

## Some Aspects on Dental Occlusion and its Importance in Clinical Dentistry \*

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### ABSTRACT

Opinions, both among clinicians and academics, differ much on how to define and examine dental occlusion, and how to treat occlusal problems. Most individuals exhibit deviations from the so-called ideal occlusion, but still the great majority is functioning well. Those individuals have a *physiological occlusion* and are in no need of any therapeutic intervention. In textbooks and prosthodontic education all over the world, it is maintained that jaw registration must include a face-bow transfer. However, there is no good evidence for this opinion. In Sweden the use of face-bows has been almost totally abandoned both in dental education and general practice during the last few decades. The extensive fixed dental prostheses on natural teeth and dental implants produced in Sweden with well-documented excellent long-term results have been performed in simple articulators without face-bow transfer. When fabricating crowns and small fixed dental prostheses in patients with a stable occlusion, indices can be left out, which has been shown to increase the accuracy of the mounting in the articulator. The long-lived belief that complete dentures must have a balanced occlusion has been refuted by studies comparing this classical occlusal design with canine-guidance: complete dentures do not need a balanced occlusion to function well. The etiological importance of occlusal features in temporomandibular disorders has been depreciated lately and focus is now on psychological and general health factors. Recent findings on the neuroplasticity of the brain can help explain the great variation among individuals regarding adaptation capacity to tooth loss and occlusal changes, including various designs of prosthodontic restorations.

**Key words:** complete dentures, dental implants, jaw registration, number of teeth, shortened dental arches

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### Introduction

Many dental students and dentists consider dental occlusion a difficult subject. It has been and is to some extent still a controversial issue in clinical dentistry. Early textbooks on occlusion emphasized the great importance of a full complement of teeth for the health of the masticatory system and warned for the risk of temporomandibular disorders (TMD) in individuals with "occlusal disturbances", defined in different ways.<sup>1, 2</sup> One of the problems in understanding occlusion is that confusion still remains concerning optimum occlusal relationships. There are no controlled studies on the optimum features of a harmonious natural and/or restored occlusion;<sup>3</sup> this is certainly true even in 2013. Nevertheless, every dentist is every day performing diagnostic and therapeutic procedures, which include

the occlusion, e.g. a simple filling, a crown, more extensive fixed prosthodontics, removable dentures, and implant-supported prostheses.

It is the aim of this article to review some current opinions on the importance of occlusion in clinical dentistry, with a focus on prosthodontics and TMD. After a short summary of the definition of occlusion, the article will discuss jaw registration, occlusal designs of different prosthodontic restorations, and the importance of occlusal features in development and treatment of TMD.

