The Management of Bruxism

A Peer-Reviewed Publication
Written by Jeff Burgess, DDS, MSD

Abstract
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Educational Objectives
At the conclusion of this educational activity participants will be able to:
1. Describe the etiology of bruxism.
2. Discuss the techniques used to evaluate bruxism.
3. Identify the consequences of untreated bruxism.
4. Identify treatment options for bruxism.

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Author Disclosure
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Abstract
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Etiology
Research in the last 10 years has shown that may factors can contribute to awake and sleep bruxism. These include genetic predisposition, sleep architecture, psychology (e.g. distress, anxiety, and personal characteristics) and environmental factors (e.g. smoking). Central nervous system function related to levels of catecholamine and dopamine, prior brain trauma, disease or drug use (e.g. ecstasy, caffeine, serotonin reuptake inhibitors and some anxiolytic medications), medical conditions such as Parkinson’s disease, mental retardation and cerebral palsy have also been associated with bruxism. There is some speculation that bruxism occurs to provide salivation during sleep in response to esophageal acidity or gastroesophageal reflux disease (GERD). The historical perspective that bruxism is caused by malocclusion has largely been disproven; although in some cases tooth interference may play a role in the initiation of behavior.

Multiple brain areas are activated during awake bruxism. The research assessing sleep bruxism indicates that even before there is tooth contact, a series of physiological events occur in sequence. These include an initial activation of the autonomic cardiac system, increased brain activity, a rise in jaw opener muscle tone and an increase in heart rate.

Diagnosis
The patient’s subjective symptoms and clinical signs are the factors typically used in the dental setting to determine the presence of awake or sleep bruxism. Symptoms of bruxism include awareness of tooth grinding, pain in the TMJ or jaw musculature, jaw muscle and joint dysfunction, temporal headache, tooth hypersensitivity or mobility and poor sleep quality (including the spouse or sleeping partner). Clinical signs of bruxism consist of abnormal tooth wear, significant loss of vertical dimension, tongue indentations, the presence of a linea alba along the biting plane of the buccal mucosa, gum recession or periodontal disease, masser muscle hypertrophy and broken restorations or teeth.

The presence of sleep bruxism is also revealed by laboratory assessment of sleep architecture and specifically by the number of episodes of grinding behavior that occur during different phases of sleep. It is known that rhythmic masticatory muscle activity (RMMA) occurs once or twice per hour in phases 1 and 2 of non-REM sleep for about 60% of non-bruxing individuals but in 80% of patients identified as bruxers. However, RMMA is also associated with other sleep disorders such as parasomnias, acid reflux, obstructive sleep apnea and snoring so it may not reliably differentiate bruxers from people with other sleep problems. The number of microarousals, identified as the incidence of K-complexes or K-alfas, has also been used to define the presence of bruxism. The above laboratory techniques are not practical for the general dentist attempting to assess and manage bruxism but may be necessary to consider in differentiating sleep bruxism from other conditions such as sleep apnea, epilepsy and other suspected REM disordered behaviors.

Polysomnography (sleep study) shows promise for identifying patients with sleep bruxism. Diagnostic criteria have been suggested by Lavigne GJ, et al, based on an analysis of 18 bruxers and 18 asymptomatic subjects. The criteria for defining sleep bruxism includes: more than four bruxism episodes per hour, more than 6 bruxism bursts per episode and/or 25 bruxism bursts per hour of sleep, coupled with at least two episodes with grinding sounds. The validity of this system has not been established but this standard may prove useful in research and selective clinical situations. Another criterion that is being used to define sleep bruxism includes microarousals that are defined by increased autonomic, cardiac and respiratory activity which, according to one report, tends to repeat 8-14 times per hour of sleep in affected individuals.

Several other strategies have shown diagnostic promise in identifying sleep bruxism. Given that a sudden shift in cardiac activity may predict bruxing behavior, a compact portable device (Bruxoff) that is based on this phenomena (as well as masseter muscle electromyographic activity) has been evaluated in at least two studies and shows promise for clinical use. The device uses CoDe electrodes which are said to reduce orientation problems and crosstalk. The Bruxoff® is reported to have a sensitivity of 95% and a positive predictive value of 93%.

