

KEY WORDS

Occlusion, temporomandibular disorders, occlusal interferences, occlusal adjustment, orthopaedic stability

LEARNING OBJECTIVES

- To highlight the findings of occlusal studies with regards to the significance or non-significance of occlusal factors in relation to temporomandibular disorders (TMD)
- To outline the theory of orthopaedic stability
- To understand the role of occlusal adjustments for managing patients with TMD

AUTHOR

**Ziad Al-Ani BDS MSc PhD MFDS
RCS(Ed) FHEA**

Senior Lecturer, Glasgow Dental Hospital and School

ZIAD AL-ANI

Prim Dent J. 2020;9(1):43-48

OCCLUSION AND TEMPOROMANDIBULAR DISORDERS: A LONG-STANDING CONTROVERSY IN DENTISTRY

ABSTRACT

The relationship between temporomandibular disorders (TMDs) and occlusion remains controversial. Some authors believe that occlusion is the primary factor in the onset of TMD symptoms, whereas others feel that occlusion has no role in this at all. The majority of reasoning behind causation is based upon anecdotal rather than scientific evidence. Existing evidence in the literature supports the absence of a disease-specific association. This article describes this controversy and provides the reader with findings from contemporary literature.

Introduction

The cause of temporomandibular disorders (TMDs) has been considered to be complex and multifactorial.^{1,2} There are numerous factors that can contribute to a TMD.^{1,2} The accepted theory of a multifactorial aetiology of TMD has resulted in a lessening of emphasis on occlusion as the prime aetiological factor.

Dentists have long debated the significance of the occlusion as an aetiological factor in the development of TMDs. The role of occlusion in the development of TMD is controversial as the majority of reasoning behind causation is based upon anecdotal rather than scientific evidence. The occlusion-TMD field, therefore, is still often a source of speculation and the 'occlusal question' remains unsolved.³

A long-standing controversy

Opinion regarding the importance of occlusion has shifted between it being the main causative factor and there being no correlation at all. Some authors believe that occlusion is the primary factor in the onset of TMD symptoms, whereas others feel that occlusion has no role and that aetiological factors are based more on behavioural, psychological and neurological problems.^{4,5} Moreover, the relationship between TMD and malocclusion also remains controversial, but there is no evidence to support an increased incidence of TMD in patients with malocclusion.⁶⁻⁸

To date, most occlusal studies have assessed the static relationship of the teeth and considered the significance, or non-significance, of occlusal factors in relation to TMDs only when signs and

OCCLUSION AND TEMPOROMANDIBULAR DISORDERS: A LONG-STANDING CONTROVERSY IN DENTISTRY

symptoms are present. The findings are certainly not conclusive regarding any single factor being consistently associated with a TMD.

In an attempt to assess the relationship between TMD and occlusion, Lipp found that experimental, epidemiological and clinical studies failed to support a significant role of occlusion in the development of a TMD.⁹ The same author suggested that remodelling capacity of the articulatory system would allow accommodation to most occlusal function and dysfunction.⁹

Furthermore, controlled studies of occlusal factors and TMD show either no relationship, or at best only a weak correlation, between specific variables and TMD.¹⁰⁻¹³

Association not implication

In a series of studies by Seligman and Pullinger, an overjet of >4mm, unilateral posterior crossbite and retruded contact position, and intercuspal position slides of greater than 1.75mm were associated with TMDs, albeit these associations were found to be statistically weak. They also found that no single occlusal factor was able to differentiate TMD patients from healthy subjects.^{14,15}

The same authors concluded that many occlusal parameters, traditionally believed to be influential, contribute only in a minor manner to the development of TMDs and that the occlusion cannot be considered to be the most important factor in the aetiology of a TMD.^{15,16} They justified this, however, by stating that 'some occlusal features may place greater adaptive demands on the system. While most individuals compensate without problems, adaptation in others may lead to greater risk of dysfunction'.¹⁶

These studies, however, reported on the static relationship of the teeth rather than contacts during dynamic occlusion. This has represented the traditional approach to evaluating occlusion. Static relationships provide only a limited insight into the role of occlusion and TMD, nevertheless, Pullinger and co-workers showed that specific occlusal factors might make some biological contribution and thus should not be ignored. However, they argued that a

biological system is able to adapt to various morphologic features until stability is achieved.¹⁶

The same authors estimated that occlusal factors initiate symptoms in approximately 5% of TMD patients. They also suggested that some occlusal variables may be a result rather than a cause of TMD.¹⁶ When considering those authors who argue that specific occlusal factors might make some biological contribution to a TMD and thus should not be ignored,^{17,18} it should be remembered that a biological system will frequently adapt to various morphologic features until stability is achieved.

