

# Concepts of occlusion in prosthodontics: A literature review, part I

V. Rangarajan, B. Gajapathi, P. B. Yogesh, M. Mohamed Ibrahim, R. Ganesh Kumar, Prasanna Karthik

Department of Prosthodontics, Sri Venkateswara Dental College and Hospital, Thalambur, Chennai, Tamil Nadu, India

## Abstract

Occlusion and its relationship to the function of the stomatognathic system have been widely studied in dentistry since many decades. This series of articles describe about occlusion in the complete denture, fixed partial denture, and implants. Part I and II of this articles series describe concepts and philosophies of occlusion in complete denture. So far, available research has not concluded a superior tooth form or occlusal scheme to satisfy the requirements of completely edentulous patients with respect to comfort, mastication, phonetics, and esthetics. Since then, several balanced and nonbalanced articulation concepts were proposed in the literature. A balanced articulation appears to be most appropriate because of tooth contacts observed during nonfunctional activities of patients. This article discusses about evolution of different concepts of occlusion and occlusal schemes in complete denture occlusion.

**Key Words:** Articulation, complete denture, occlusion

## Address for correspondence:

Dr. B. Gajapathi, Department of Prosthodontics, Sri Venkateswara Dental College and Hospital, Off OMR, Near Navalur, Thalambur, Chennai - 600 130, Tamil Nadu, India. E-mail: [drgajapathi@gmail.com](mailto:drgajapathi@gmail.com)

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## INTRODUCTION

Dentate status can affect diet, nutritional status, and general health. A complete maxillary denture can have an impact on taste and swallowing ability. Masticatory efficiency in complete denture wearers is approximately 80% lower than in people with natural dentition. Other factors that affect chewing ability include mobile teeth, bone resorption, reduced sensory perceptions, and motor impairment.<sup>[1]</sup> The early history of the first artificial tooth is obscure, but it is known that 100s of years ago, teeth were carved from

stone, wood, ivory, and metal. Human teeth were also used in early dentures. Every time opposing teeth contact there is a resultant force. Although this force may vary in magnitude and direction, it must always be resisted by supporting tissues. Some dentists believe there should be cusps on the teeth and that they must be in complete harmony with the dynamics of temporomandibular joint function. Other dentists believed that the teeth should not have cusps. There are numerous concepts, techniques, and philosophies concerning complete denture occlusion.<sup>[2,3]</sup>

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## CONCEPTS OF COMPLETE DENTURE OCCLUSION<sup>[2,3]</sup>

### Static concept

The static relations in occlusion include centric occlusion, protrusive occlusion, right and left lateral occlusion. All of these relations must be balanced with the simultaneous contacts of all the teeth on both sides of the arch at their very first contact. The cuspal inclines should be developed so that the teeth can glide from a more centric occlusion to eccentric positions without interference and without the introduction of rotating or tipping forces.

### Dynamic concept

The dynamic concept of occlusion is primarily concerned with opening and closing movements involved in mastication. Jaw movements and tooth contacts are made, as the teeth of one jaw glide over the teeth of the opposing jaw. Movements of the mandible which occur when the teeth are not in contact are termed as free movements.

### Occlusal rehabilitation in complete denture fall into four occlusal concepts<sup>[4]</sup>

- Unbalanced articulation
- Balanced articulation
- Linear or monoplane articulation
- Lingualized articulation.

## CONCEPTS PROPOSED TO ATTAIN BALANCED OCCLUSION<sup>[5]</sup>

### Gysi concept

In 1914, 33° cuspal form was introduced by Gysi. He gave an inclination of 33° to the cuspal inclines to harmonize them with the condylar inclination of 33° to the horizontal. In lateral mandibular movements, cusps contact bilaterally to enhance the stability of the dentures. In centric occlusion, the masticatory forces directed toward the ridges [Figure 1a]. In a right lateral position, the occlusal contact forces are directed away from the ridges. In extreme working lateral position, contacts on both cusps incline, contact force are also directed outside the ridges [Figure 1b].