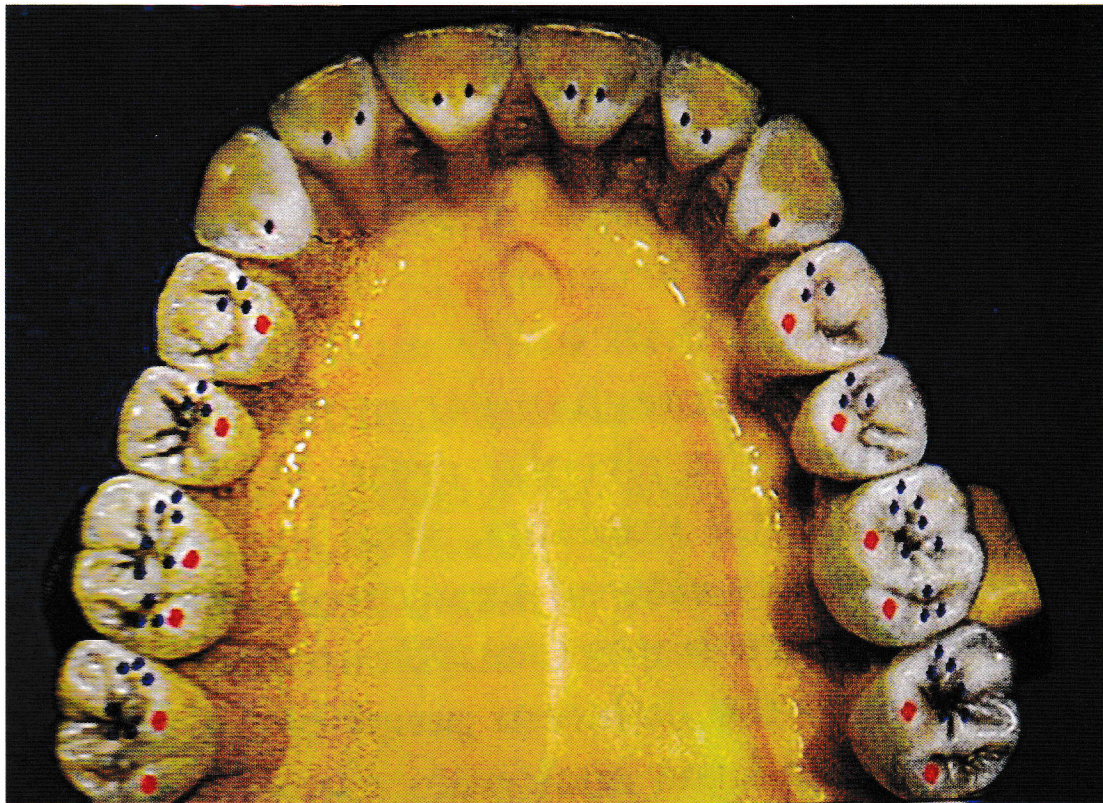


Figure 1. Occlusal tooth contacts in the ideal occlusion. (With permission from reference 8)

### Definition of dental occlusion

There are many definitions of occlusion available but an often used one is "the relationship of the maxillary and mandibular teeth as they are brought into functional contact".<sup>4</sup> The often-cited Glossary of Prosthodontic Terms (GPT)<sup>5</sup> defines it as the static relationship, whereas the dynamic relationship is called articulation. In GPT there are 35 definitions of terms beginning with "occlusal", from occlusal adjustment to occlusal vertical dimension, which indicates that occlusion is related to a great number of issues in clinical dentistry.

### The occlusion of the natural dentition

The so-called ideal occlusion has been much emphasized in dental education but in fact we rarely see patients with dentitions that are in accordance with that term. In the clinic it is easy to observe the great variation of the dental and occlusal morphology among patients. The great majority of them exhibit deviations from the ideal occlusion but nevertheless most of them seem to function well. These individuals

can be said to have a physiologic occlusion and they need no therapeutic intervention.<sup>6</sup> The ideal occlusion is mainly a theoretical invention and has hardly any place in the clinic. However, the conception that the ideal occlusion should be the standard in diagnosis and treatment of our patients has terrorized generations of dentists. The frequent textbook recommendation to provide patients lacking molar support with removable partial dental prostheses (RPDP) has often led to overtreatment, and when oral hygiene is not optimal, to the well-known repair cycle.<sup>7</sup> A few examples of the discrepancy between the ideal occlusion and "normal" occlusion are given in the following.

