Bruxism: Is There an Indication for Muscle-Stretching Exercises?

Simone Gouw, RPT1/Anton de Wijer, PhD2/Nico H.J. Creugers, DDS, PhD3/Stanimira I. Kalaykova, DDS, PhD2

Bruxism is a common phenomenon involving repetitive activation of the masticatory muscles. Muscle-stretching exercises are a recommended part of several international guidelines for musculoskeletal disorders and may be effective in management of the jaw muscle activity that gives rise to bruxism. However, most studies of muscle-stretching exercises have mainly focused on their influence on performance (eg, range of motion, coordination, and muscle strength) of the limb or trunk muscles of healthy individuals or individuals with sports-related injuries. Very few have investigated stretching of the human masticatory muscles and none muscle-stretching exercises in the management of (sleep) bruxism. This article reviews the literature on muscle-stretching exercises and their potential role in the management of sleep bruxism or its consequences in the musculoskeletal system.


Bruxism, recently defined by an international expert group as “a repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible,”1 affects not only the teeth and oral tissues, potentially causing tooth wear and dental fractures, but also the musculoskeletal system, giving rise to muscle pain and dysfunction.2 Bruxism can occur when a person is sleeping (sleep bruxism) or awake (awake bruxism).1 This review focuses on sleep bruxism.

Exercise therapy, such as muscle stretching, is often recommended for the management of musculoskeletal disorders.3–10 Muscle stretching is done for preventive and therapeutic purposes and aims to obtain muscle relaxation, improve the ability to move, and/or decrease pain. It is unclear whether stretching exercises can reduce sleep bruxism and its musculoskeletal consequences.

This review outlines the pathophysiology of bruxism and muscle stretching, briefly describes muscle architecture and muscle physiology, and considers the possible influence of muscle stretching on bruxism. Since most of the available literature on muscle stretching concerns the limb and trunk muscles, findings are discussed in terms of clinical considerations for applying stretching on the masticatory muscles. The aim of this review is to provide insight into whether stretching of the masticatory muscles can reduce bruxism.

Bruxism

Bruxism can be classified as possible, probable, and definite.1 Possible bruxism is based on self-reported data collected with questionnaires and/or patient history, probable is based on self-report and physical examination, and definite is based on self-report, physical examination, and polysomnographic (PSG) recording, preferably with audiovisual recordings. PSG is considered the gold standard in the diagnosis of bruxism.11

A systematic review showed that the prevalence of generic bruxism in adults varies from 8% to 31.4%, that of awake bruxism ranges from 22.1% to 31%, and that of sleep bruxism is 12.8% ± 3.1%.12 For sleep bruxism, a distinction is made in prevalence based on self-report (12.5%), based on PSG recordings (7.4%), or based on both PSG and self-report (5.5%).13 The prevalence is similar in males and females, but bruxism is more common in children14 and its prevalence decreases with age.

It is not known how often bruxism gives rise to clinical problems. Only one study tried to distinguish between the overall prevalence of self-reported
nocturnal tooth grinding, which was found to be 8.2%, and the prevalence of tooth grinding that caused problems (such as pain of the jaw muscles), which was found to be 4.4%.15

Etiology and Pathophysiology

The etiology of bruxism is still unclear, but it is considered multifactorial, with peripheral (morphologic) and central (pathophysiologic and psychologic) factors described. It is also not clear whether bruxism is the extreme manifestation of a physiologic activity or a specific pathologic entity.16 Carrat7 recently proposed distinguishing between primary, secondary, and comorbid bruxism, with bruxism being considered primary or idiopathic in the absence of medical causes; secondary or iatrogenic when it is associated with drug intake or with medical diseases; and comorbid when it accompanies sleep disorders. Studies of bruxism etiology are hampered by the lack of standardized diagnostics or even definition of bruxism. In this review, the current etiologic factors will be listed and not described in detail.