Another clinical device that may be useful in determining the presence of sleep bruxism and the specific teeth that are involved is the Brux Checker® (BC). This device consists
of a red coated foil. The material is molded over the teeth for diagnostic purposes or is placed over an appliance prior to and following treatment to determine its therapeutic effect. Another device for assessing bruxing activity that has been studied is the BiteStrip®. This is a single use self-adhesive home screening device that the patient places over the masseter muscle before sleeping. After establishing a baseline level of activity by clenching several times, a central processing unit within the device then records the number of clenching events based on computing an average from the baseline values.

However, as noted above, for the majority of practitioners the diagnosis of bruxism continues to remain largely empirically based.

Consequences of Unmanaged Bruxism
When awake and sleep bruxism is not managed properly over time the behavior can result in mild to severe tooth wear/attrition and the loss of vertical dimension, tooth cusp and restoration fracture, tooth sensitivity/pain, recession of the attached gingiva as well as bone loss, tooth mobility and loss, mucosal (cheek and tongue) ulceration and severe tongue indentations. Although somewhat controversial, the behavior may also cause or contribute to several temporomandibular disorders including jaw muscle and joint dysfunction, orofacial pain, opening limitation and other symptoms associated with TMD (e.g. ear symptoms such as plugging, tinnitus, subjective hearing loss, as well as temporal headache and sleep disturbance). There is also literature suggesting that migraine headache may be initiated or exacerbated by bruxism.

Treatment of Bruxism

Appliance Therapy
In the last 10 years appliance therapy has been extensively researched and there are several systematic reviews of studies assessing the effectiveness of maxillary and mandibular appliances in controlling nocturnal behavior. Unfortunately, some of these systematic reviews indicate that the prior research may not be particularly helpful in determining the effectiveness of appliance therapy, particularly with respect to the management of TMD. This is because the reviewed studies suffer from inherent problems in methodology. In addition to the issues associated with TMD research, there are also problems with study design in the research addressing bruxism. For example, in one recent meta-analysis of 32 relevant bruxism studies using a similar outcome variable, the arousal index, only five were found to be randomized and include controls (the gold standard for efficacy studies). The authors conclude that insufficient evidence exists to support splint therapy for improving this particular variable related to sleep bruxism. They further state that additional RCTs are warranted with attention to appropriate study methodology before final conclusions can be drawn regarding treatment efficacy.

Klasser, Greene, and Lavigne also extensively review the literature assessing oral appliances in the management of sleep bruxism in adults and report that only one study had good methodology. It compared palatal splints to mandibular advancement devices and transcutaneous electric nerve stimulation (TENS). They note that the results showed that neither appliance was significantly better than the other or TENS in reducing nocturnal bruxism.

In another systematic study assessing 177 papers only 13% used a randomized clinical trial design; and because of this the authors felt that they could not make evidence-based recommendations regarding splints for reducing bruxism.

Nonetheless, despite these reviews, with respect to the destructive activity associated with sleep bruxism, there is essentially no other viable non-invasive treatment that can protect the dentition and periodontal structures as well as appliance therapy when used over a prolonged period of time. Thus, this intervention remains the first choice for treating persistent nocturnal bruxism, regardless of etiology.

With respect to causation, it is important to note that the research has largely debunked the idea that oral appliances work by altering or perfecting the occlusion. Consequently general bite adjustment or equilibration is not recommended as treatment for bruxism. A broad range of appliance configurations are now available for the treatment of sleep bruxism.

Types of Appliances
As previously noted, many different types of appliances (although some are merely different on the basis of their terminology) can be used to treat sleep bruxism. Some of the devices that have supportive literature include the bite splint (hard or soft), the disclosure splint, flat occlusal splint, Levandoski splint, Michigan occlusal splint, muscle depogramming splint, night guard, occlusal correcting splint, occlusal disengagement splint, the pivoting appliance, anterior stop point appliance, mandibular advancement device, the Grindcare® device and the stabilization splint. The following discussion reviews some of the appliances that are commonly used for treating sleep bruxism.

The Flat Planed Stabilization Splint
This device, also called an occlusal bite guard, the Michigan splint, stabilization splint, bruxism appliance, bite plate and night guard varies in appearance and properties. It is usually laboratory processed (although it can also be constructed in the dental office) and consists of a non-flexible acrylic material. This device is designed to cover the occlusal surfaces of either all of the maxillary or all of the mandibular teeth. The determination of which arch to cover remains a subjective clinical decision because there are no comparative studies that can be used to determine if covering one arch is more effective than covering another (or if covering both arches is
benter than covering just one arch). The occlusal table of the device is adjusted to be flat so that there is even contact with the opposing cusp tips. Sometimes there is incorporation of a form of cusp disclusion.