Moreover, Lobbezoo-Scholte et al., showed that occlusal interferences were found in the same distribution among patients of three different diagnostic TMD groups, and that occlusal interferences were present with the same incidence in non-patient groups.¹⁷

Some authors used magnetic resonance imaging (MRI) and tomography to study the relationship between the temporomandibular joint (TMJ) components, the lateral pterygoid muscle and the occlusion of TMD patients.¹⁸ No association was found between the morphology of the TMJ osseous structures, disc position, the lateral pterygoid morphology and occlusal factors.¹⁸

Moreover, a case-control study showed no significant difference in occlusal factors among adolescents with TMD compared with those in a control group.¹⁹ Adolescents with TMD, however, showed significantly higher level of stress and aggressive behaviour compared with the controls, and they concluded that psychological factors may play a more prominent role.¹⁹

The role of guidance scheme and interferences

Although the occlusal relationships, such as working side interferences, non-working side interferences, and the discrepancy between the centric occlusion (CO) and centric relation (CR) have often been considered as a contributing factor for TMD,

no consistency has been shown in studies to support these theories.²⁰⁻²⁴

No significant differences have been demonstrated between signs of TMD and a lateral slide from CR to CO, non-working contacts and posterior interferences.²⁰⁻²² This appears to be as a result of the lack of valid and reliable methods of evaluating the occlusion in addition to the multifactorial nature of the various signs and symptoms.

In one study, data from 28 studies was collected to investigate the relationship between experimental occlusal interferences and TMD. It was found that experimental occlusal interferences which contact only in lateral jaw movement were only occasionally 'harmful to jaw function', and there was no reliable evidence to demonstrate that occlusal interferences cause bruxism.²⁰ The authors of this study commented that studies which suggested experimental occlusal interferences were able to induce a clinical TMD were largely based on observation and the authors' personal opinion, and that the introduction of occlusal interferences did not result in significant evidence for development of TMD.

Using MRI analysis, Ohta et al., examined 41 TMD patients and found that the introduction of simulated nonworking side interference was associated with apparent disc displacement.²¹

Minagi et al., however, adopted a different view regarding the role of non-working side interference.²² In a clinical study, they found a significantly positive correlation between the absence of non-working side contacts and an increased prevalence of joint sounds. Their study suggests that such contacts may be 'protective'.

In a review article, Ash offered some suggestions regarding the role of occlusal interferences in TMD.²³ He postulated that natural occlusal interferences have usually been present for long periods of time and adaptation would have occurred. This was, however, a review article and he did not offer any substantive evidence in support of his belief. Ash also suggested that no occlusal adjustments should be made without prior successful splint therapy.²³

Al-Ani et al., conducted a clinical study to examine the relationship between lateral retrusive, which occurs when the mandibular mesial cusp slopes contact the distal cusp ridges of maxillary teeth, and lateral protrusive canine guidance, which occurs when mesial cusp slopes of maxillary teeth contact distal cusp ridges of mandibular teeth during lateral excursion of the mandible, and TMJ disc displacement.²⁴ They found that the incidence of ipsilateral lateral retrusive guidance was significantly higher in a patient group with TMJ clicking than in a control group. They reported a statistically significant association between the presence of TMJ clicking and lateral retrusive canine guidance.²⁴

In a recent systematic review, Manfredini et al.,³ reviewed the literature on the association between features of dental occlusion and TMDs. They concluded that, although there were a few papers that may have suggested a possible association, the existing evidence supports the absence of a disease-specific association, and there is no ground to hypothesise a major role for dental occlusion in the pathophysiology of TMDs. They recommended that dental clinicians will need to move towards the acceptance of the biopsychosocial model and abandon some of the older held beliefs about treating TMD.