Dental occlusion has long been considered a peripheral pathophysiologic factor in bruxism. However, there is an absence of strong evidence to support this hypothesis.16,19 Moreover, Lobbezoo et al20 found no difference in the orofacial anatomy (ie, dental and skeletal relationships) between patients with and without bruxism.

The relationship between bruxism and psychosocial factors, such as anxiety and psychologic distress, has been confirmed for awake bruxism.21 Other emotions, such as anger and frustration, have hardly been studied in relation to bruxism.22-25

Besides psychosocial factors, multiple exogenic pathophysiologic factors such as antidepressant drugs26,27 and other drugs related to the dopaminergic, serotonergic, and adrenergic systems;28 amphetamine-related drugs;29 tobacco use; increased alcohol intake; and caffeine consumption15,30,31 have been associated with sleep bruxism. Most current evidence supports the hypothesis that bruxism is mediated by the central and autonomic nervous systems and especially by the dopaminergic system. This hypothesis is based on the role of the dopaminergic system in other movement disorders, such as torticollis and Parkinson’s disease.16

Moreover, sleep-related arousal and obstructive sleep apnea syndrome seem to be related to sleep bruxism.32,33 Finally, bruxism may be linked to genetic factors or to a familial learned behavior (children mimicking their parents’ behavior). Finnish twin studies show that childhood sleep bruxism persists into adulthood in 86.9% of individuals34,35. It is more likely that changes in multiple genes, rather than in a single gene, underlie the increased oral motor activity seen in bruxism.2

It can be concluded that there is no single explanation for why sleep bruxism develops and leads to problematic consequences such as pain and dysfunction.

Management

Owing to the unclear etiology and pathophysiology of bruxism, management strategies are mainly focused on reducing symptoms. Strategies that are currently studied and used in clinical practice can be distinguished as peripheral approaches, including occlusal interventions and oral appliances36,37 and botulinum toxin;38 central approaches, including the use of serotonergic and dopaminergic drugs;27 and behavioral therapy,39-45 such as sleep hygiene advice,46 habit reversal techniques,40,46,47 and biofeedback.48,49 A few years ago, Lobbezoo et al48 proposed the triple-P approach, based on a combination of oral appliances (ie, plates), counseling/behavioral strategies (ie, pep talk), and centrally acting drugs (ie, pills). This combination has in daily practice become the usual care for (sleep) bruxism. This approach emphasizes the importance of a multimodal approach, even if the strategies used are not effective as stand-alone therapies. In an updated review, the researchers describe an expanded multi-P approach, consisting of plates, pep talk, pills, psychology, and physiotherapy.51 This trend offers opportunities for physiotherapeutic strategies such as muscle-stretching exercises.

Two examples of management strategies that are already used in the field of physical therapy are habit reversal and biofeedback. Habit reversal is based on the idea that habits exist because of response chaining, limited awareness, excessive practice, and social tolerance and asserts that they can potentially be broken by applying the habit-reversal technique developed by Azrin and Nunn.48 The technique has been investigated for nervous tics (eg, in Tourette syndrome) and trichotillomania (hair-pulling disorder) and is commonly used in physiotherapy. One study found that awareness.relaxation training significantly decreased diurnal masseter EMG activity.47 Awareness training seems to have positive effects on awake bruxism. Although the effects on sleep bruxism are not studied, it is frequently used in practice.

Biofeedback, by which a stimulus is given whenever bruxism occurs, has been studied as treatment, but a recent systematic review did not find strong evidence to support its use in the management of sleep bruxism. However, the diversity of biofeedback methods used did not allow pooling of data in that review.48 Awake bruxism was reduced, but only for the short term.49
Muscle-stretching exercises, as part of exercise therapy, are widely used for muscle-related problems such as tension or cramp. Indeed, stretching is used for muscle cramp in athletes, although there is inconsistent evidence that stretching reduces exercise-associated cramps. Several guidelines recommend stretching exercises for musculoskeletal pain and disorders. Stretching exercises for the masticatory muscles have proven beneficial for temporomandibular disorders, reducing pain and improving function, but have not yet been investigated in relation to bruxism. As muscle-stretching exercises have yielded promising results in relation to muscle-related outcomes, this article will take a closer look at the potential benefits of muscle stretching in the treatment of bruxism.