### French concept<sup>[5]</sup>

According to the concept, the occlusal surface of the mandibular posterior teeth had been reduced to increase the stability of the dentures. The maxillary posterior teeth have slight lingual occlusal inclines of 5° for first premolar, 10° for second premolar, and 15° for first and second molars, so that a balanced occlusion could be developed laterally as well as anteroposteriorly by the arrangement of teeth on a curved occlusal plane.

In centric occlusion, half of width of mandibular posterior teeth helps to direct the masticatory forces in a buccal direction to the mandibular residual ridge [Figure 2a]. In a right lateral

position, the occlusal contact forces are directed toward the ridges on the working side and away from the ridges on the balancing side [Figure 2b].

### Sears concept<sup>[5]</sup>

Sears in 1922 with his chewing members and in 1927 with channel teeth (both were nonanatomic teeth) developed a balanced occlusion by a curved occlusal plane anteroposteriorly and laterally or with the use of a second molar ramp. In centric occlusion, nonanatomic teeth will exert contact forces toward the ridges [Figure 3a]. In the right lateral position, the occlusal contact forces directed toward the ridge on the working side and toward the buccal side of the ridge on the balancing side [Figure 3b].

### Pleasure concept<sup>[5]</sup>

In 1937, Dr. Max Pleasure presented an occlusal scheme called the “pleasure curve,” in which a reverse curve is used in the bicuspid area for lever balance, a flat scheme of occlusion is set in the first molar area, and a spherical scheme set in the second molar area by raising the buccal incline to provide for a

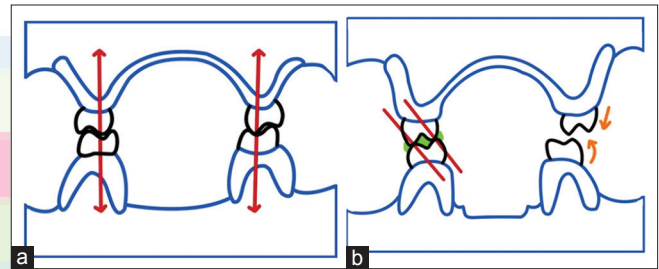


Figure 1: (a) Gysi's concept: In centric occlusion (b) Gysi's concept: In right lateral position

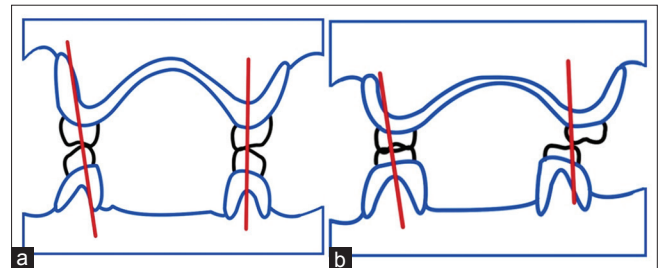


Figure 2: (a) French's concept: In centric occlusion (b) French's concept: In right lateral position

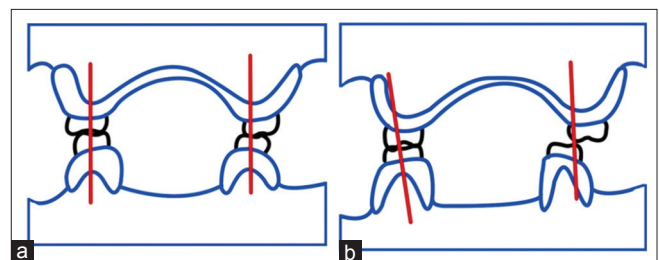


Figure 3: (a) Sear's concept: In centric occlusion (b) Sear's concept: In right lateral position

balancing contact in lateral position. The distal of the second molar can also be elevated to produce a compensating curve for protrusive balance [Figure 4a].

