Bruxism: Theory and Practice

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Foreword

For years the dental profession has been intrigued, fascinated, and sometimes even obsessed with the phenomenon we call bruxism. It has been underdiagnosed, overdiagnosed, and even misdiagnosed. Some have described it as the most destructive process affecting the masticatory structures, while others refer to it as a benign routine activity. Some suggest it is rare, while others say it is very common. Some say it is a major contributor to temporomandibular disorders, while others say it is not even related.

The etiology of bruxism has been hotly debated for years. Some believe it is a peripherally generated activity associated with tooth contacts, while others believe it is a central brainstem-driven process. There is a long list of suggested causes of bruxism such as eccentric tooth contacts, dental malocclusion, emotional stress, anxiety, sleep disturbances, genetic factors, medications, alcohol consumption, breathing disorders, allergies, mental disorders, and even pin worms. Bruxism is even mentioned in the Holy Bible as the "gnashing of teeth" associated with anger and frustration.

The dental profession has learned that studying bruxism is difficult and controversial. Most patients are unaware of their bruxing activity and therefore deny it. Bed partners are sometimes more reliable reporters. We dentists seem to inform all our patients that they brux; they just don't know it. We most probably do this because we see the evidence of tooth wear, yet timing may be a serious issue. For instance, significant tooth wear in a 40-year-old patient may present as a dental problem; yet this wear might have occurred 20 years earlier and bruxism is no longer a contributing factor.

Clinicians have also developed a wide variety of treatments for bruxism, many with no scientific evidence. Dental treatments have ranged from selectively adjusting the occlusion to prosthetic or orthodontic therapies. We have developed a wide variety of occlusal appliances, most with limited to no supportive data. We have suggested non-dental therapies such as medications, biofeedback, stress reduction, and acupuncture. We have even used negative-feedback devices including electric shocks, loud noises, and taste aversion. It is obvious that we need to understand and document the most effective method to manage bruxism.

It is quite evident that the profession needs a comprehensive review of this complex phenomenon known as bruxism. Dr. Daniel Paesani recognized this need and has put together the most thorough body of information ever created by the profession. He has assembled some of our finest experts from around the world to contribute their knowledge and insights to this text. His comprehensive list of chapters has left no stone unturned. This text is the most complete overview of bruxism the profession has ever had opportunity to review.

There are several reasons why I am very pleased to have been asked to write the foreword to this textbook. First, this text represents the first comprehensive attempt to review bruxism, and the profession needs to be enlightened and informed about this important subject. I am also very pleased

because I have known Daniel Paesani for almost 30 years and I know and appreciate his dedication to the field. Dr. Paesani was one of my very first international residents in our Orofacial Pain Center and he came from Rosario, Argentina to Lexington, Kentucky with much passion for the field and personal sacrifice. I have always admired his dedication and work ethic, and this text is a product of just that. I believe it will serve our profession well.

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Preface and Acknowledgments

Over my 12 years as Professor of Masticatory System Physiology in the School of Odontology of the Universidad del Salvador/AOA (Buenos Aires, Argentina), the biggest problem we have had to face has been the lack of scientific compilations on bruxism, which are needed for students to take bruxism as an object of study.

At first, we used to request students to visit the Medline web page – the most important biomedical-literature database worldwide – and perform searches, but before long we realized that was not the right track. The students faced the difficulty of having to select which pieces of information to use from the thousands of publications retrieved by search engines. Of course, since these were first-degree students, they were not yet sufficiently qualified to differentiate concepts that had been validated by scientific method from concepts based simply on mysticism and dogma. We, the professors, would spend long hours assisting them with these issues, and we would use the scarce, precious time available to us to select and compile the study material rather than to teach.

This experience made me wonder why – researchers and published books being so many and bruxism being such an important entity in the odontological field – not a single volume existed devoted exclusively to bruxism. When I found no answer to this question, I started to think about taking on the responsibility to compile information with the aim of publishing a volume exclusively devoted to bruxism and its treatment.

