig. 15. Here the registered marks occur on the mesial ridge of the lingual surface of the upper canine. On the lower canine, the mark follows the ridges of the cusp.

Fig. 16. Anterior group protection is the result of the association of incisors to the canine protection.

Fig. 17. Posterior group function is the result of the association of posterior buccal cusps to the canine protection. In this case, the kinematic relationship is a total posterior group function.

Fig. 18. The two maxillary bicusps are involved in gliding contacts in association with the canine protection: the kinematic relationship is a partial posterior group function.

Fig. 19. Depending on the static relationship of the canines in the sagittal plane, the posterior group function shows registration marks on the central ridges of the upper buccal cusps or . . .

Fig. 20. . . . On the mesial marginal ridges and on the mesial cusp ridges of the upper posterior teeth.
lingual surface of the upper canine and the distal cusp ridge of the lower canine (Fig. 15). In this last case, on the lower tooth a large surface is produced by the engagement of the contact point area during the occluding movement.

4) Sometimes, one or more incisors are associated with the canine protection (Fig. 16). This relationship is called anterior group function.

5) If during the terminal occluding movement, one or more posterior teeth are related by gliding contacts during canine function, the relationship is a posterior group function (Fig. 17).

(1) If all the posterior teeth are involved, it is a total posterior group function (Fig. 17).

(2) If only some posterior tooth or teeth are concerned, it is a partial posterior group function (Fig. 18). The same term applies to all the mediate disclusions: late or progressive disclusion.

(3) Again the registered contacts on the occlusal surfaces depend on the relative position of the mandibular arch to the maxillary arch in the sagittal plane.

(4) The contacts occur on the central ridges of the upper buccal cusps (Fig. 19) or

(5) On the distal ridges of the buccal cusps and then on the mesial marginal ridges of the upper teeth (Fig. 20). In this last case, the contact spots on the distal ridges of the lower buccal cusps are induced by the travel of the contact point areas during the closing motion (Fig. 20).

The gliding contact on the upper canine remains during all the period of intercuspation.

(6) Sometimes, if the contralateral mandibular condyle pathway is not very inclined, gliding contacts appear between the central ridges of the lower lingual cusps and the peripheral ridges of the upper lingual cusps. If the gliding contact on the lingual surface of the upper canine is never lost, this kind of kinematic relationship is acceptable, but it should not be created in a prosthetic procedure.

For a good function of the stomatognathic complex, the upper canine must be involved in the end of every lateral mandibular movement through a gliding contact on its lingual surface.

The lack of canine function can be accepted as an adaptative situation, but it predisposes for pathology and dysfunction. Every
Fig. 21. Prematurity on the first upper bicuspid prevents the upper canine from its proprioceptive function. Gingival recession at the level of the maxillary premolar is a clinical symptom of the impossible substitution of this tooth for a protective function.

Fig. 22. Many buccal cusps are involved in gliding contacts, but the canine cannot control the mandibular lateral movement. A pathologic symptom is the gingival recession bucal of the first upper bicuspid.

Time, when the canine is refrained from playing its proprioceptive role, it is necessary to determine the reason of this situation: prematurity (Fig. 21), malposition (Fig. 22), and so on.

Gliding contacts on the buccal cusps of the upper posterior teeth without any contact on the canine are pathologic because the first premolar is not able to be a substitute for the canine. This is because of its morphology, its weak supporting tissues and its low level proprioceptive capacities (Fig. 21, 22).

The clinical situation must be exactly evaluated in order to decide if the lingual surface of the upper canine must be modified by addition to obtain the functional relationship with the opposite tooth or if grinding the posterior teeth can recreate the same results.

Likewise, a lateral incisor cannot assume the canine proprioceptive and mechanical functions even if it is associated with the central incisor.

When canine is missing, the kinematic relationships are adaptative and compensatory. All the posterior teeth can be involved in a "faulty" posterior group function, but this represents the last resort.

All these kinematic relationships are commonly put together under the general term of "unilateral balanced occlusion" or better "unilaterally balanced kinematic relationship". It is generally agreed that lateral contacts between the teeth of the two arches occur only on one side: the ipsilateral or working side. On the
contralateral or idling side, there is no contact.

The last type of kinematic relationship supposes a posterior group function on the ipsilateral side (Fig. 23) while sliding contacts are developed on the contralateral side between the central ridges of lower lingual cusps and the central ridges of upper buccal cusps (Fig. 24). This type of relationship is commonly called "bilateral balanced occlusion" or better "bilateral balanced kinematic relationship". It is usually applied to full dentures.

**SUMMARY AND CONCLUSION**

For every prosthetic restoration, the clinical situation must be evaluated relative to classical references such as intrinsic value of the teeth, coronal height to radicular length ratio and periodontal status; the functional relationship of the teeth of both arches should be analyzed under their static and kinematic aspects.

A definition of the static relationship of the dental arches is given considering the importance of the locks of occlusion to obtain the necessary fastening of the mandible to the maxilla for swallowing.

The importance of the incisal and canine guidances is discussed, particularly concerning the aspect of disclosure. The proprioceptive capacities of the anterior teeth with the functional kinematic relationships of both dental arches should influence the final prosthetic decisions.
REFERENCES


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