The theory of 'orthopaedic stability'

Many authors suggest that the position of the condyles is critical to the equilibrium of the masticatory system and that occlusal factors may affect this position.^{25,26} Conversely, condylar displacement could also affect activity of the masticatory muscles, with the result that muscle spasm may be a source of pain. It is also suggested that muscle spasm might displace the condyle, and occlusal interferences may therefore be a result rather than a cause.²⁷

Juniper²⁷ suggested that following displacement of the disc, the condyle may also become displaced and the relationship of the lower teeth to the upper teeth becomes changed, resulting in premature contacts. The effect of the change of occlusion on the stable position of the condyle in the fossae has

been frequently discussed in the literature.^{28,29}

This theory of 'orthopaedic stability', which has been proposed by some authors,²⁹ is based on the concept of the importance of the 'harmony' between the intercuspal position of teeth and the stable position of the condyles in the fossae. The absence of this 'harmony' leads the condyle on one or both sides to be in an unstable relationship with the disc and articular fossa. When the elevator muscles contract, this instability leads the condyle on the affected side to move superiorly, seeking a more stable relationship with the disc and fossa (see Figure 1).

In addition to the intra-capsular disorder, i.e. the disc displacement resulting from this movement, this might lead to a decrease in occlusal contacts as a result of upward displacement of the condyle with the possibility of new occlusal interferences coming into function and further aggravating the condition.³⁰

Occlusal adjustment for treating TMD patients

As mentioned earlier, much of the basis for the idea that 'occlusion' plays a major role in the aetiology of TMD comes from observing the results of various occlusal therapies, and many of the theories which support the association are unsubstantiated. Success in therapy, however, does not demonstrate a causal association between occlusion and development of a TMD.³¹

Occlusal adjustments may be tempting to the clinician. If there is obvious interference, in the past it has been suggested that 'picking up a handpiece and removing the interference' may lead to an improvement in the patient's symptoms. This, however, is a dangerous course of action if previous analysis of articulated and mounted study casts and a plaster equilibration has not been undertaken. Otherwise, removal of premature contacts or interferences will be merely guesswork. It is similar to the analogy of sawing the legs off a table without any measurement. If a part is removed from one leg, it is frequently necessary to form repeated adjustments to the other three legs until a stable

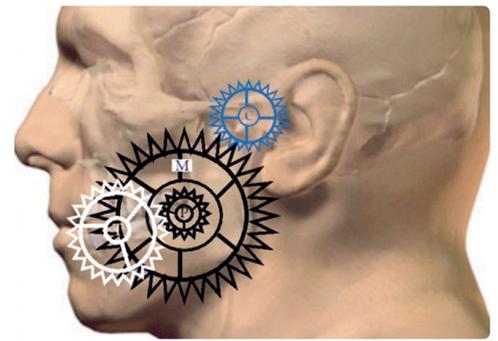


Figure 1: The effects of occlusal factors on mandibular stability and vice versa. No problem will be created with T (teeth) in a stable position and when C (condyle) is in a stable relationship with the articular fossa. When C is in unstable position (as in most cases of internal derangement) and M (muscles) is overactive, C could move superiorly seeking a more stable relationship to regain the harmony with M and T (the musculoskeletally stable position). Failure to achieve this might lead to an intra-capsular disorder which might result in changes at M and T. It should be noted, however, that this process is mainly affected by a neuromuscular mechanism

position is reached, if indeed this can be achieved.

To assess the effectiveness of occlusal adjustments in preventing and treating TMD patients, Koh and Robinson conducted a Cochrane systematic review of six studies which included 392 patients.³² The authors reported that there was an absence of evidence from randomised controlled trials (RCTs) that occlusal adjustments prevent or manage a TMD and, therefore, occlusal adjustment cannot be recommended for the management or prevention of TMD. The authors concluded that future trials should use standardised diagnostic criteria and outcome measures when evaluating TMD.³²

It is apparent when treating a patient with an occlusally balanced appliance that the mandibular position can alter quite markedly as treatment progresses and painful muscles relax.³¹ For this reason, what initially might be deemed to be an occlusal interference or