After preparing an extensive list of chapters, and with the purpose of addressing all the topics related to bruxism, I invited a group of colleagues whose brilliant professional careers, experience, and dedication to the subject would *a priori* guarantee their addressing the specific topics with scientific and scholarly rigor. The premise was that each paragraph, each idea, each suggestion should be based on scientific evidence, so that the work, apart from being useful to college professors and students, is an interesting book for general practitioners, one that provides answers to the many questions arising in everyday dental practice. Also, specialists in craniomandibular disorders will benefit from the in-depth analysis of the subjects and the extensive, up-to-date bibliographies contained herein, which provide a quick, well-organized way to access the evidence they need in their professional practice and as a tool for planning future research. So, the volume is divided into three sections.

- The first section comprises eight chapters dealing with bruxism knowledge and guidelines for diagnosis, sleep physiology, main etiological theories, influence of peripheral and emotional factors, movement disorders, and bruxism in children.
- The second section comprises nine chapters and is devoted to the effects of bruxism on the masticatory system components. Some of the topics are: the noxious action of bruxism on dental pulp, periodontal ligament, temporomandibular joints, muscles, and its relation-

ship with pain. Some bruxism effects that are currently controversial are discussed, for which purpose a wide review of the literature on the subject is provided. Special emphasis has been placed on tooth wear and on the differential diagnosis of bruxism's several causes. One chapter has been specifically devoted to dental erosion, and another chapter to endogenous erosion mechanisms, since general practitioners often mistake tooth wear caused by endogenous erosion for tooth wear caused by bruxism.

- The third section comprises eight chapters and deals with various aspects related to the treatment of bruxism. The pharmacological effects of certain central-action drugs and some peripheral-action drugs, such as botulinum toxin, are described. The text also deals with the treatment of bruxism involving dental implants and appliances constructed with dental materials particularly recommended for bruxers. Topics related to dental occlusion are discussed with the aim of facilitating understanding of the concepts needed to enter the fascinating world of complex oral rehabilitation. One chapter deals with techniques used for the reconstruction of teeth affected by significant wear.

The volume also includes a review of the scientific evidence on the treatment of bruxism, especially bruxism splints. The different procedures used for protecting the masticatory system against the effects of bruxism are described and illustrated by means of case reports.

Acknowledgments

I would like to express my gratitude to:

- the contributing authors, whose valuable expertise and thorough dedication ensured the excellent coverage of a wide range of topics related to bruxism
- Professors Jeffrey Okeson, Ross Tallents, Per-Lennart Westesson, and Annika Isberg for introducing me to the marvelous world of science
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- my family, Triana, Guido, Julia, Pedro, Susana, and Candela, who, in all their love, gave up sharing many irretrievable days with me.

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Contents

PART 1: OVERVIEW OF THE PROBLEM

Part 1

Overview of the problem

Introduction to Bruxism

Daniel A. Paesani

Introduction

In the glossary of terms of the American Academy of Orofacial Pain, bruxism is defined as a "total parafunctional daily or nightly activity that includes grinding, gnashing, or clenching of the teeth. It takes place in the absence of subjective consciousness and it can be diagnosed by the presence of tooth wear facets which have not resulted from the chewing function".[1]

In order to understand the remoteness of the act of "gnashing the teeth", we can cite the following passages from the Bible:

Psalm 35:16 "Like profane mockers at a feast, they gnash at me with their teeth"

Psalm 112:10 "The sinner shall see and be angry, he shall gnash his teeth and consume away"

Job 16:9 "he grinds his teeth at me"

Matthew 8:12 "But the children of the kingdom shall be cast out into outer darkness: there shall be weeping and gnashing of teeth"

At the beginning of the twentieth century, Karolyi used the term "traumatic neuralgia" to refer to the grinding of the teeth and described it as the cause of a periodontal condition by then called *pyorrhea*.[2] The term "bruxism" comes from the Greek expression *brychein odontas* that means grinding the teeth. In French, *bruxomanie* was used for the first time by Marie and Pietkiewicz in 1907.[3] Then, Frohman was responsible for the first publication in the odontological literature when he referred to "bruxomania" as a pure psychological state.[4]

