Bruxism in Prospective Studies of Veneered Zirconia Restorations—A Systematic Review

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Purpose: The objectives of this work were to systematically review the effect of bruxism on the survival of zirconia restorations on teeth and to assess the prevalence of nocturnal masseter muscle activity in a clinical sample. ***Materials and Methods:*** A Medline search was performed independently and in triplicate using the term "zirconia" and activating the filter "clinical trial." Furthermore, three other electronic databases were searched using the same term. Only papers published in English on prospective studies of veneered zirconia frameworks on teeth were included. To estimate the prevalence of sleep bruxism in clinical settings, subjects with no clinical signs of bruxism and who did not report grinding and/or clenching were examined by use of a disposable electromyographic device. ***Results:*** The initial search resulted in 107 papers, of which 22 were included in the analysis. Bruxers were excluded in 20 of these articles. In 1 study bruxers were not excluded, and 1 study did not provide information regarding this issue. The methods used to identify bruxers were heterogeneous/not described, and no study used reliable, valid methods. Of 33 subjects without clinical signs of bruxism, nocturnal muscle activity exceeded predefined muscle activity for 63.8% of the subjects. ***Conclusion:*** There is a lack of information about the effect of bruxism on the incidence of technical failure of veneered zirconia restorations because all available studies failed to use suitable instruments for diagnosis of bruxism. Nocturnal muscle activity without clinical symptoms/report of bruxism was observed for a relevant number of patients. *Int J Prosthodont 2014;37:127–133. doi: 10.11607/ijp.3652*

In the last decade, veneered zirconia frameworks have frequently been used in dentistry, and their clinical performance has been assessed in prospective in vivo studies.[1,2] It has been shown that chipping of these restorations is a major complication,[3] and several proposals for overcoming this problem have been published.[4–6] Some of these proposals have proved their effectiveness in in vitro or in vivo studies and might, therefore, have contributed to reducing the incidence of complications.

In addition to technical reasons, bruxism is a biologic cause that might also be responsible for failure of the veneer.[7,8] Bruxism is defined by the American Academy of Sleep Medicine as a stereotyped oral motor disorder characterized by sleep-related grinding and/or clenching of the teeth.[9] It is characterized by phasic and/or tonic contractions of the jaw muscles. Because rhythmic muscle contraction of the jaw muscles is observed for approximately 60% of "normal" sleepers,[10] bruxism may be regarded as an extreme manifestation of activity occurring normally during sleep. It has been shown in epidemiologic studies that the prevalence of bruxism is approximately 20% for clenching and 6% for grinding.[11,12] It has also been found that severe manifestations of these activities are present in approximately 5% of subjects.[11,12] Thus, it is highly likely that some patients who request prosthodontic treatment are bruxers. However, identification of bruxers is challenging, and the problem has been addressed in a recent consensus paper about bruxism.[13] Distinction between possible, probable, and definite sleep or awake bruxism has been proposed. Polysomnographic recordings are regarded as the best method of diagnosis of definite

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bruxism. In this context, Mainieri et al[14] validated a disposable, easy to use electromyographic device and found that the device can be regarded as a moderately successful method of screening to aid diagnosis of sleep bruxism. Although this device cannot replace polysomnographic recordings, it might usefully aid more robust diagnosis by complementing clinical and anamnestic examinations.

In clinical studies dealing with veneered zirconia restorations, three approaches can be used to overcome this problem: exclusion of bruxers, grading of the severity of bruxism for each subject, or inclusion of all subjects irrespective of bruxism. For all three of these, a suitable diagnostic instrument should be used to rate the subjects as, at least, probable bruxers because definite diagnosis of bruxism requires polysomnography and is, consequently, not realizable in a clinical study with moderately sized populations. If inadequate methods are used to assess bruxism, however, the number of subjects with (probable) bruxism is unknown. The same is true if subjects are included irrespective of bruxism. Inclusion of subjects with bruxism might, however, have a substantial effect on the results of the study,[15] especially with regard to chipping.[8] For this reason, most manufacturers' guidelines advise against use of any ceramic material for bruxers, implying that patients with bruxism must be reliably identified.

The purpose of this study was to assess the way in which this issue was handled in prospective studies on veneered zirconia restorations on teeth. This information is essential if the results of these studies are to be applied to the general population (generalizability). The prevalence of nocturnal muscle activity as a possible sign of bruxism in a clinical sample should also be assessed by use of a disposable electromyographic (EMG) device. Assuming that increased muscle activity is an indicator of bruxism,[16] this approach could aid in the identification of bruxers. This information could also assist in the interpretation of the findings of this review. The hypothesis of this study was that most other studies excluded bruxers and that, consequently, the generalizability of the results of these studies is questionable.