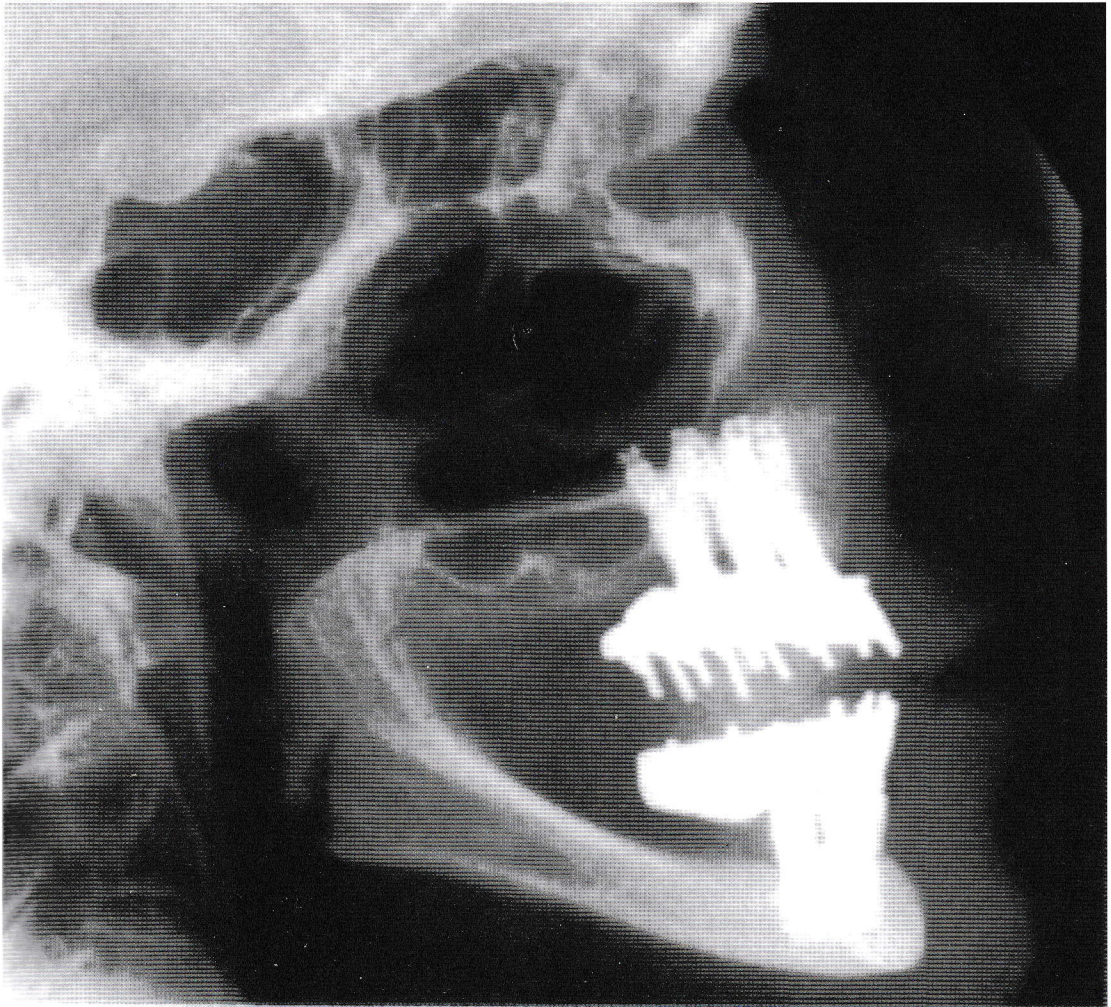


Figure 2. Lateral cephalogram of an edentulous subject successfully treated with implant-supported fixed prostheses in both jaws. The lack of occlusal support in the molar region represents moderate shortened arches. (With permission from reference 7).

### ***Number of occlusal contacts***

Many textbooks on occlusion show beautiful illustrations of the contact relationship between the maxillary and mandibular teeth. The number of contacts varies but is in general much higher than found in the clinic. For example, the classical textbook Occlusion by Ramfjord and Ash<sup>1</sup> shows 36 contacts, with molars and premolars having more than one. Another textbook<sup>8</sup> demonstrates 64 contacts in the maximal intercuspal position (MIP) (Figure 1). This is without relevance as clinical studies have demonstrated much lower values. A Swedish study

found a mean of 11 contacts in light biting and 18 in hard biting.<sup>9</sup> A third of the examined subjects had 2 to 6 contacts in light biting and 9 to 16 in hard biting, thus strongly deviating from the ideal occlusion. Still all of the participants reported their masticatory function as satisfactory.

### ***Contact patterns of mandibular excursions***

There have been hard debates over the years between those who advocate *canine guidance* – with only the working side canines in contact in lateral excursion – and those who prefer *group function* – with two or more working side teeth in contact. There

is no evidence that one of these patterns is better than the other, both are found in natural dentitions and both can be used in prosthodontic restorations.

In a similar way, *anterior guidance* is often mentioned as necessary in fixed prosthodontic restorations, without any good evidence. It is however probably so that both canine and anterior guidance are easier to perform in the laboratory and easier to check in the clinic than other patterns, which may be of advantage.<sup>7</sup>

consideration in treatment planning for partially edentulous patients. A review of the literature on SDA concluded that "shortened dental arches comprising anterior and premolar teeth in general fulfil the requirements of a functional dentition".<sup>11</sup> The SDA concept has been well accepted in many parts of the dental community, though not in all. The WHO has declared the concept clinically acceptable when resources are limited on the individual and / or society level. An ongoing well-designed multi-centre



Figure 3. A teacher at the dental technician school at the University of Gothenburg throws away face-bows assisted by the author in 1997. The reason was that the face-bows had not been used during the last 10 years.