Pleasure rationalized that the occlusion should be of special design due to the instability of the lower denture. Resultant forces should be directed vertically and or lingually. In centric occlusion, contact forces are directed toward the ridges [Figure 4b] and in right lateral working position, the occlusal forces are directed toward the lingual side of the lower ridge on the working side and toward the buccal side of the lower ridge on the balancing side depending on the inclination of second molar ramp [Figure 4c].

### Frush concept<sup>[5]</sup>

In 1967, Frush gave the “Linear occlusal concept,” which employed an arbitrary articulator balance, followed by intraoral corrections to obtain balance. A single mesiodistal ridge on the lower posterior teeth contacted a flat occlusal surface of the upper posterior teeth set at an angle to the horizontal. The intention was to eliminate deflective occlusal contacts and increased stability. In centric occlusion, contact forces directed toward the ridges according to the linear occlusal concept [Figure 5a]. In a right lateral position, the contact forces toward the ridge on the working side and slightly toward the buccal side of the lower ridge on the balancing side at a given inclination of 6° [Figure 5b].

### Hanau’s quint<sup>[2,3,6]</sup>

In 1925, Rudolph L. Hanau presented a discussion paper entitled, “Articulation: Defined, analyzed, and formulated” [Figure 6].

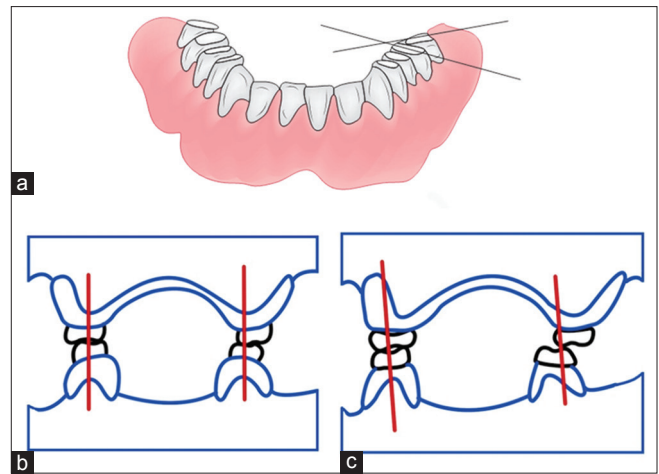
He believed articulation of artificial teeth was related to nine factors:

- Horizontal condylar inclination
- Compensating curve
- Protrusive incisal guidance
- Plane of orientation
- Buccolingual inclination of tooth axes
- Sagittal condylar pathway
- Sagittal incisal guidance
- Tooth alignment
- Relative cusp height.

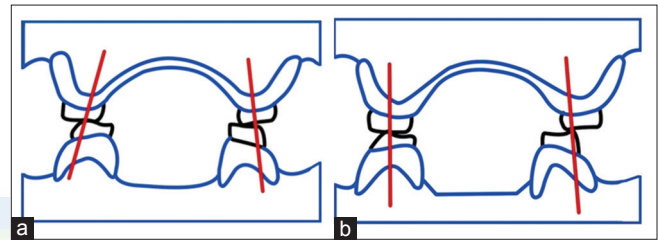
He mathematically charted the nine factors and listed the laws of balanced articulation in a series of 44 statements. Hanau combined the original nine factors and reduced them to five.

Thielemann subsequently simplified Hanau’s factors in a formula for balanced articulation.