Materials and Methods

Systematic Review of the Literature

The following PICO inquiry was used: patient (need for a crown or bridge by patients without bruxism); intervention (insertion of a veneered zirconia restoration); control (need for a crown or bridge by patients with bruxism); outcome (chipping and/or delamination and/or fracture of the restoration).

The three authors performed a Medline (via Pubmed) search in July 2012 using the term "zirconia" and activating the filter "clinical trial." Reviews were also identified in Medline (via Pubmed) using the term "zirconia" and activating the filter "systematic review." The Cochrane library of systematic reviews was also searched using the term "zirconia." Finally, one of the authors searched for gray literature in OpenSIGLE, an information system for gray literature in Europe, and for unpublished data in ClinicalTrials.gov. The reference lists of all identified papers and/or reviews were searched by hand for relevant literature (using the snowballing strategy as described by Greenhalgh and Peacock[17]). Only papers published in English on prospective studies of veneered zirconia frameworks on teeth were included. Reviews used to identify further relevant papers had to assess the incidence of complications and/or survival of veneered zirconia frameworks on teeth.

All papers were analyzed independently by all three authors. First, it was assessed whether bruxers were excluded from the study. Second, if applicable, the manner in which bruxism was diagnosed and graded was assessed. If no information was found, the authors tried to contact the corresponding author of the manuscript to obtain the missing information.

Assessment of Bruxism in a Clinical Sample

For a clinical trial of zirconia restorations, 20 subjects without severe bruxism were recruited. This study was approved by the review board of Heidelberg University Hospital, and all subjects provided a signed consent form. As a first step, potential subjects were screened by assessing wear facets, by tooth and tongue examination, by detailed anamnesis, and by screening examination for temporomandibular disorders (TMD).[18] The inclusion criteria for this study were subjects without any clinical signs of bruxism (attrition score[19] < 2, no muscle pain), subjects who did not report grinding and/or clenching, and subjects who did not report other medical or mental disorders and/or sleep disorders.[16] Subjects meeting the inclusion criteria were examined in a second step by use of a disposable electromyographic device (BiteStrip, up-2dent). Thus, the subjects who were examined by use of the BiteStrip were those who were most likely to be classified as nonbruxers in the studies under review. The BiteStrip device measures the electromyographic activity of the masseter muscle, and its use has been reported to be a useful means of screening for bruxism.[14,20] It is easy to use, lightweight, and small. It consists of two electrodes, a small amplifier, software, and a display. The subjects were instructed in use of

the device. At home, the BiteStrip was attached in the region of the masseter muscle in accordance with the manufacturer's guidelines. It was then calibrated by maximum voluntary clenching (MVC) three times. The threshold is automatically set to 30% of MVC, and the device starts to analyze muscle activity 30 minutes after activation. The time each muscle exceeded the threshold was counted and recorded. During the next few days the subjects made an appointment at the clinic to return the device to a study nurse.

Results

Review of the Literature

The initial search for original articles resulted in 107 papers (Fig 1). In addition, 31 reviews were identified, of which 5 met the inclusion criteria.[7,21–24] The review that was identified in the Cochrane library was also identified in PubMed.[25] No further relevant articles and/or results were found in OpenSIGLE or ClinicalTrials. After assessing the titles and abstracts of the original papers and inclusion of original research articles identified in the reference lists of the 5 reviews, follow-up publications (eg, 3- and 5-year results of the same study) were identified and only the latest publication was included. As a result, 22 original research articles were included in the analysis.

Bruxers were excluded in 20 articles (Table 1; two authors answered the reviewer's request). In 1 study bruxers were not excluded,[26] and 1 study did not provide information about this issue.[27] However, no study reported the number of patients excluded because of bruxism and no study assessed the effect of bruxism on the incidence of technical complications for zirconia restorations by grading the severity of bruxism. Furthermore, the methods used to identify bruxers were only reported in 9 studies[28–36]: in 1 study, patient interview was used exclusively[36]; in another 5 studies, extensive loss of tooth structure was used[30–32,34,35]; in 1 study, both patient report and tooth wear were used[32]; and in 2 studies, the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and severe occlusal parafunctions were used as exclusion criteria.[28,29] The systematic review revealed there are no reliable data on a potential relationship between failure of the veneer of zirconia restorations and sleep bruxism.