The Importance of Bruxism in Daily Care

Bruxism may be considered a normal habit; but under certain circumstances, such as an increase in the frequency of episodes and the strength of masseter contractions, it may turn into a phenomenon with pathological consequences.[5] Bruxism may dramatically change the result and the duration of the delicate and careful treatments performed by clinicians. Whereas a soft form of bruxism hardly ever affects oral structures, a hard manifestation

Table 2-1

Questionnaire for detection of bruxism.

	Yes	*No*	*Don't know*
Do you grind your teeth when you sleep?			
Has anybody heard you grind your teeth while you sleep?			
On waking up, do you usually find that you are clenching your teeth?			
When you wake up, do you usually have jaw pain or jaw fatigue?			
When you wake up, do you usually have the feeling that your teeth are loose?			
When you wake up, do you usually have sore teeth and/or sore gums?			
When you wake up, do you usually have a headache in the temples?			
When you wake up, do you usually have a jaw lock?			
Have you ever found that you were clenching your teeth in the daytime?			
Have you ever found that you were grinding your teeth in the daytime?			

- *complementary methods:* use of intraoral devices for tooth wear quantification (splints; Bruxcore®, Boston, MA, USA) and bite force detectors; masseter electromyography (EMG, ambulatory EMG, disposable EMG devices such as BiteStrip®); and sleep polysomnography.

Fig 2-1 Enamel fracture in both central incisors, as a result of bruxism in the protrusive direction. Note also the abrasive wear of vestibular enamel, caused by hard tooth brushing.

Clinical Diagnosis

Symptoms

A rapid way of collecting information is to request the patient to answer a questionnaire. It is the most widely available method to be used in everyday practice. Chapter 1 has already discussed the advantages and disadvantages of this method in the diagnosis of bruxism symptoms.

Questionnaires are very useful for obtaining a great amount of information in a short time. A good questionnaire should include a wide range of questions concerning the patient's general health status, diseases, medication, etc. Of course, as the main subject of this book is bruxism, we will just be dealing with the questions that specifically refer to it.

Table 2-1 shows sample questions that can be added to the general questionnaire usually used during the patient's first appointment; such a general questionnaire is simply about a collection of symptoms that can be attributed to bruxism. It is advisable to include "Don't know" among the

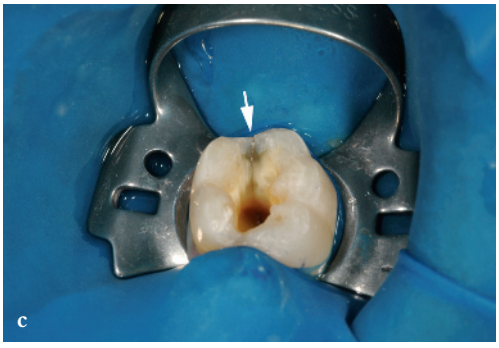

Fig 2-2 **(a)** Fracture line in a mandibular molar (arrow) caused by bruxism of the clenching type. **(b)** No fracture is evident in the periapical radiograph, although a reactive area in the interradicular space can be seen (arrow). **(c)** Opening of the molar reveals that the fracture has reached the pulp chamber (arrow).

possible choices; this will prevent false-positive and false-negative answers from patients who are not sure of how to respond. At the first appointment, during history taking, it is recommended that the clinician quickly asks the patient the same questions from the questionnaire again in order to confirm the accuracy of the patient's answers.