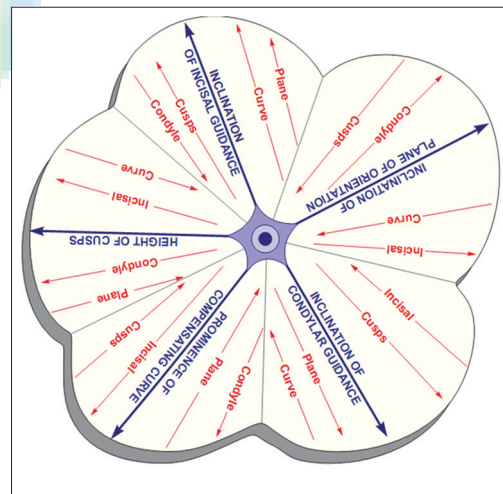
$$[K \times I] / [OP \times C \times OK].$$



**Figure 4:** (a) Pleasure curve (b) Pleasure’s concept: In centric occlusion (c) Pleasure’s concept: In right lateral position



**Figure 5:** (a) Frush’s concept: In centric occlusion (b) Frush’s concept: In right lateral position



**Figure 6:** The articulation quint

Where, K = Condyle guidance.

I = Incisal guidance.

C = Cusp height inclinations.

OP = Inclination of the occlusal plane.

OK = Curvature of the occlusal surfaces.

### Trapozzano concept<sup>[6]</sup>

Trapozzano reviewed Hanau’s five factors and decided that only three factors were actually concerned in obtaining

balanced occlusion. He eliminated the plane of orientation since its location is highly variable within the available inner ridge space. He also suggested that the occlusal plane can be located at various heights to favor a weaker ridge [Figure 7]. Trapozzano stated, no need for a compensating curve, as it is obsolete since the cuspal angulation will produce a balanced occlusion.

**Boucher concept**<sup>[2,3,6,7]</sup>

There are three fixed factors:

- The orientation of the occlusal plane, the incisal guidance, and the condylar guidance
- The angulation of the cusp is more important than the height of the cusp
- The compensating curve enables one to increase the effective height of the cusps without changing the form of the teeth.

**The lott concept**<sup>[2,3,6,7]</sup>

He stated the laws as follows:

- The greater the angle of the condyle path, the greater is the posterior separation
- The greater the angle of the overbite (vertical overlap), the greater is the separation in the anterior region and the posterior region regardless of the angle of the condylar path
- The greater the separation of the posterior teeth, the greater, or higher, must be the compensation curve
- Posterior separation compensation curve to balance the occlusion requires the introduction of the plane of orientation [Figure 8]
- The greater the separation of the teeth, the greater must be the posterior teeth.

**Bernard levin's concept**<sup>[2,3,6,7]</sup>

Bernard Levin's concept of the laws of articulation is quite similar to Lott's, but he eliminated the plane of orientation [Figure 9].

He has named the four factors as Quad. The essentials are as follows:

- The condylar guidance is fixed and is recorded from the patient. The balancing condylar guidance includes the working condyle Bennett movement, which may or may not affect lateral balance
- The incisal guidance is usually obtained from the patient's esthetic and phonetic requirements. However, it can be modified for special requirements, e.g., a reduction of the incisal guidance is considered to be helpful when the residual ridges are flat
- The compensating curve is the most important factor for obtaining balance. Monoplane or low cusp teeth must employ the use of a compensating curve
- Cusp teeth have the inclines necessary for obtaining

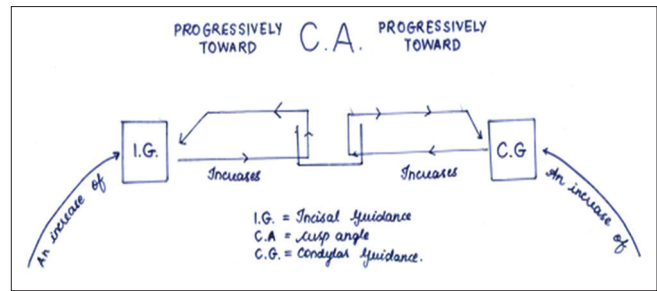


Figure 7: Trapozzano's triad of occlusion

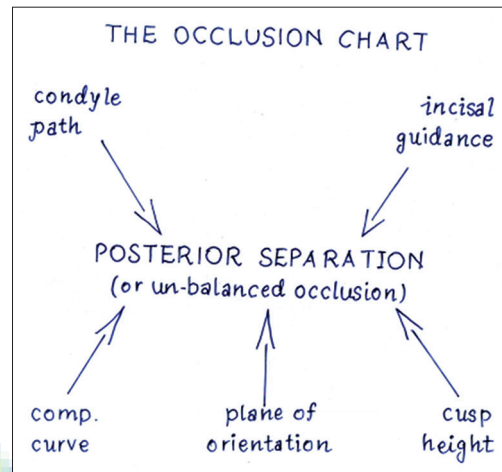


Figure 8: The laws of occlusion (Lott)