### **Shortened dental arches**

The old dogma in prosthodontic decision-making that tooth loss must always be replaced has been questioned. The shortened dental arch (SDA) concept<sup>10</sup> has proven to be worth serious

randomized controlled trial (RCT) is trying to assess the outcome and survival rates for two treatment alternatives in patients with missing all molars in one jaw: removable dental prostheses or no replacement according to the SDA concept. Up to the 5-year control no significant differences have been found

between the two groups.<sup>12</sup> The authors concluded that if the long-term results will confirm the present observations, this would strengthen the importance of considering patient preferences rather than the number of posterior teeth in clinical decision-making.

Two studies comparing the treatment outcomes of removable partial dental prostheses (RPDP) and small cantilevered fixed dental prostheses (FDP) over 5 years found better comfort and patient satisfaction, less caries and fewer prosthetic complications in the FDP than in the RPDP group. The originally higher cost for FDPs was offset by the more extensive restorative need in the RPDP group during the observation period. Replacement of missing molars in patients who are well adapted to shortened dental arches is thus not mandatory.<sup>7</sup> The SDA principle has also been successfully applied in implant prosthodontics (Figure 2).

### **Number of teeth**

How many teeth that are required for a well-functioning masticatory system cannot be answered in general but must be evaluated individually with respect to the wide variation in occlusal morphology and individual adaptability present in the population. It is clear however that many subjects with less than a 28-tooth dentition report that they are satisfied with their masticatory function. It seems that most of the recent literature accepts the opinion that acceptable dental occlusion is possible in subjects with a reduced dentition.<sup>13</sup>

### **Maxillomandibular registration**

Prosthodontic work is in general performed in an articulator. There are many different types of articulators, from small and simple to advanced instruments. There is no documentation showing that clinical results are better for prostheses fabricated in complex systems than those made with a simpler one. Whatever recording system and articulator used, it is always necessary to carefully check the occlusion of the prostheses when inserted in the mouth.<sup>13</sup> In most textbooks it is stated that the jaw registration must be done with a face-bow to make the mounting of the casts in the articulator comparable with the situation in the patient. However, there is no scientific evidence for that opinion, which has made the great majority of dentists in Scandinavia stop using or have never used a face-bow.<sup>14</sup> The face-bow has even been removed in some centres for dental training (Figure 3).

During the last few years, several international studies have confirmed that face-bow transfer does not offer clinically significant advantages compared to average mounting according to the Scandinavian approach.<sup>15</sup> The reduction in time and cost with a simplified jaw registration without face-bow can be better used for other measures to improve the clinical quality of the prosthodontic work. Several studies from Scandinavia have demonstrated excellent long-term outcome of both tooth-borne and implant supported fixed prostheses, which practically to 100 % were fabricated in simple articulators and without face-bow transfer.<sup>13</sup>

### **Maxillomandibular relations**

Most crowns and fixed dental prostheses (FDPs) are best placed to fit into the present maxillomandibular relationship. To use the existing maxillomandibular intercuspatation position (MIP), provided it is stable, is advantageous by easier adaptation for the patient and simplification of both the clinical and laboratory work. Many texts advocate the centric relation (CR) or retruded (contact) position (RP) for both the recording and therapeutic position. This is often necessary for large FDPs in strongly reduced dentitions and in edentulous jaws – complete dentures and implant-supported restorations – where there are no tooth contacts to secure a MIP. For small restorations in a stable occlusion it is better to use MIP. To use CR / RP in such situations is illogical as most subjects have a small distance between the retruded and intercuspal positions, usually not exceeding 1 mm.

CR is defined in 7 different ways in GPT<sup>5</sup>, obviously without consensus of which to use. Most definitions give a certain relationship between caput and fossa of the temporomandibular joint (TMJ). This is hardly usable in the clinic (if you do not have a radiological eye sight). This is why we in Scandinavia prefer RP, as it is a well defined (a position on the most posterior hinge axis of the mandible), tooth-related in dentate situations and clinically easy-to-use position.<sup>16</sup>

Among the many controversies related to occlusion, the method of recording RP is one. There are different opinions about the value of the two-hand grip according to Dawson, the one-hand recording according to Ramfjord and Ash, or using some instrument. There is no evidence that any of the methods gives a more secure result than the others. A passive recording of the retruded hinge movement

guided by the dentist with a light pressure backwards has been shown to be an easily learned method providing high precision.<sup>17</sup>