The evidence suggests that appliance thickness may have an effect on treatment outcome with thinner appliances (3mm) providing significantly greater reduction in EMG activity than thicker (6mm) devices. The literature also suggests that the manner in which a patient’s occlusion is defined (i.e. centric relation or centric occlusion) in the clinical and laboratory process does not appear to have an impact on overall treatment efficacy.

The flat planed stabilization appliance may be the most commonly prescribed device by dentists treating TMD and bruxism. Patient adherence to the use of this device is generally good although comfort can be a problem that limits its use. Adverse reactions, including iatrogenic malocclusion, tooth staining and caries are relatively rare but have been reported. In addition, at least one report suggests that while the devices reduce bruxing episodes, they may also increase psychological stress in some patients. A review of PubMed and other sources does not reveal other serious adverse reactions associated with the use of flat-planed stabilization splints.

**The NTI Device (Nociceptive Trigeminal Inhibition)**

The NTI device is described as an anterior tooth stop that is recommended for the treatment of bruxism. Most studies have been directed towards determining the effectiveness of this device in managing the broader category of TMD in association with bruxism. However this research suffers from problems in methodology. In a systematic assessment of 68 publications addressing the management of TMD and bruxism, only two randomly controlled trials were found that satisfied the author’s inclusion criteria. In comparison with the occlusal stabilization splints it appears that the NTI device may provide a significantly greater reduction in maseter muscle EMG activity during sleep, at least in patients with TMD. Substantial literature specifically looking at the effect of the NTI on sleep bruxism is lacking. However, a study involving 10 patients that assessed EMG values offers evidence that the device may reduce sleep bruxing events. Regardless of the potential effect on muscle activity, because the NTI appliance discludes the posterior teeth, it should offer protection from the destructive effect of the behavior occurring during sleep. Adverse reactions can include the over-eruption of the posterior teeth and malocclusion if the appliance is worn 24 hours a day for a prolonged period of time.

An FDA cleared appliance with a novel mechanism of action has recently been developed (NiteBite®). It functions by preventing teeth from contacting and allowing the muscles to relax. The appliance utilizes the proprioceptive response to tooth contact, which causes the jaw to open reflexively. When the mandibular teeth contact the appliance, the reflex is triggered, resulting in opening of the jaw, returning the mandible to the rest position in which there is muscle relaxation and an absence of tooth contact.

**The Adjustable Mandibular Advancement Device**

Another device utilized for controlling sleep bruxism is the mandibular advancement device (MAD), also termed the mandibular anterior repositioning splint and the mandibular orthopedic repositioning appliance (MORA).

This device is usually laboratory processed from thermo-plastic material. One splint fits over the mandibular teeth and the other the maxillary teeth. By connecting the two appliances via a mechanism that allows incremental forward adjustment (several different mechanical strategies are available for making the adjustments) the lower jaw can be advanced relative to the upper arch. Historically this device has been used to treat mild to moderate sleep apnea. When 28 patients with a clinical history of moderate or severe sleep bruxism without spontaneous TMD pain were managed for 30 days with a MAD device, a statistically significant improvement was found between initial and post intervention sleep bruxism scores as measured by the BiteStrip®. However in another controlled study comparing the mandibular advancement device with a flat planed stabilization splint the latter was found to be more effective in reducing sleep bruxism. One disadvantage of the above study was that three different configurations were used to establish the mandibular-maxillary relationship and advancement so the effect of a single strategy in relation to the flat appliance could not be assessed. Another study, however, indicates that different degrees of anterior advancement have varying effects on bruxism reduction.

The MAD appliance can cause pain localized to the gums or anterior teeth which is a disadvantage to this therapy. Although uncommon, other adverse reactions have included malocclusion and TMJ pain and dysfunction.

**Soft Splint**

A number of studies suggest that in-office or home prepared appliances made of soft compressible acrylic may also reduce sleep bruxism as well as the symptoms and signs of TMD. In the studies by Truelove (2006) and Naikmasur (2008) soft splints compared equally well with hard stabilization splints in the management of TMD. No significant side effects or adverse reactions were reported in the 200 and 40 subjects respectively in each study after prolonged use.