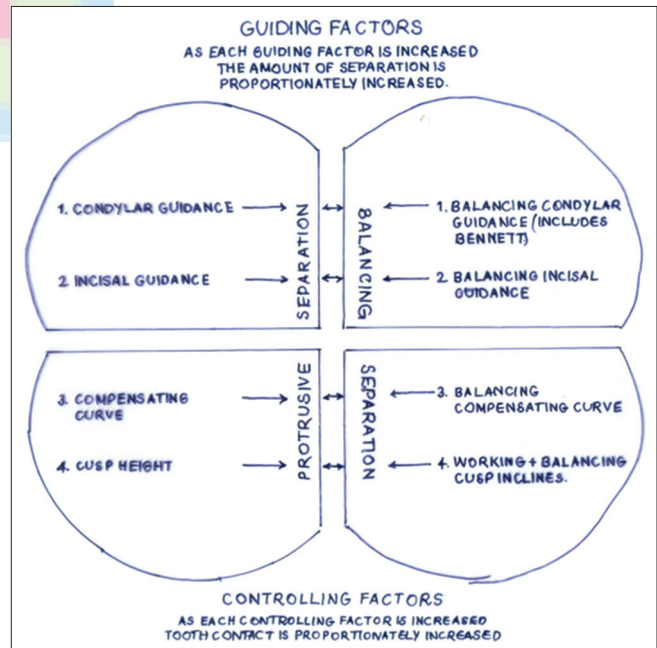


Figure 9: Levin's concept

balanced occlusion but nearly always are used with a compensating curve.

The Quad is relatively easy to understand and use. The concept of controlling posterior separation is an



important goal for achieving a bilaterally balanced denture occlusion.

**According to Brien R. Lang tooth forms or molds are of four types<sup>[3,4,7]</sup>**

- Anatomic
- Nonanatomic
- Zero degree
- Cuspless teeth.

Cuspless teeth are teeth designed without cuspal prominence on the occlusal surface.

## DISCUSSION

Balanced Occlusion is defined as the bilateral, simultaneous, anterior, and posterior occlusal contact of teeth in centric and eccentric positions. Balanced occlusion in complete dentures is unique, as it does not occur with natural teeth. If it occurs in natural teeth, it is considered as a premature contact on the nonworking side and is considered to be pathologic. Usually, anatomic teeth are used to arrange teeth in balanced occlusion [Figure 10a-c]. Nonanatomical teeth can be used with balancing ramps.<sup>[2,3]</sup>

### Importance

The concept was originally put forth to enhance the retention of complete dentures during mastication. However, it became apparent that even a grain of food on the working side eliminates the balance on the nonworking side. It was aptly summarized as “enter bolus, exit balance” by Sheppard.<sup>[8]</sup>

Allen A. Brewer and Donald C. Hudson have shown that complete denture teeth do contact at times during mastication. However, it will last for 17 min in a day.<sup>[9]</sup> Balance is now deemed necessary during many excursive movements such as swallowing saliva, closing to reseat dentures, and bruxism performed by patients in between meals. Hence, if the balance is not present, the bases could shift, tip or torque on their foundations during

the eccentric movements and cause inflammation leading to accelerated bone resorption. Though some authors argue that these contacts other than mastication are not likely to be made with any great deal of force, it is seen that many patients enjoy comfort only when the eccentric balance is present. Equal contact of all posterior teeth (centric occlusion) in centric relation is essential for the health of the mucosa.<sup>[10-12]</sup>