### **Complete dentures**

In the fabrication of complete dentures for edentulous patients there is no basis for deciding which recording and therapeutic position to be used. It is however consensus in dental education and textbooks to use RP at the recording. The artificial teeth are then set up in the mounted RP. Since most denture teeth have low cusp height and the dentures are slightly mobile in the mouth such a "point centric" seldom causes clinical problems. A rapid adaptation usually occurs to an intercuspation slightly in front of RP.<sup>18</sup>

The so-called balanced occlusion has been the norm in dental education and in textbooks on complete dentures. Some gnathologists made the heretical suggestion that as canine-guided occlusion functions in dentate individuals, it might also function in complete denture wearers. A German group tested this assumption in a comparative study. The results, astounding to many prosthodontists, were that the patients preferred the dentures with only canine contacts at lateral excursions because they were considered better regarding chewing, retention and esthetics.<sup>19</sup> A recent systematic review exhibited that this was not a solitary observation: among 7 randomized controlled trials only one found better results for dentures with balanced occlusion, whereas the others demonstrated that the canine-guided occlusion had better (2) or equal results (4) in the comparison between the two types of occlusal design.<sup>20</sup> The conclusion is that complete dentures do not need balanced occlusion to function satisfactorily.

### **Removable partial dental prostheses**

Many studies have shown that there is a great risk of caries and other lesions in the residual dentition of patients wearing removable partial dental prostheses (RPDPs). This has led to a bad reputation for this type of restoration. Such lesions can however be avoided, or at least diminished, if the patients are given adequate information about oral hygiene, the remaining teeth have been treated to optimal health, and the prostheses are constructed to provide good function and minimal damage to the oral tissues.<sup>21</sup> Even if fixed tooth-borne and implant-supported prostheses often function better, RPDPs have some important advantages: they are cheaper, they can be fabricated in a simpler and faster way, and they can

function well when they are made on correct indications. Thus, RPDPs are still an important treatment option for partial edentulism, and not only in patients, and countries, with a stretched economy.<sup>21</sup> It is difficult to find good evidence in the literature for recommendations of occlusal design for RPDPs besides what has been written for complete dentures.

### **Fixed tooth-borne prostheses**

The greatest part of fixed prosthodontic work consists of crowns and small bridges /FDPs. For such restorations in a stable occlusion, the maxillomandibular registration is simple. The usual type of recording indices can be left out in cases with a well-defined intercuspation. Studies have shown that the corresponding casts can be occluded free hand with greater seating accuracy than when using an index.<sup>13</sup> Many dental technicians verify that for crowns and short bridges, the submitted indices seldom are used in the laboratory because they are not trimmed and difficult to control. Instead the mounting is made after the casts are occluded free hand. It is thus possible to simplify the registration procedure by excluding indices in the fabrication of small restorations when the occlusion is stable. When it is clinically considered necessary, for example when the occlusion is unstable, a recording index should of course be taken to secure a correct mounting of the casts in the articulator.

If it often occurs that the prosthodontic work does not fit well, for example the restorations are too high when inserted, dentist and technician together should try to find out the reason for the failure. There are many possible sources of error in the long chain from the clinic to the produced prosthesis: impression – also the reproduction of the opposite jaw is important, index, transport, the various phases of the laboratory work, etc. That dentist and dental technician blame each other is not meaningful. A constructive joint analysis with mutual respect should be done and may disclose the cause of the error and how it might be remedied. Since opinions on occlusion often differ, it is important that the dentist and the dental technician present their views and discuss how best to achieve the best possible clinical result.

### **Implant-supported prosthodontics**

Also in implant prosthodontics there are divergent conceptions of occlusal design. However, based on the successful results of implant-supported

restorations from clinics all over the world with a great variety of ideas of jaw recording and occlusal design, it can be guessed that occlusal factors and occlusal morphology is not that critical for long-term results as often is stated. The great difference in bone contact between teeth and implants led originally to the belief that the occlusion must be shaped differently on tooth-borne and implant-supported restorations. The current view seems to be that principles and methods used in tooth-borne prosthodontics can be employed also in implant prosthodontics.<sup>14</sup> Systematic reviews have emphasized that there is no evidence to promote any special occlusal philosophy for implant-supported restorations. In a similar way as in conventional prosthodontics, the occlusion of implant-supported prostheses can be managed by means of simple principles and methods for maxillomandibular registration and occlusal design.<sup>22</sup>