Signs

In the clinical examination, some signs may be present to suggest bruxism. The character of these signs (and symptoms) is "relative", since they alone are not sufficient evidence of bruxism; although frequently mentioned in the literature, the fact is that they have not yet been validated by scientific method. Future controlled investigations will have to determine the corresponding sensitivity and specificity values for each of them. So far, only the clinical validity of tooth-grinding sounds during sleep (witness statements based on two episodes per week) has been studied. When checked against polysomnography, they showed a sensitivity of 78% and a specificity of 98%.[1]

Tooth wear

Although this has a strong association with bruxism, it is not a specific sign since there are many causes of tooth wear. Grinding causes the teeth to deteriorate in a specific way (attrition). Tooth wear can be studied by direct visual inspection of the mouth, by examining plaster models of the patient's teeth, and by taking a look at intraoral pictures. This subject is discussed in detail in Chapter 9.

Fractures

There may be fractures in natural teeth, prostheses, dental implants, and dental restorations (Figs 2-1 to 2-11).

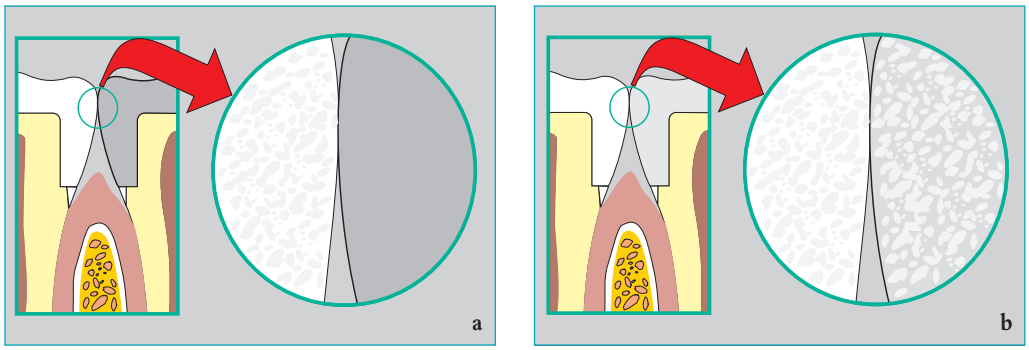

Fig 19-10 Proximal contact between restorations with different hardnesses: **(a)** porcelain–metal, and **(b)** porcelain–composite. Several mechanisms are present – two-body, three-body, and corrosive wear.

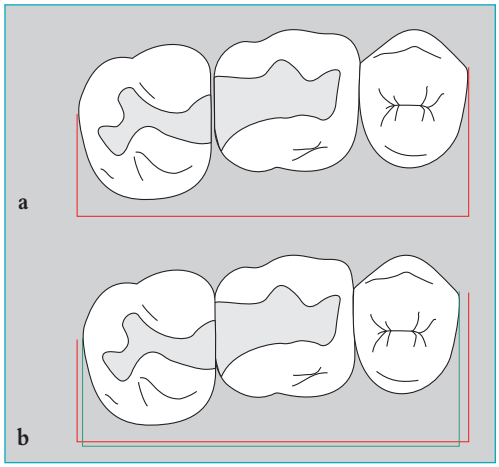

Fig 19-11 **(a and b)** Proximal wear in teeth with proximal composite resin restorations. This type of wear is also seen on enamel and is increased in the presence of periodontal mobility. (Modified from Söderholm.[28])

lubricant that acts in each case can be seen in Table 19-3. The contacts can be tooth against tooth, tooth against restoration, restoration against restoration, as well as a tooth brush or other foreign body – which includes foods.

Corrosive wear or erosion can take place when a chemical process is added, as happens by the effect of acid in bulimic patients. Wear by superficial fatigue can be the consequence of a habit such as biting on a solid object (e.g., a pen), which involves the application of high compressive loads. In the case of bruxism, two-body wear or attrition is found. Tooth surfaces come into direct contact, the frequency of sliding is incremented as well as the loads that are applied, and all these factors lead to significantly greater wear and increased possibility of fatigue failure.[15]

Evaluation of Wear Behavior

Laboratory simulator and clinical studies can be used to evaluate intraoral wear.