**Muscle-Stretching Exercises**

Muscle-stretching exercises have been used for centuries—first in yoga, and in the last century mostly in sports and rehabilitation. These exercises are used to reduce stiffness or tension, improve mobility, reduce pain, and adapt muscle structure and/or function. While stretching primarily stretches muscle fibers, it probably also stretches other structures (ie, tendons, fascia, nerves). It gives rise to a feeling of increased muscle control, flexibility, and a comfortable muscle tone. The various types of stretching exercises are listed in Table 1.

Most research on muscle stretching has been done with athletes, both healthy and injured, and has focused on limb and trunk muscles. Very little research has investigated stretching of the masticatory muscles. Muscle stretching is typically applied as part of a multicomponent exercise program, which makes drawing conclusions about its individual value difficult. Several reviews of stretching are available that provide general recommendations. Current concepts in muscle stretching for performance and rehabilitation are outlined below. As bruxism involves the masticatory muscles, which differ from the limb and trunk muscles, available knowledge will be translated into clinical considerations in the context of bruxism.

### Physical Effects

Muscle-stretching exercises are used in training sessions and for warming up and cooling down, and are essential for some sports. However, results of studies of several physical effects of muscle stretching are contradictory.

Several studies on passive stretching, also known as static stretching, showed a reduction in electromyography (EMG) activity, while another study showed no reduction. Results from studies of static stretching are similarly contradictory, with some studies reporting a reduction in muscle activity and others reporting no reduction. One study found a single bout of dynamic stretching to significantly decrease presynaptic inhibition. There is evidence to support and to reject dynamic stretching in reducing EMG activity.

Stretching increases the range of motion (ROM) of joints, which is limited by joint aspects (including joint congruency and the capsuloligamentous structures) and muscle tightness. Most research into the effect of stretching on flexibility involves the hamstring muscles. The increase in ROM is not due solely to increased muscle length, but also to an increase in stretch tolerance. Chan et al showed increased muscle extensibility, while most studies show an increase in ROM due to an increase in stretch tolerance. Konrad and Tilp concluded that this increased tolerance may be due to adaptations of nociceptive nerve endings. Static stretching is considered to be the most effective at increasing ROM (Table 1).

Muscle-stretching exercises also tend to improve the elastic properties of tendons. A tendon with high elastic properties is able to save energy and release it with the next contraction, which is beneficial in sports involving running and jumping. However, the mechanism by which stretching influences performance (which is defined by muscle functions such

<table>
<thead>
<tr>
<th>Type of stretching</th>
<th>Main characteristics</th>
<th>Parameters</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Static stretching (passive)</td>
<td>A specific position is held with the muscle in tension to a point of a stretching sensation</td>
<td>10–30 s (&lt; 90 s), 2–4 repetitions</td>
<td>Improve range of motion, prevent injury, improve performance</td>
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<tr>
<td>Active dynamic stretching</td>
<td>Gently propelling the muscle toward the maximum range of motion</td>
<td>3–6 repetitions of 15–30</td>
<td>Improve viscoelasticity, improve range of motion</td>
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<tr>
<td>Ballistic dynamic stretching</td>
<td>Rapid, alternating movements or bouncing at end-range of motion</td>
<td>3 repetitions of 15</td>
<td>Improve viscoelasticity, improve range of motion</td>
</tr>
<tr>
<td>Proprioceptive neuromuscular facilitation</td>
<td>75% to 100% of a maximal contraction or 20% to 60% of a submaximal contraction</td>
<td>≥ 1 repetition</td>
<td>Improve muscle flexibility</td>
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as flexibility, coordination, strength, and endurance) depends on the type of sport practiced. For example, stretching shortly before cyclic movement, such as running, improves performance by decreasing viscoelasticity, whereas stretching on a regular basis decreases performance, probably due to too-long muscle-tendon units. Stretching shortly before explosive effort, such as jumping, decreases performance due to microruptures in the muscle, whereas stretching on a regular basis improves performance. On the other hand, regular static stretching exercises can improve specific exercise performance, for example in gymnastics.

