Musculoskeletal Disorders and the Occlusal Interface

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Introduction

In 1973, Beyron[1] presented proposals for description of a functionally optimal occlusion and principles for occlusal rehabilitation; according to him, optimal occlusion is characterized by:

- Stable jaw relationship with bilateral contact in retrusive closure
- Stable tooth-to-tooth relationships providing axially directed forces on the posterior teeth in complete occlusal closure
- Freedom in retrusive range, with maximum intercuspation slightly (1 mm or less) and straight in front of the retruded contact position
- Smooth bilateral function, facilitated by group contact on the laterotrusive side close to maximum intercuspation and by no contact on the mediotrusive side; in symmetric protrusion, early anterior group contact
- Acceptable interocclusal distance

Available evidence for Beyron's proposals, including references of studies with different evidence levels,[2] is presented in the following text and summarized in Table 1.

Maximum Number of Stable and Axially Directed Bilateral Centric Stops

The Oral Health Impact Profile (OHIP), implying an evaluation of the function of the jaws, has shown social and psychologic factors to be of importance for the oral health.[3]

Hatch et al[4] showed that tooth units, together with bite force, were determinants of masticatory performance. In young girls (11 to 15 years), as well as in 19-year-olds, the number of centric stops varied.[5,6] No sex difference has been reported. The masticatory efficiency index in that study was higher in the group with normal occlusion than in the Class II malocclusion group; when the girls estimated their masticatory ability, the normal group reported their ability to be better than did the Class II group. When pooling the Class II malocclusion and normal groups in a logistic regression analysis, the number of occlusal contacts was found to be the most influential predictor for the variation of masticatory efficiency index. In a 2-year longitudinal study, young girls with normal occlusion continuously had more occlusal contacts than did girls with Class II malocclusion.[7]

It is obvious that the methods used to record contacts, for example, the thickness of the recording medium and the biting procedure, are of importance. The number of occlusal contacts in light biting is only about half that in hard biting in young girls with both normal and Class II malocclusion, as well as in young adults and adults.[7,8]

Table 1 Literature Lending Support to Evidence for Beyron's Proposed Criteria for an Optimal Occlusion

Study	Year	Level of evidence*
Allen et al[3]	2001	2c
Beyron[1]	1973	5
De Boever et al[12]	2000	2a
De Boever et al[11]	2000	2a
Hakestam et al[13]	1997	2c
Hatch et al[4]	2000	2c
Henriksson et al[6]	1998	2b
Henriksson et al[7]	2000	2b
Marklund and Wänman[15]	2000	2a
Riise[8]	1982	ES
Rivera-Morales and Mohl[16]	1991	3a
Vallon and Nilner[14]	1997	2b
Wänman and Agerberg[5]	1991	ES
Witter et al[9]	1988	2b
Witter et al[10]	1990	2b

ES = epidemiologic study.
*1a = Systematic review of RCTs; 1b = individual RCT; 2a = systematic review of cohort studies; 2b = individual cohort studies; 2c = "outcomes" research; 3a = systematic review of case-control studies; 3b = individual case-control study; 4 = case series; 5 = expert opinion.

In adults, the masticatory ability is affected to a lesser degree than masticatory performance when occlusal units are missing, and the capacity of the stomatognathic system to adapt to loss of molar support is great. This statement relies on the studies of the shortened dental arch (SDA) concept.[9,10] The masticatory ability and oral comfort in adults were presented to be sufficient as long as 20 "well-distributed teeth" or 10 occluding pairs remained, such as in premolar dental arches. The number of patients in that study was sufficient, making it possible to estimate the minimum number of teeth needed to have an acceptable masticatory function and oral comfort. The reason for the difference found regarding reported pain in and around the temporomandibular joint in the SDA and control groups was not further analyzed. Sex differences in patients with SDA have not been reported. A review regarding tooth loss and prosthodontic treatment[11] found no proof for prosthodontic restoration as prevention for or treatment of temporomandibular disorders (TMD).

Edentulous occlusal gaps most often are recommended to be replaced for esthetic function, but also to avoid possible negative consequences such as tipping of neighboring teeth or elongation of an opposing tooth. The frequency and severity of such changes after loss of single teeth without replacing them are not well known, but no or only minor overeruption has been presented, even in a long-term perspective. Tilting or elongation of teeth can give rise to interferences, which in turn can disturb the function and possibly create musculoskeletal disorders. The risk for this is, however, not known.

In controlled studies in which interferences have been created, symptoms of TMD have been reported to occur, although the studies included small samples only.[12] When and why such disorders occur in connection with artificial interferences are not fully known. There is no linear relationship between tooth loss and musculoskeletal disorders. This is at least understood from a study of edentulous non–denture wearing individuals in whom signs and symptoms of musculoskeletal disorders were practically absent.[11,12]

A better esthetic and chewing function, as well as an enhancement of the general well-being, were important factors reported by patients who were to undergo extensive prosthodontic treatment. Different personality traits seemed to play a role in patient expectations. Patient satisfaction with prosthodontic treatment has been reported to be multidimensional.[13]

Rheumatoid arthritis is one example of an inflammatory joint disease in which continuous changes of the maximum centric stops may occur because of destruction of joint tissue. What impact this has on the individual patient's function or dysfunction is not fully understood.[11]