In-vitro Laboratory Studies

The use of in-vitro studies provides an approximation of the evaluation of wear of new materials before their clinical application.[31,32]

Is the prediction of wear behavior of dental materials possible? One important point to keep in mind when evaluating lab studies is the difficulties that appear when attempting to simulate conditions present in the oral cavity. The very many variables that participate in wear make its measurement with a single parameter difficult, even when variations seen from patient to patient are not considered.[31]

The weak correlation that is seen between mechanical properties and wear is remarkable. Some physical properties such as water sorption can give just a hint of potential wear, particularly when corrosive wear is considered.

Table 19-3

Most frequent wear types within the oral cavity: comparison between dental and materials science terminology (modified from Vale Antunes and Ramalho[3]).

Causes of wear	Dental term	Material terminology	Lubricant/abrasive
Physiologic			
Without occlusal contact	Abrasion	Three-body	Saliva/food
Direct contact	Attrition	Two-body	Saliva
Contact and sliding	Attrition	Two-body	Saliva
Pathologic			
Bruxism	Attrition	Two-body	Saliva
Xerostomia	Attrition	Two-body	–
Chemical attack	Erosion	Corrosion	Saliva
Negative habits	Attrition/abrasion	Two- or three-body	–
Hygiene			
Tooth brushing	Abrasion	Three-body	Water/dentifrice

Clinical Studies

Understanding clinical wear requires studies in which the different factors that interact are taken into account. Clinical studies are the best option in the actual evaluation of wear, but they are expensive and need to be long term.[33–35]

Clinical wear can be expressed by the amount (in micrometers) of material loss per year, using normal tooth wear for comparison. For example, the American Dental Association considers that a loss no greater than 50 µm per year has to be established by means of systematic clinical studies if a material is to be used in posterior restorations.

Both direct and indirect methods are used in these studies. Most of the direct studies follow criteria that have been established by Ryge:[36] color matching, marginal integrity, secondary caries, anatomic form, and surface roughness. Some changes in categorization are introduced according to each study's specific needs. Inter-examiner variability is the main limitation to obtaining adequate discrimination in the use of scales.

Indirect methods use impressions and models, which are evaluated, or epoxy resin replicas that can reproduce worn surfaces, and scanning electron microscopy observation.

Loss of vertical dimension is commonly measured in clinical studies. Visual examination is fast and no additional cost is required, but it is prone to subjective variation; often just changes in anatomic force are registered without any quantification. Special optical or scanning electron microscopes and profilometers allow for greater precision in the evaluation of material loss. Surface changes in exposed cavity walls can be evaluated so as to establish the types of wear that are present.

Many discrepancies are seen between results from in-vitro lab studies and observation in long-term clinical studies. The evaluation of actual behavior with reliable measurements is still a problem to be solved. Present efforts are focused on the use of wear simulators for wear studies, and these results have be corroborated later by clinical studies.[31]