However, there are only a limited number of studies specifically assessing the effect of soft splints on sleep bruxing behavior. In one (Okeson, 1978) that involved only 10 subjects comparing hard and soft appliances and their effect on nocturnal muscle activity, soft splints were found to significantly increase nocturnal muscle activity in half of the participants. In another study subjects experienced an increased sense of tiredness following soft splint use. Given issues with the
methodology used in these two studies, it remains unclear if the findings are relevant to the clinical effectiveness of soft splints in managing sleep bruxism.

**Pharmacotherapy**

Several different drug types have demonstrated utility in treating sleep bruxism. These include hydroxyzine, clonazepam, levodopa (L-Dopa) combined with benserazide, pergolide (a dopamine D1/D2 receptor agonist), propranolol and gabapentin. The evidence for the effectiveness of serotonergic medication in reducing sleep bruxism is poor. L-tryptophan has not found to be useful in this regard and the effect of antidepressant medications has been mixed. In fact, the selective serotonin reuptake inhibitor (SSRI) antidepressants have been shown to exacerbate bruxism. In addition, certain street drugs such as ecstasy can cause severe bruxism.

Best practices dictates that drugs prescribed for sleep bruxism should only be used short term for maximum benefit. Prolonged use of some drugs (e.g. L-dopa) has been associated with an increase in bruxing behavior. Prescribing clinicians need to be familiar with the general effects, side effects and potential drug interactions before utilizing these drugs to manage sleep bruxism.

In patients with Huntington’s disease, autism and Parkinson’s disease, or those who are experiencing severe bruxism as a result of brain injury, coma, or amphetamine abuse, injecting the jaw musculature with botulinum toxin A may help reduce the behavior. Complications associated with injecting the jaw musculature with botulinum toxin A may include bleeding, spot tenderness, bruising, toxic reactions and infection.

**Behavioral Management of Bruxism**

Some of the interventions that have been suggested as treatment of diurnal bruxism include meditation, hypnosis, guided imagery, self-monitoring, habit retraining, cognitive behavioral intervention and biofeedback. Unfortunately not one of these therapies has been validated for the treatment of sleep bruxism by sound scientific study (e.g., randomized controlled trials and studies using nocturnal polysomnography and psychometry). Since these interventions are noninvasive and have been shown to be effective in controlling other forms of habitual behavior, they may be useful in treating daytime bruxing behavior. However, because of the lack of research, it is unclear if the management strategies for treating daytime bruxism affect behavior that occurs during sleep. Hypnosis is partially supported by case reports. Meditation is reported to reduce stress, improve self-esteem and self-control which theoretically could indirectly impact night time bruxism if sleep quality is improved. Other physical medicine approaches such as cardiovascular toning programs, TENS, acupuncture, manual massage and a few alternative naturopathic approaches (B-5, magnesium, calcium, potassium or Vitamin C supplementation) have also been suggested for the management of sleep bruxism. None of these therapies have been studied appropriately to allow reasonable comment on their efficacy for day or night time behavior.

**Conclusion**

Scientific inquiry over the last 10 years related to the etiology, diagnosis and treatment of bruxism has greatly expanded our knowledge of this condition. Sleep studies have provided a deeper insight into the etiology of the behavior and offer measures and criteria that should be helpful in differentiating bruxism from other sleep disorders. There are several ‘objective’ clinical measures that can now be used to document the full extent of the behavior and provide a means of judging therapeutic success. Although research has not helped to provide a definitive answer regarding the effectiveness of appliance therapy in reducing muscle activity associated with bruxism, various types of intraoral appliances do offer protection from the clinical effects of the behavior. ‘Best practices’ is for short-term use of medication as intervention. Finally, there is currently little research demonstrating the efficacy of behavioral management for sleep bruxism.

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Author Disclosure
Jeff Burgess, DDS, MSD, has no potential conflicts of interest to disclose.
1. Which of the following factors is not thought to generally contribute to bruxism?
   a. Genetic predisposition
   b. Distress or anxiety
   c. Neurological disease
   d. Malocclusion

2. Current research on sleep bruxism indicates that just before the teeth contact:
   a. There is activation of the autonomic cardiac system
   b. There is an increase in brain activity
   c. There is an increase in jaw opening muscle tone
   d. All of the above

3. The Glossary of Prosthodontic Terms defines bruxism as:
   a. A parafunctional tooth grinding habit consisting of involuntary rhythmic non-functional gnashing, grinding, or clenching of the teeth
   b. A parafunctional tooth grinding habit consisting of involuntary spasmodic non-functional gnashing, grinding, or clenching of the teeth
   c. Both a and b
   d. Neither a or b