Assessment of Bruxism in a Clinical Sample

Thirty-three subjects recruited for a clinical trial on zirconia restorations were assessed for sleep bruxism by use of the electromyographic BiteStrip device.

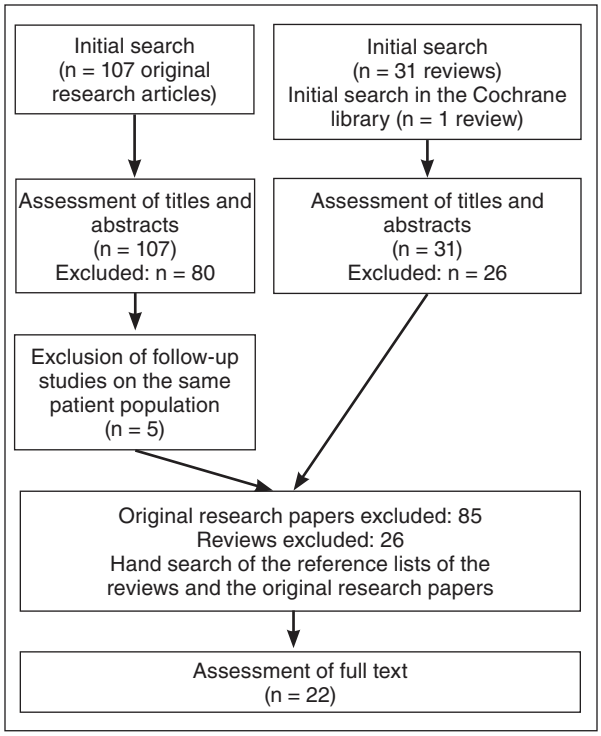

Fig 1 Flowchart of the literature search.

No clinical signs of bruxism (eg, linea alba, tongue scalloping, abnormal wear of teeth) were observed for these subjects, and none reported nocturnal or daytime muscle activity. The following results were obtained by use of the BiteStrip. Twelve subjects (36.3%) had no or low-level masseter muscle activity corresponding to up to 30 episodes of muscle activity within 5 hours during sleep. For five subjects (15.2%), mild muscular activity was observed, ie, from 31 to 60 episodes within 5 hours. Moderate muscular activity (61 to 100 episodes within 5 hours) was observed for seven subjects (21.2%). Severe muscular activity (more than 100 episodes within 5 hours) was observed for nine subjects (27.3%) who were, therefore, excluded from the clinical trial (Fig 2). Four other subjects had to be excluded for other reasons. Assuming masseter muscle activity above the threshold value is an indicator of bruxism, no bruxism was observed for approximately 36% subjects.

Discussion

Several studies have assessed the reliability and validity of wear facets, TMD, facial pain, occlusion, and psychosocial aspects as clinical signs of sleep bruxism. Although some variables might be somewhat related to bruxism, none of these factors alone is

Table 1 Bruxism Assessment in the Studies

Author(s)	No. of restorations	Bruxism and/or parafunctions as exclusion criteria	No. of patients excluded because of bruxism	Method used to diagnose bruxism
Sagirkaya et al (2012)[44]	267 (tooth supported: 167)	Yes	No information provided	No information provided
Sorrentino et al (2012)[35]	48	Yes	No information provided	"Severe wear facets"
Salido et al (2012)[45]	17	Yes	No information provided	No information provided
Peláez et al (2012)[46]	20	Yes	No information provided	No information provided
Schmitter et al (2012)[2]	30	Yes	No information provided	No information provided
Rinke et al (2011)[47]	92	Yes	No information provided	No information provided
Crisp et al (2011)[31]	34	Yes	No information provided	"Evidence of occlusal parafunctions/ pathologic tooth wear"
*Christensen and Ploeger (2010)[26]	293	No	–	–
Roediger et al (2010)[48]	99	Yes	No information provided	No information provided
Schmitt et al (2010)[27]	19	No exclusion criteria provided		
Tsumita et al (2010)[36]	21	Yes	No information provided	"Patient interviews"
Beuer et al (2010)[29]	68	Yes	No information provided	"Severe occlusal parafunctions," "according to RDC/TMD"
Wolfart et al (2009)[49]	58	Yes	No information provided	No information provided
Sailer et al (2009)[33]	76	Yes	No information provided	"No obvious signs of bruxism"
Schmitt et al (2009)[34]	30	Yes	No information provided	"Severe occlusal wear"
Cehreli et al (2009)[30]	30	Yes	No information provided	"Extensive loss of tooth structure"
Beuer et al (2009)[28]	21	Yes	No information provided	"Severe occlusal parafunctions," "according to RDC/TMD"
Edelhoff et al (2008)[50]	22	Yes	No information provided	No information provided
Molin and Karlsson (2008)[51]	19	Yes	No information provided	No information provided
Tinschert et al (2008)[52]	65	Yes	No information provided	No information provided
*Sailer et al (2007)[1]	33	Yes	No information provided	No information provided
Raigrodski et al (2006)[32]	20	Yes	No information provided	"Severe wear facets and/or report of parafunctional activities"

*Information received on request.