### **Temporomandibular disorders**

Signs and symptoms of temporomandibular disorders (TMD) are common in the population. To the most common symptoms such as TMJ sounds, pain in jaw muscles and TM joints and restrictions in jaw movements other pains and symptoms in the face and head have been added. Internationally it is now more often talked about orofacial pain than TMD. The field has been and is still controversial. Occlusal disturbances were for long believed to be the dominant cause of TMD. Elimination of so-called occlusal interferences with various types of occlusal therapy such as occlusal adjustment was taught in the dental schools and became a common treatment modality for TMD in general practice. TMD patients often get better after different simple treatments including occlusal adjustment, which strengthens the dentist's belief in an association between occlusal disturbances and TMD. Only when randomized controlled trials were introduced in the TMD field, it was revealed that other therapies without influence on the occlusion provide equally good or better results. Systematic literature reviews have demonstrated that the association between occlusal factors and TMD is weak and consequently there is seldom an indication for irreversible occlusal therapy in TMD patients.<sup>23</sup> Simple treatments including brief information, counselling / reassurance, analgesic medication for pain relief, and jaw exercises will help the majority of patients with TMD.<sup>24</sup> The etiological importance of occlusal features has been depreciated

lately and focus is now on psychological and general health factors. A number of general disorders and diseases have demonstrated comorbidity with TMD, which also weakens the belief of an etiological relationship between occlusion and TMD.<sup>25</sup>

### **Oral appliances / occlusal splints**

Oral appliances of various types are common and often successful alternatives in the management of TMD. The probably most common is the stabilization splint, which, as indicated by the name, is supposed to act through stabilization of the occlusion. Several studies during the last few years have however shown that a so-called placebo splint, a plate covering only the palate, is as effective as a stabilization splint. A group of TMD patients who received a dentist-guided instruction in home self-treatment without an occlusal splint had improved as much after 12 months as groups who had been treated with two types of occlusal splints. The mechanism for improvement seems therefore not to go via stabilization of the occlusion.<sup>14</sup> In summary there is evidence that occlusal factors have no or only weak etiological importance for TMD.

### **Discussion**

Occlusion is a central conception in clinical dentistry but it has been considered difficult to get a clear understanding of it. Many students and clinicians admit that they are uncertain, sometimes even confused, of terminology, diagnosis and treatment of patients with occlusal problems. The situation may be further complicated when the interpretation of the occlusal status differs between dentist and patient. Sometimes the patient has no problem with his / her occlusion but the dentist considers it needs some intervention. This requires a careful discussion before any treatment is started. The opposite occurs fortunately more seldom: the patient complains about the occlusion but the dentist finds it quite acceptable. The management of the small group of patients suffering from a severe disorder, which has been named *dysocclusion*, or previously "phantom bite syndrome", is extremely difficult.<sup>7</sup>

Opinions about how occlusion should be organized on different types of prostheses have varied much between dentists, between dentists and dental technicians, between dental schools and dental training institutions, both within and between countries, and not the least over time. In spite of the fact that different principles and methods have been employed in oral rehabilitation, the great majority of

the patients treated seem to have adapted well to the new restorations and been satisfied with the treatment. This may be surprising, especially to professionals who assert that they work with the “best methods”. Results of recent neurophysiologic research can help explain this. Changes in occlusion or other oral structures will lead to neuroplastic changes in parts of the central nervous system, which are important for the capacity to adapt to new peripheral conditions.<sup>26</sup> This neuroplasticity of the brain is relevant for interventions in the mouth including changes in the occlusion brought about for example by prosthodontic rehabilitation. This new knowledge can enhance our understanding of patients’ adaptation to different types of prosthodontic work and variations in occlusal design and morphology.<sup>27</sup>

The controversies related to occlusion have mainly dealt with “mechanical” factors such as instrumentation, materials, jaw positions, interferences, number of teeth, etc. Focus should more be directed towards patients’ experience of the treatment and its association with satisfaction and improvement of the quality of life. The neuroplasticity of the brain is also a field that can teach us more about the adaptation to various prosthodontic restorations and hopefully reduce the conflicts about details in the organization of occlusion.

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