OCCLUSION AND TEMPOROMANDIBULAR DISORDERS: A LONG-STANDING CONTROVERSY IN DENTISTRY

premature contact at the onset of treatment might not be one at the end. As an initial therapy, occlusal adjustment is therefore not recommended as jaw and tooth relationships cannot be accurately determined in the presence of pain. The approach of 'pick up a handpiece and remove interferences at the first visit' is not defensible. It would therefore appear to be sound advice not to make permanent and irreversible adjustment to the occlusion in the presence of a TMD, as when the disc is repositioned occlusal contacts will change.³¹

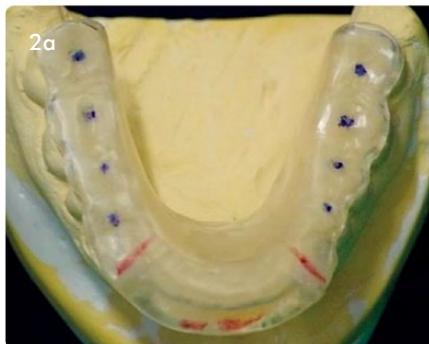
Gray and Al-Ani³³ argue in favour of caution in the use of occlusal adjustment as a remedy for TMD, suggesting that this can cause medico-legal concerns. They suggested that, medicolegally, it is difficult to defend haphazard removal of tooth substance or the surface of crowns or other restorations in an attempt to treat a TMD if this has not been pre-planned, and it should therefore be avoided.

There is insufficient evidence to suggest that any occlusal treatment is as effective, or more effective, than any other rehabilitation treatment in TMD. There is also insufficient evidence to support the generalised preventive influence of occlusal adjustment or orthodontic correction of malocclusion on TMD development.^{31,32}

Tsukiyama et al.,³¹ found that the data from occlusal adjustment experiments did not demonstrate therapeutic benefit in comparison with a control group and concluded that the evidence reviewed was not supportive of occlusal adjustment as therapy for TMD.

In general, the literature suggests that occlusal equilibration, therefore, should not be provided as an initial therapy for TMD patients, and it should not be performed to prevent or treat signs or symptoms.³¹⁻³⁴

It has also been suggested that if an anterior repositioning appliance successfully treats symptoms of an internal derangement, then the occlusion should be restored to the treatment position.³⁰ Contrary to what some practitioners advocate, however, occlusal therapy is not needed to



Figures 2a and 2b: A well-balanced stabilisation splint should be considered prior to commencing occlusal adjustment in a TMD patient

maintain a TMD patient's long-term symptomatic improvement.³⁵⁻⁴⁰

Since occlusal treatments are typically irreversible and the evidence of their therapeutic or preventive effects on TMD is insufficient, it is recommended that reversible treatment such as self-care, well-designed splints,⁴¹ physiotherapy and pharmacotherapy should always be used initially to manage signs and symptoms of TMD. As symptoms of pain and dysfunction in a TMD patient may come and go without any obvious change in any recognisable factor, one must be very hesitant about introducing any permanent changes in any part of the gnathological system.³³

Irreversible occlusal adjustments should never be undertaken in the presence of acute muscle pain or TMD symptoms. Ideally, occlusal adjustments should not be done until after a period of successful splint treatment. If a well-balanced stabilisation splint is worn (see Figures 2a and 2b) and the patient's symptoms resolve, only to return when the splint is 'weaned off', then there might be a logical reason to address the occlusion of the natural teeth, but not without further and detailed occlusal analysis, and only after meticulous planning with articulated plaster casts and with informed and valid consent. This would indicate whether provision of an 'improved' occlusion would benefit the patient's symptoms.

If occlusal adjustment or equilibration is deemed necessary for other clinical

reasons, it should always be planned on articulated study models mounted on a semi-adjustable articulator (see Figure 3) before irreversible and permanent changes are made to the patient's natural dentition.⁴²

In this way, the sequence of alterations can be carefully planned, and it can also be determined whether the desired result is realistically achievable.

It is acknowledged that occlusal treatment can be used successfully to correct an uncomfortable occlusion in a patient with or without TMD. For example, a patient who reports an uncomfortably high, recently placed restoration can be treated with occlusal adjustment of this restoration as the primary treatment.

Given that there are other, less invasive approaches available and TMD symptoms may be self-limiting, it would seem correct that occlusal adjustment is not indicated unless additional evidence is forthcoming.^{33,42-43}

Extensive restorative treatment in TMD patients

As discussed earlier, if the patient has a TMD, the occlusal contacts may not be the same as when symptom-free, especially if there is an acute disc displacement. Therefore, an occlusal interference may be a result, rather than a cause, of a temporomandibular disorder.