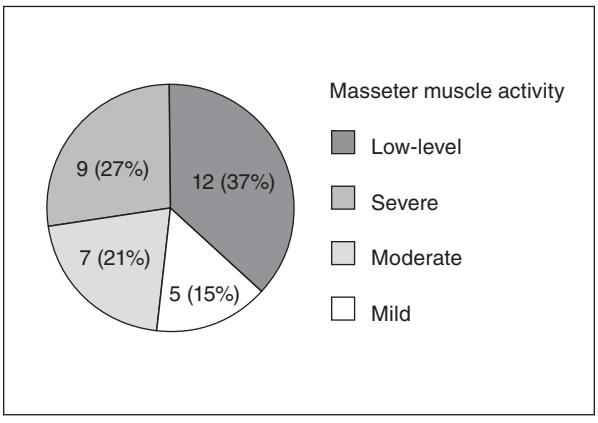

Fig 2 Masseter muscle activity measured using a disposable electromyographic device.

suitable for reliable and valid identification of bruxers. Wear facets,[37] TMD,[38] facial pain, occlusion,[39] and psychosocial aspects[40] did not prove to be causally related to sleep bruxism. For wear facets, for example, it is very difficult to discriminate between different causes (physiologic attrition or result of parafunctional activity). It is, furthermore, necessary to distinguish between functional and parafunctional wear facets and between active wear facets because of current parafunctional activity and inactive wear facets because of past parafunctional activity. To summarize, use of these factors to identify bruxers is doubtful and it remains unclear which subjects have been excluded from clinical trials by use of these criteria. An international consensus paper about bruxism has

recently been published[13]; it proposes a system of diagnostic grading of possible, probable, and definite sleep or awake bruxism. The best method for definitive diagnosis of sleep bruxism is polysomnographic recording.[41] This approach is both costly and time-consuming, however, and, consequently, not suitable for use in clinical trials on new restorative materials.

EMG devices are suitable for assessment of muscle activity and might, therefore, aid in the diagnosis of bruxism.[42] In recent years, easy to use, small, and portable EMG devices have been introduced for domestic use. Although these devices might aid rapid, inexpensive, and reliable diagnoses of bruxism,[14,20] they are suitable for estimation of muscular motor activity only. Assuming the activity of the masseter muscle increases during bruxism,[16] these recordings might be an indicator of bruxism. This approach needs further elaboration, however, as stated in the consensus paper.[13]

In most of the studies identified, the way in which bruxism was diagnosed was not reported. Thus, it remains unclear how many (probable) bruxers were included. In nine studies,[28–36] anamnestic questions, wears facets, and/or functional aspects were used to diagnose bruxism. In most of these studies, one of these criteria, only, was used, resulting in uncertainty with regard to exclusion/inclusion of study patients. Thus, the number of patients with bruxism in each study is unknown. The same is true for the study that did not exclude bruxers.

To estimate the number of subjects with bruxism who might have been included in the studies identified, a pilot study using a disposable EMG device was initiated. In this pilot study, dentate patients without clinical signs of bruxism were screened by use of a disposable EMG device. The results showed that activity of the masseter muscle was above the threshold value for approximately 64% of these patients. A shortcoming of this study is the assumption that increased muscular activity is an indicator of bruxism: although this assumption seems reasonable, there is a lack of supporting evidence.

The prevalence of bruxism in this study is above that reported in the literature.[11,12] In this context, it must be remembered that in this study muscle activity was recorded for a sample of patients at a clinic and not for a representative sample, which might explain the differences. Because of the lack of prevalence data in the literature for this special clinical setting (ie, prevalence of excessive nocturnal muscle activity for patients without clinical signs of bruxism and without self-report of bruxism), inclusion of the results of the pilot study in this review was mandatory to enable the interpretation of the results of the review. Another reason for the higher prevalence might be that in some cases the muscle activity of the masseter might be associated with orofacial activity other than bruxism, resulting in false-positive results for bruxism.