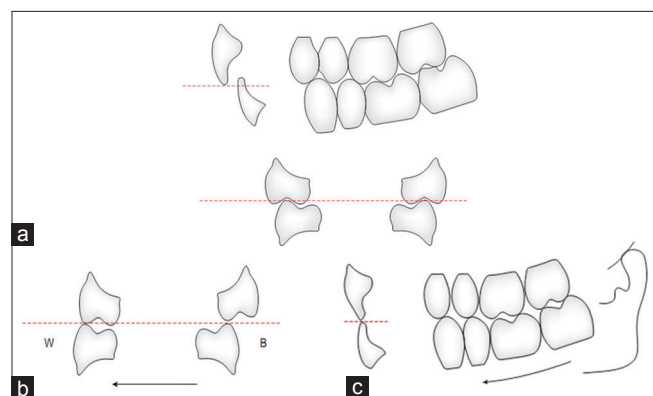
It has been determined by studies that measured the force necessary to masticate food can vary from 5 to 175 pounds with natural teeth. This wide range of force is due to a person's choice of foods, the condition of the supporting structures of the teeth, integrity of the crown, and subject's muscular development.<sup>[2]</sup>

The force used in mastication by denture patients has been studied, and the findings are significant. In a study of 100 denture wearers with ages varying from 26 to 83 years, the average force in the molar and bicuspid area during mastication was 22–24 pounds. The force exerted in the incisor area dropped to nine pounds. Gibbs *et al.* showed that the average closing force during mastication of complete denture wearers is only 11.7 pounds, which is considerably below the weakest closing force of subjects with natural teeth. The comparison between natural and artificial teeth shows that complete denture wearers can exert only from 10% to 15% of the force of a patient with good natural teeth. It appears, therefore, that the average complete denture wearer has barely adequate force for the work required during mastication.<sup>[2,13,14]</sup>

Hence, arranging modified anatomic teeth in a semi-adjustable articulator, which can accept face bow transfer and horizontal and lateral condylar guidance records from which incisal guidance can be established for every individual patient. Based on the interocclusal records, selective grinding is done to reduce the occlusal interferences to avoid deflective forces that are transmitted to the supporting structures. Then thorough patient education, motivation, and regular recall will preserve the health of the supporting structures for the longer period.

Consequences of wearing the same complete dentures for a long period are attrition of artificial acrylic teeth and loss of occlusion. These conditions result in uneven force distribution and pathological changes in the underlying oral tissues, which will in turn results in poor patient comfort, destabilization of occlusion, inefficient masticatory function, and esthetic problems. Ultimately, patient may not be able to wear dentures and will be diagnosed as prosthetically maladaptive.

The patients with complete dentures should follow a regular control schedule at yearly intervals so that an acceptable fit and stable occlusion can be maintained. Patient should be motivated to practice proper denture-wearing habits like not wearing dentures during the night.



**Figure 10:** (a) Balanced occlusion: In centric occlusion, (b) balanced occlusion: In right lateral position, (c) balanced occlusion: In protrusive position

## CONCLUSION

Complete edentulism not only hampers the mastication, esthetics, but also affects the psychological well-being of the patient. There has been much controversy about various concepts and the theories put forward to achieve occlusion. However, the use of these principles according to the individual merits of the case, have been neglected. Each case should be thoroughly evaluated based on the hard and soft tissue anatomy, resorption pattern, neuromuscular control, and the patient compliance.

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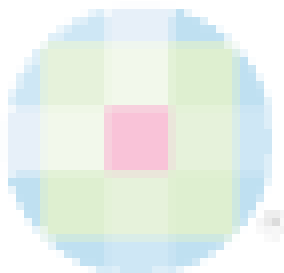
Nil.

## Conflict of interest

There are no conflict of interest.

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