Freedom in Retrusive Range of Occlusal Contact

The study of freedom in the retrusive range of occlusal contact will be enabled by a sagittally oriented rotation of the mandibular jaw upward, leading to an initial intermaxillary occlusal contact, where the mandible is situated in the retruded contact position (RCP) or centric relation. It is an established fact that in most individuals this mandibular position, RCP, lies slightly posterior to the intercuspal position (IP). In fewer than 10% of a large sample do these two positions coincide, but normally there is a distance between RCP and IP of up to 1 mm in the incisal region. The distance can be asymmetric, and there seems to be no difference with different ages or between sexes. Epidemiologic studies have presented associations between asymmetric slide and dysfunctional symptoms, but the associations have not identified patients with musculoskeletal disorders. Slides of more than 2 mm are seldom found in asymptomatic populations, and a distance of 2 mm or more has been proposed to be more common in patients complaining of musculoskeletal disorders than in patients without these disorders. Lateral slide has also been alleged to be one type of occlusal disturbance found more commonly among patients suffering from musculoskeletal disorders.[5,12] In a randomized controlled study of patients with musculoskeletal disorders treated with occlusal adjustment, the treated patients reported themselves to be better in an up to 3-month perspective, but not in a longer one.[14]

Multidimensional Freedom of Contact Movements

Multidimensional freedom of contact movements has been examined in population-based studies showing that the natural dentition exhibits various contact patterns under protrusive as well as lateral excursions of the mandible, but without any clear-cut correlations to musculoskeletal disorders, dysfunction, or better function. Mediotrusion interferences, for example, have been found to correlate to single symptoms of musculoskeletal disorders but have not alone been able to identify such disorders.[15] Findings in different studies have, however, been contradictory. Gender differences have not been proven.[12] When prosthodontic treatment is indicated, there are various occlusal philosophies or principles for different reconstructive measures.

Interocclusal Distance

An acceptable interocclusal distance can be judged by measuring the space between the maxillary and mandibular teeth when the mandible is in the rest position, known as the interocclusal distance, or freeway space. The width of the space, ie, the vertical distance, between the resting and closed positions is recommended to be in the range from 1 to 3 mm. Clinical studies with electromyographic recordings have, however, presented the rest position to be up to 8 mm.

There is no precise method available to measure the interocclusal distance, but a potential for adaptation to altered vertical dimensions of occlusion has been reported, and no report has claimed great difficulties with patient acceptance of a new freeway space. The experimental studies, however, included only a small number of individuals, and all the increased occlusal vertical dimensions were tested by use of splints, not fixed restorations.[16]

What Do We Know?

- The occlusion is not the only etiologic factor in patients suffering from musculoskeletal disorders.
- There is a great variation in the number of centric stops at light and hard biting in young ages and adults.
- There is great belief in the benefit of filled occlusal gaps for function and improvement of musculoskeletal disorders.
- Inflammatory joint diseases can influence the occlusal interface.
- There are individual contact patterns at jaw movements both with and without symptoms of musculoskeletal disorders.
- In most individuals, the RCP lies slightly posterior to the intercuspal position.
- Depleted dentition (fewer than 20 teeth) could lead to functional problems.

What Do We Not Know?

- The importance of the number of centric stops for an individual's masticatory function and dysfunction, or for general health and psychosocial function
- Why and when patients rehabilitated with an SDA will develop musculoskeletal disorders
- The efficacy of restored molar support in musculoskeletal disorder patients with SDA
- If and in what individual cases the occlusion is important for evolving musculoskeletal disorders
- When tilting and elongation do occur, and the time span for adaptation to occlusal gaps in different regions of the mouth

- How, when, and why inflammatory joint diseases influence the occlusal interface
- The importance of occlusal design for function and dysfunction or evolution of musculoskeletal disorders

What Research Strategies Are Needed?

- Clinical research regarding function, dysfunction, and musculoskeletal disorders, where a holistic view of the patients is central.
- Clinical studies in both short- and long-term perspectives to achieve knowledge about the influence of tooth loss on psychosocial factors and quality of life.
- Clinical studies of patients rehabilitated with different treatment modalities to understand their acceptance of reconstructions in both short- and long-term perspectives.
- Clinical studies on patients suffering from inflammatory joint diseases to achieve knowledge of the development of the diseases in the stomatognathic system and about the importance of different kinds of occlusal treatments.
- For a better understanding of the effect on function, dysfunction, and musculoskeletal disorders, randomized controlled trials are needed in the evaluation of different kinds of reconstructions or reconstructions made according to different therapeutic principles for the mandibular position, contact pattern of mandibular excursions, and occlusal designs.

What Needs Highlighting in Educational Programs?

An integrated clinic for students to meet patients—allowing an opportunity to examine, discuss, diagnose, prognosticate, treat, and eventually rehabilitate together with clinicians trained in research—would probably give students a good opportunity to understand evidence-based dentistry.[17] It has been shown that the visual appearance of patients can provide valuable clues to the nature of the underlying disorder.[18] Because of the rapid development in dentistry, students need to be trained in reading research articles to become critical readers of the literature. Training students to critically appraise medical information will increase the number of clinicians who are capable of self-directed lifelong learning. An educational curriculum should focus on learning, not teaching.[19]

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