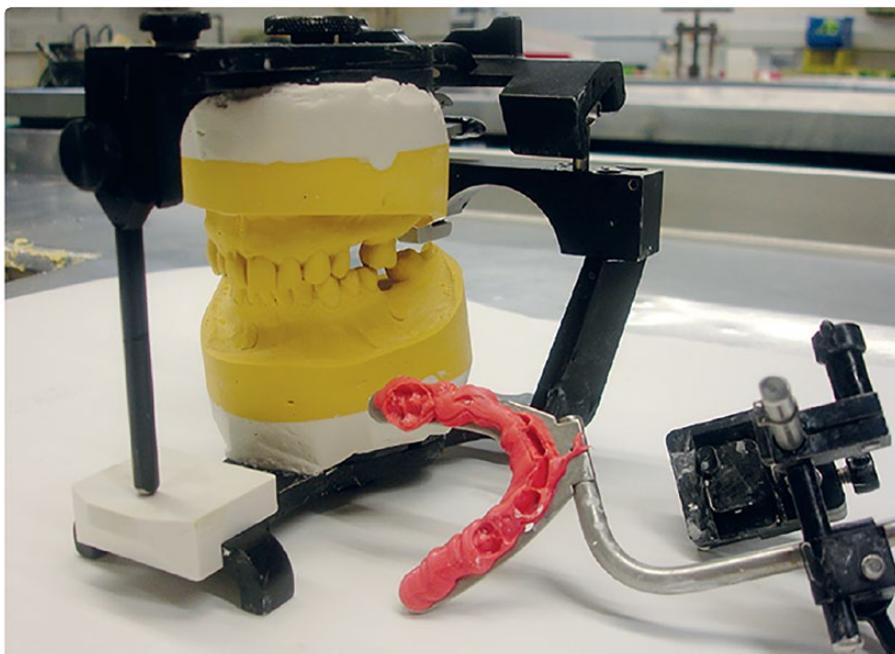


Figure 3: Occlusal equilibration should always be planned on study models mounted on a semi-adjustable articulator

In their study of a group of TMD patients, Al-Ani et al.³⁰ found that if the articular disc is out of position then the number of occlusal contacts appears to be reduced. The authors concluded that it would appear to be good advice not to make permanent and irreversible adjustment to the occlusion in the presence of disc

displacement, as when the disc is repositioned occlusal contacts are likely to change.

It is not sensible to continue with an extensive restorative treatment plan in the presence of acute disc displacement if this occurs part-way through treatment

as, when the disc is out of place, the occlusal contacts between maxillary and mandibular teeth will change both in position and number. Some authors suggested that the dental clinician should seek advice about whether it is necessary to treat the disc displacement before placement of the final restorations.^{33,42}

Conclusion

Despite the controversy of the role of occlusion in patients with TMDs, occlusion as part of the articulatory system is obviously a component feature in TMD patients. A detailed examination and recording of the patients' static and dynamic occlusion is essential to the successful diagnosis and management of these patients.

The decisions taken in the management of TMD patients should be scientifically supported in accordance with the principles of the evidence-based dentistry.⁴³ A balanced view regarding the relationship between occlusal factors and TMD would be that on some occasions, occlusal irregularities may be important contributing factors. However, scientifically controlled, longitudinal studies are needed to provide more reliable information concerning the relationship between occlusion and TMD.⁴⁴⁻⁴⁶