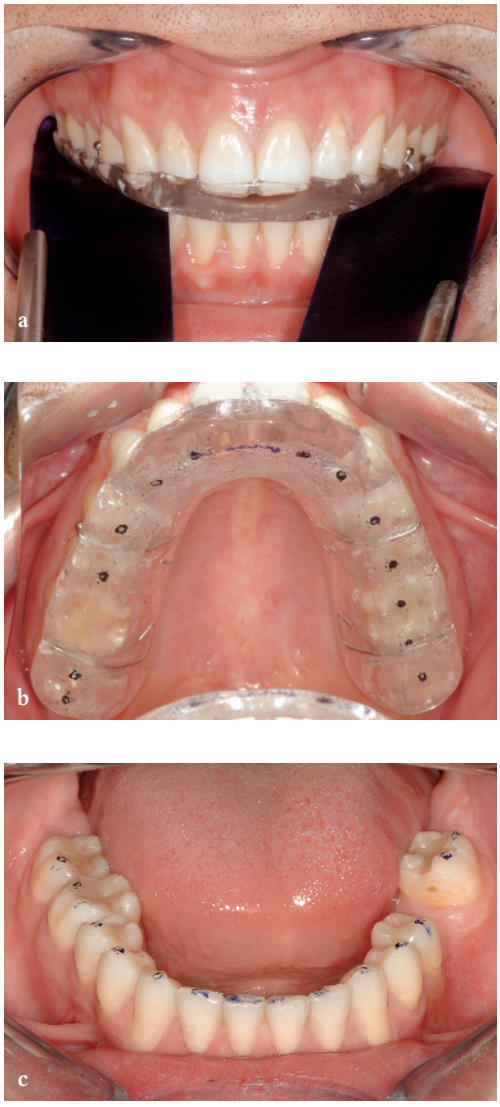

Fig 25-32 Occlusal adjustment of the splint. **(a)** Ask the patient to close their mouth repeatedly and give a series of taps with their teeth on the splint, while articulating paper is placed between the splint and the teeth. **(b and c)** The aim is to obtain one contact point per cusp or antagonist incisal edge.

Splint attachment problems are much simpler to solve, since only retainer tightening is required.

In order to perform splint occlusal adjustment, it is advisable not to polish the surface of the splint fully. Another option is to request the laboratory to deliver the splint with a coarse surface, or to remove the splint's gloss by using thin sandpaper in order to better visualize occlusal contacts. Once the patient is in the dorsal recumbent position, they are requested to give a series of quick taps with their teeth on the splint, while articulating paper is made to come between splint and teeth (Fig 25-32). An acrylic bur is used to wear out all the premature contact points. This procedure is repeated as many times as necessary, until all the vestibular cusps and incisal edges simultaneously occlude on the surface of the splint. The simultaneous contacts obtained during mouth closure are comparable to maximum intercuspation at a dental level. Thus, each of these points (closure stops) will be responsible for the stability of its respective antagonist tooth. Also, the combined action of all of them guarantees a steady position of the jaw during mouth closure and, especially, during tooth clenching episodes while the bruxer is wearing the splint.

Next, the aim is to make anterior guidance harmonious (Figs 25-33 and 25-34). To do this, it is advisable to use articulating paper of a different color. Articulating paper is placed between the teeth and the splint while having the patient make lateral and protrusive movements. Any contact in the posterior segment should be carefully removed, with the exception of those contacts matching the ones obtained in the previous step (closure stops). In short, during closure, one contact per cusp or lower incisal edge should occur in the splint; during eccentric movements (lateral movement and protrusion), the anterior guidance should prevent premolar and molar cusps from coming into contact with the surface of the splint.

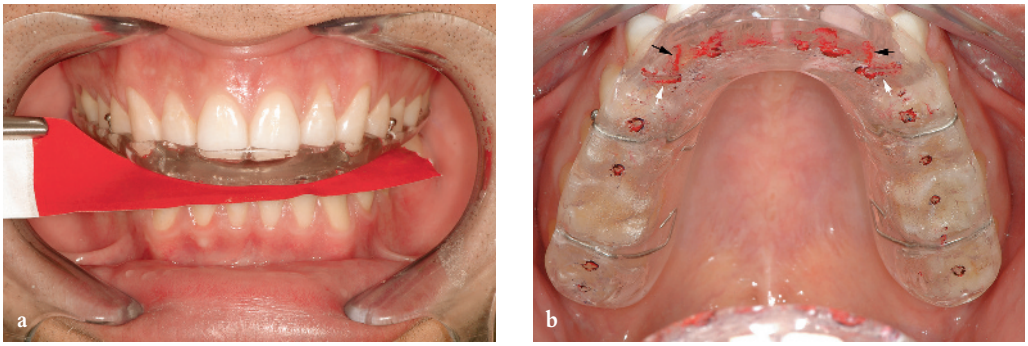

Fig 25-33 **(a)** With articulating paper of a different color, anterior guidance functioning is tested. **(b)** The white arrows indicate the trajectories created during lateral movements; the black arrows indicate protrusive movement trajectories.

Fig 25-34 **(a–c)** Correct functioning of the anterior guidance of the splint causes the posterior segments to separate and protects them against premature wear during tooth grinding episodes.