Use of clinical data to diagnose bruxism in the studies identified seems to be the procedure usually used in the clinical setting of a dental office. The dental practitioner commonly uses the same clinical data to identify bruxers: wear facets, TMD symptoms, and self-report. The results of the studies identified with regard to bruxism seem, therefore, to be generalizable.[43] However, the association between bruxism and technical failures of all-ceramic restorations remains unclear because of a lack of studies that include reliable and valid diagnoses of bruxism. The assumption that the results of these studies are valid for nonbruxers only is, however, not justified.

Although it is stated in most of the studies identified that bruxers were excluded, the hypothesis of this study must be rejected because the way in which bruxers were identified was questionable in most studies. Consequently, on the basis of findings from assessment of muscle activity in this study, it is very likely that bruxers were included in the studies identified, which results in generalizability of the findings with regard to bruxism.

Conclusion

Although several studies assess the survival of veneered zirconia restorations, there is a lack of information about the effect of bruxism on the incidence of technical failures because none of the available studies used a reliable and valid instrument to diagnose bruxism. A relevant number of patients had nocturnal muscle activity without clinical symptoms of bruxism.

Acknowledgments

The authors reported no conflicts of interest related to this study. This study was not industrially supported. The clinical trial about zirconia restorations that was mentioned in the manuscript was supported by Wieland Dental.

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Literature Abstracts

The morbidity of oral mucosal lesions in an adult Swedish population

Authors evaluated the prevalence and severity of symptoms of oral mucosal lesions reported by general dental practitioners using a standardized registration method. Based on clinical photographs, oral medicine specialists also evaluated the lesions and the degree of agreement was calculated. Of 6,448 adult patients, 950 patients (14.7%) presented with at least one mucosal lesion. One hundred forty one patients (14.8%) reported subjective symptoms and among them, 65 patients (6.8%) scored their symptoms $\geq$ 30, and 28 patients (2.6%) scored their symptoms $\geq$ 60 on a visual analog scale. Aphthous stomatitis was the most debilitating condition. The top three mucosal lesions were snuff dipper's lesion (4.8%), lichenoid lesions (2.4%), and geographic tongue (2.2%). Oral medicine specialists and general practitioners agreed on the diagnosis of lesions 85% of the time (n = 803). Authors also compared patients with the six most common lesions with patients without lesions. Compared with control patients, aphthous ulcers patients reported more allergies. Leukoplakia patients more commonly smoked. Lichenoid lesion, geographic tongue, and snuff lesion patients more commonly had hypertensive diseases. Patients with lichenoid lesions, geographic tongue, and fissured tongue used more cardiovascular medications.

Robledo-Sierra J, Mattsson U, Svedensten T, Jontell M. *Med Oral Patol Oral Cir Bucal* 2013;18:e766–772. **References:** 22. **Reprints:** Prof Mats Jontell, Department of Oral Medicine and Pathology, Institute of Odontology, Sahlgrenska Academy, University of Gothenburg, PO Box 450, 405 30 Gothenburg, Sweden. **E-mail:** jontell@odontologi.gu.se—*John Chai, Evanston, Illinois, USA*

Interventions for replacing missing teeth: Antibiotics at dental implant placement to prevent complications

The prophylactic use of antibiotics in implant surgery remains controversial. The authors conducted a Cochrane review on the topic and identified four randomized controlled clinical trials with at least 3 months of follow-up that compared the clinical outcome of dental implant surgery with or without the administration of prophylactic antibiotic regimens. Outcome measures included prosthesis failures, implant failures, postoperative infections, and other adverse events. Three studies compared 2 g of preoperative amoxicillin (927 patients) and the other compared 1 g of preoperative amoxicillin plus 500 mg four times a day for 2 days (80 patients). Meta-analyses showed a statistically significant higher number of patients experiencing implant failures in the group not receiving antibiotics. The number needed to treat to prevent one patient from having an implant failure was 33 (95% confidence interval, 17 to 100), based on a patient implant failure rate of 5% in patients not receiving antibiotics. Thus, antibiotics would prevent one patient from experiencing an early implant loss out of every 33 patients who received antibiotics. There was no evidence of the antibiotic regime being associated with a significant selection of antibiotic-resistant bacteria. Adverse outcomes were not statistically significant. The authors suggested the use of a single dose of 2 g prophylactic amoxicillin prior to dental implant placement, although they noted that whether postoperative antibiotics are beneficial and which one is the most effective are questions yet to be answered.

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