REFERENCES

- Gauer RL, Semidey MJ. Diagnosis and treatment of temporomandibular disorders. *Am Fam Physician*. 2015;91(6):378-86.
- Gray R, Al-Ani Z. Temporomandibular Disorders: A problem-based approach. London: Wiley-Blackwell; 2011.
- Manfredini D, Lombardo L, Siciliani G. Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era? *J Oral Rehabil*. 2017;44(11):908-923.
- Kerstein R. Occlusion's role in TMD problems? An interview with Dr Robert Kerstein. *Dent Today*. 1996;15(3):68-71.
- Okeson JP. Management of Temporomandibular Disorders and Occlusion. 5th ed. St Louis, London: Mosby; 2003.
- Bales J, Epstein J. The role of malocclusion and orthodontics in temporomandibular disorders. *J Can Dent Assoc*. 1994;60(10):899-905.
- Bush FM. Malocclusion, masticatory muscle, and temporomandibular joint tenderness. *J Dent Res*. 1985;64(2):129-133.
- Egermark-Eriksson I, Carlsson GE, Magnusson T, Thilander B. A longitudinal study on malocclusion in relation to signs and symptoms of craniomandibular disorders in children and adolescents. *Eur J Orthod*. 1990;12(4):399-407.
- Lipp MJ. Temporomandibular symptoms and occlusion: a review of the literature and the concept. *J Colo Dent Assoc*. 1991;69(3):18-22.
- Bales JM, Epstein JB. The role of malocclusion and orthodontics in temporomandibular disorders. *J Can Dent Assoc*. 1994;60(10):899-905.
- Mohlin B, Axelsson S, Paulin G, et al. TMD in relation to malocclusion and orthodontic treatment. *Angle Orthod*. 2007;77(3):542-8.
- Egermark-Eriksson I, Carlsson GE, Magnusson T, Thilander B. A longitudinal study on malocclusion in relation to signs and symptoms of craniomandibular disorders in children and adolescents. *Eur J Orthod*. 1990;12(4):399-407.
- Huber MA, Hall EH. A comparison of the signs of temporomandibular joint dysfunction and occlusal discrepancies in a symptom-free population of men and women. *Oral Surg Oral Med Oral Pathol*. 1990;70(2):180-183.
- Seligman DA, Pullinger AG. Analysis of occlusal variables, dental attrition, and age for distinguishing healthy controls from female patients with intracapsular temporomandibular disorders. *J Prosthet Dent*. 2000;83(1):76-82.
- Pullinger AG, Seligman DA. Quantification and validation of predictive values of occlusal variables in temporomandibular disorders using a multifactorial analysis. *J Prosthet Dent*. 2000;83(1):66-75.
- Pullinger AG, Seligman DA, Gornbein JA. A multiple logistic regression analysis of the risk and relative odds of temporomandibular disorders as a function of common occlusal features. *J Dent Res*. 1993;72(6):968-979.
- Lobbezoo-Scholte AM, Lobbezoo F, Steenks MH, et al. Diagnostic subgroups of craniomandibular disorders. Part II: Symptom profiles. *J Orofac Pain*. 1995;9(1):37-43.
- Liu ZJ, Yamagata K, Suenaga S, et al. Morphological and positional assessments of TMJ components and lateral pterygoid muscle in relation to symptoms and occlusion of patients with temporomandibular disorders. *J Oral Rehabil*. 2000;27(10):860-874.