4. Diurnal bruxism is:
   a. Bruxism that occurs during the day
   b. Bruxism that occurs at night during sleep
   c. Both a and b
   d. Neither a or b

5. Subjective symptoms associated with sleep bruxism include:
   a. Dreaming
   b. TMJ and jaw muscle pain
   c. Both a and b
   d. Neither a or b

6. Which of the following is considered a clinical sign of bruxism?
   a. Abnormal tooth wear
   b. Significant loss of vertical dimension
   c. Gum recession
   d. All of the above

7. Which of the following is not considered a clinical sign of bruxism?
   a. Masseter muscle hypertrophy
   b. Broken fillings or teeth
   c. Dental caries
   d. Linea alba

8. Which of these statements accurately describes one of the laboratory parameters of sleep architecture that occurs during bruxism?
   a. Rhythmic masticatory muscle (RMMA) activity occurs one to two times an hour in phases 1 and 2 of non-REM sleep
   b. RMMA occurs in 60% of non-bruxing individuals and 100% of patients identified as bruxers
   c. RMMA has been shown to reliably differentiate bruxers from people with other sleep problems
   d. RMMA occurs in phases 3 and 4 of REM sleep

9. The polysomnography diagnostic criteria that has been suggested by Lavigne, et al. for identifying patients with bruxism includes which of the following?
   a. More than four bruxism episodes per hour
   b. More than 6 bruxism bursts per episode and/or 25 bruxism bursts per hour of sleep
   c. At least two episodes of the above occurring with grinding sounds
   d. All of the above

10. Clinical devices that have proven benefits in establishing bruxism include:
    a. A compact portable device that measures masseter muscle electromyographic activity
    b. A foil material that can be placed over the teeth
    c. Both a and b
    d. Neither a or b

11. Which of the following statements accurately describes the BiteStrip®?
    a. It is a single use self-adhesive home screening device
    b. It measures the number of clenching events
    c. Both a and b
    d. Neither a or b

12. The consequences of not treating bruxism include which of the following?
    a. Tooth mobility and loss
    b. Gingival recession
    c. Tooth cusp fracture
    d. All of the above

13. Which of the following interventions is not currently considered to be effective in the treatment of bruxism?
    a. Intraoral appliance therapy
    b. Bite adjustment (equilibration)
    c. Clonazepam medication
    d. Botox muscle injection

14. Which of the following does not accurately describe the state of current research involving appliance therapy and bruxism?
    a. A substantial number of quality studies have assessed the efficacy of appliance therapy in treating bruxism
    b. Many studies of appliance therapy include patients with TMD
    c. Many studies assessing the effectiveness of appliances in the management of bruxism have inherent problems in methodology
    d. Many authors have concluded that more randomized controlled trials are needed

15. Which of the following is an accurate description of the state of appliance therapy for bruxism?
    a. Appliances are not helpful in managing the effects of bruxism
    b. There are numerous types of appliances that can be used to manage the effects of bruxism
    c. Both a and b
    d. Neither a or b

16. Which of the following names have been used to identify an oral appliance?
    a. The Washington occlusal splint
    b. The Michigan occlusal splint
    c. Both a and b
    d. Neither a or b
17. The flat planed stabilization splint is designed to:
   a. Cover the occlusal surfaces of all of the maxillary or the mandibular teeth
   b. Cover the anterior teeth
   c. Cover only the palate
   d. Connect both the upper and lower arches

18. Which of the following statements is true regarding the research on flat planed stabilization splints?
   a. It has been clearly shown that placement of an appliance over the teeth in the mandibular arch is superior to placement over the teeth in the maxillary arch
   b. It has been clearly shown that both arches need to be covered for maximum benefit
   c. It has not been shown that covering one arch is more effective than covering the other arch in treating bruxism
   d. There are comparative studies that can be used to help determine if there is greater efficacy in covering the upper or lower arch.