OCCLUSION AND TEMPOROMANDIBULAR DISORDERS: A LONG-STANDING CONTROVERSY IN DENTISTRY

- 19 List T, Wahlund K, Larsson B. Psychosocial functioning and dental factors in adolescents with temporomandibular disorders: a case-control study. *J Orofac Pain.* 2001;15(3):218-227.
- 20 Clark GT, Tsukiyama Y, Baba K, Watanable T. Sixty-eight years of experimental occlusal interference studies: what have we learned? *J Prosthet Dent.* 1999;82(6):704-713.
- 21 Ohta M, Minagi S, Sato T, et al. Magnetic resonance imaging analysis on the relationship between anterior disc displacement and balancing-side occlusal contact. *J Oral Rehabil.* 2003;30(1):30-33.
- 22 Minagi S, Watanable H, Sato T, Tsuru H. The relationship between balancing-side occlusal contact patterns and temporomandibular joint sounds in humans: proposition of the concept of balancing-side protection. *J Craniomandib Disord.* 1990;4(4):251-256.
- 23 Ash MM. Occlusion: reflections on science and clinical reality. *J Prosthet Dent.* 2003;90(4):373-384.
- 24 Al-Ani MZ, Gray RJ, Davies SJ, Sloan P. A study of the relationship between lateral guidance and temporomandibular joint internal derangement. *Eur J Prosthodont Rest Dent.* 2003;11(2):65-70.
- 25 Padala S, Padmanabhan S, Chithranjan AB. Comparative evaluation of condylar position in symptomatic (TMJ dysfunction) and asymptomatic individuals. *Indian J Dent Res.* 2012;23(1):122.
- 26 Weffort SY, de Fantini SM. Condylar displacement between centric relation and maximum intercuspation in symptomatic and asymptomatic individuals. *Angle Orthod.* 2010;80(5):835-842.
- 27 Juniper RP. Temporomandibular joint dysfunction: a theory based upon electromyographic studies of the lateral pterygoid muscle. *Br J Oral Maxillofac Surg.* 1984;22(1):1-8.
- 28 Bakke M1, Möller E. Craniomandibular disorders and masticatory muscle function. *Scand J Dent Res.* 1992;100(1):132-8.
- 29 Okeson JP. Occlusion and functional disorders of the masticatory system. *Dent Clin North Am.* 1995;39(2):285-300.
- 30 Al-Ani Z, Davies S, Sloan P, Gray R. Change in the number of occlusal contacts following splint therapy in patients with a temporomandibular disorder (TMD). *Eur J Prosthodont Restor Dent.* 2008;16(3):98-103.
- 31 Tsukiyama Y, Baba K, Clark GT. An evidence-based assessment of occlusal adjustment as a treatment for temporomandibular disorders. *J Prosthet Dent.* 2001;86(1):57-66.
- 32 Koh H, Robinson PG. Occlusal adjustment for treating and preventing temporomandibular joint disorders. *Cochrane Database Syst Rev.* 2003;(1):CD003812.
- 33 Gray R, Al-Ani Z. Risk management in clinical practice. Part 8. Temporomandibular disorders. *Br Dent J.* 2010;209(9):433-49.
- 34 Conti PC, Ferreira PM, Pegoraro LF, et al. A cross-sectional study of prevalence and etiology of signs and symptoms of temporomandibular disorders in high school and university students. *J Orofac Pain.* 1996;10(3):254-262.
- 35 Clark GT, Tsukiyama Y, Baba K, Simmons M. The validity and utility of disease detection methods and occlusal therapy for temporomandibular disorders. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997;83(1):101-106.
- 36 De Boever JA, Carlsson GE, Klineberg LJ. Need for occlusal therapy and prosthodontic treatment in the management of temporomandibular disorders. Part I. Occlusal interferences and occlusal adjustment. *J Oral Rehabil.* 2000;27(5):376-379.
- 37 De Boever JA, Carlsson GE, Klineberg LJ. Need for occlusal therapy and prosthodontic treatment in the management of temporomandibular disorders. Part II: Tooth loss and prosthodontic treatment. *J Oral Rehabil.* 2000;27(8):647-659.
- 38 McNeill C. *Science and Practice of Occlusion.* Hong Kong: Quintessence Publishing; 1997.
- 39 Yatani H, Hatanaka K, Matsuka Y, et al. Multivariate analysis of risk factors in relation to TMD symptoms. *J Oral Rehabil.* 2002;29(9):883.
- 40 Ash M M, Ramfjord SP. *Occlusion.* 4th ed. Philadelphia: WB Saunders Company; 1995.
- 41 Al-Ani Z, Gray RJ, Davies SJ, et al. Stabilization splint therapy for the treatment of temporomandibular myofascial pain: a systematic review. *J Dent Educ.* 2005;69(11):1242-50.
- 42 Gray RJ, Al-Ani Z. Conservative temporomandibular disorder management: what DO I do? Frequently asked questions. *Dent Update.* 2013;40(9):745-756.
- 43 Klineberg I, Jagger R. *Occlusion and clinical practice: an evidence-based approach.* London: Wright; 2004.
- 44 Weyant RJ. Questional benefit from occlusal adjustment for TMD disorders. *J Evid Based Dent Pract.* 2006;6(2):167-168.
- 45 Friction J. Current evidence providing clarity in management of temporomandibular disorders: summary of a systematic review of randomized clinical trials for intra-oral appliances and occlusal therapies. *J Evid Based Dent Pract.* 2006;6(1):48-52.
- 46 Manfredini D, Bucci MB, Montagna F, Guarda-Nardini L. Temporomandibular disorders assessment: medicolegal considerations in the evidence-based era. *J Oral Rehabil.* 2011;38(2):101-119.