19. Which of the following statements is accurate?
   a. The evidence suggests that thinner appliances (3mm) reduce EMG activity to a greater extent than thicker (6mm) appliances
   b. The mechanism by which the occlusion is defined (centric occlusion, centric relation)in a flat planed stabilization splint does not impact treatment efficacy
   c. Both a and b
   d. Neither a or b

20. Reported adverse reactions to stabilization appliance therapy have included:
   a. Tooth staining
   b. Caries
   c. Malocclusion
   d. All of the above

21. The NTI® appliance covers:
   a. All of the maxillary teeth
   b. All of the mandibular teeth
   c. Some of the anterior maxillary teeth
   d. Only the palatal area

22. Which of the following statements is accurate regarding the NTI® device?
   a. One study suggests that the NTI® may produce a greater reduction in masseter muscle EMG activity than the stabilization splint
   b. Most studies of the anterior tooth stop device have been directed towards the efficacy of bruxism treatment
   c. Both a and b
   d. Neither a or b

23. The adjustable mandibular repositioning device involves:
   a. The fabrication of two appliances that have a mechanism for forward adjustment of the mandible
   b. Posterior repositioning of the mandible in relation to the maxillary anterior teeth
   c. Both a and b
   d. Neither a or b

24. Which of the following statements is accurate?
   a. In a study of 28 patients with moderate to severe sleep bruxism, mandibular advancement produced a significantly improvement in sleep bruxism scores
   b. In a study where the mandibular advancement device was compared with a flat planed stabilization splint the latter was found to be more effective in reducing sleep bruxism
   c. In a study of a mandibular advancement device it was found that the amount of advancement had an effect on sleep bruxism behavior
   d. All of the Above

25. According to the available research which statement is accurate regarding soft splints?
   a. They can be used as an intervention for TMD and bruxism
   b. They have not been associated with significant side effects if worn at night
   c. They may increase nocturnal muscle activity
   d. All of the above

26. Which of the following appliances, according to the research, is recommended most often?
   a. The soft splint
   b. The stabilization splint
   c. The mandibular advancement device
   d. None of the above

27. Which of the following medications is NOT recommended for managing bruxism?
   a. Clonazepam
   b. Hydroxyzine
   c. The SSRI antidepressants
   d. Propranolol

28. Best practices indicate that drugs prescribed for sleep bruxism should:
   a. Only be used short term
   b. Should be prescribed in combination for the best result
   c. Both a and b
   d. Neither a or b

29. Which of the following drug has been associated with an increase in bruxing behavior?
   a. Ecstasy
   b. L-Dopa
   c. Both a and b
   d. Neither a or b

30. Which of the following statements is accurate?
   a. Behavioral intervention such as meditation, hypnosis and guided imagery can be helpful in reducing diurnal bruxism
   b. The effects of strategies such as self-monitoring, habit retraining, and cognitive behavioral intervention have been shown to carry-over into night time control of bruxism
   c. Both a and b
   d. Neither a or b
ANSWER SHEET

The Management of Bruxism

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EDUCATIONAL OBJECTIVES

1. Describe the etiology of bruxism.
2. Discuss the techniques used to evaluate bruxism.
3. Identify the consequences of untreated bruxism.
4. Identify variety of treatment options for bruxism.

Course Evaluation

1. Were the individual course objectives met? Objective #1: Yes No Objective #3: Yes No
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4. How would you rate the objectives and educational methods? S 4 3 2 1 0
5. How do you rate the author’s grasp of the topic? S 4 3 2 1 0
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13. Was there any subject matter you found confusing? Please describe: __________________________

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Educational Objectives

1. Identify the causes of bruxism.
2. Discuss the techniques used to evaluate bruxism.
3. Identify the consequences of untreated bruxism.
4. Identify variety of treatment options for bruxism.

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3. ✔ ✔ ✔ ✔ 18. ✔ ✔ ✔ ✔
4. ✔ ✔ ✔ ✔ 19. ✔ ✔ ✔ ✔
5. ✔ ✔ ✔ ✔ 20. ✔ ✔ ✔ ✔
6. ✔ ✔ ✔ ✔ 21. ✔ ✔ ✔ ✔
7. ✔ ✔ ✔ ✔ 22. ✔ ✔ ✔ ✔
8. ✔ ✔ ✔ ✔ 23. ✔ ✔ ✔ ✔
10. ✔ ✔ ✔ ✔ 25. ✔ ✔ ✔ ✔
12. ✔ ✔ ✔ ✔ 27. ✔ ✔ ✔ ✔
13. ✔ ✔ ✔ ✔ 28. ✔ ✔ ✔ ✔
14. ✔ ✔ ✔ ✔ 29. ✔ ✔ ✔ ✔
15. ✔ ✔ ✔ ✔ 30. ✔ ✔ ✔ ✔

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