Muscle-stretching exercises are commonly used in rehabilitation to increase muscle length and ROM and to align collagen fibers during the healing process. Athletes with hamstring strains recover faster and more effectively if they perform stretching exercises. Moreover, stretching is reported to be as effective as strengthening exercises or manual therapy in patients with chronic musculoskeletal pain, by decreasing pain and disability and increasing stretch tolerance. Stretching also has some beneficial effect in preventing work-related musculoskeletal disorders.

However, muscle stretching may not always be beneficial. For example, the increased ROM may give rise to functional instability, and muscle stretching exercises may reduce joint stability, decrease the ability of the muscle tendon to absorb energy, increase load on the ligaments, and increase pain tolerance, which may cause tissue damage. Static stretching performed just before explosive exercise is detrimental to muscle strength and performance. The detrimental effects mainly occur with longer duration of stretching (> 60 seconds). The cause for this so-called stretch-induced loss of strength is not clear and may be due to neural and mechanical factors, such as the length of the muscle. A maximal contraction before static stretching may decrease the loss of strength.

The evidence for preventive muscle stretching is contradictory, with one study reporting that muscle stretching, whether performed before, after, or before and after exercise, did not reduce delayed-onset muscle soreness in healthy adults. The overall conclusion is that stretching is ineffective in reducing the incidence of exercise-related injury.

Psychologic Effects

In daily practice, at least in physiotherapy, patients appreciate muscle-stretching exercises because the exercises meet their need for self-support. The main differences between people who do and people who do not seek medical help for signs and symptoms are coping style and locus of control. Coping style refers to the way people behave in response to stressful events, such as a physical problem. Locus of control refers to beliefs people have regarding whether the cause or course of specific events is attributable to personal (internal control) or situational (external control) elements. Locus of control is a stable personality characteristic and is associated with certain coping strategies. As expected, passive pain coping strategies and external locus of control beliefs are significantly associated with depression, higher-rated pain intensity, and increased interference of musculoskeletal problems with daily activities.

Because muscle-stretching exercises are conscious actions—the person is aware that the stretching has a purpose—they may elicit a placebo response. Placebo effects (and the opposite, nocebo effects) have been extensively investigated in pain research. Studies of patients with Parkinson disease have shown that this placebo effect is related to the activation of reward mechanisms. The expectation of a reward, the anticipation of therapeutic benefit, results in the release of dopamine in the striatum. Moreover, previous experiences with positive therapeutic effects increase the strength of the placebo effect (i.e., a higher level of positive experience with exercise therapy will lead to a stronger placebo effect). Dopamine also may be involved in placebo responses encountered in other medical disorders, such as pain and depression.

There is consensus that static stretching affects pain tolerance and that it improves performance in some, but not all, sports. There is no consensus on the intensity, duration, repetitions, and type of stretching, or on whether stretching should be used in warming up or in cooling down or if it should be preceded by a warmup. Again, all these studies investigated the limb and trunk muscles, which have different characteristics from the masticatory muscles, making direct extrapolation of findings difficult.

Masticatory Muscles and Stretching

The masticatory muscles differ in several aspects from limb and trunk muscles. These differences can be explained in terms of functionality, because the masticatory muscles are active during a large variety of specific motor tasks, such as mastication, biting, speech, and swallowing. To execute this variety of tasks, they must be able to precisely control the position of the mandible and instantaneously apply changing forces to it. Aare et al concluded that significant differences in gene expression between craniofacial and limb muscles underline the differences in structural and functional characteristics between these muscles. In the light of this specific topic, only
a few differences will be discussed, namely, muscle architecture and muscle damage and repair.

**Muscle Architecture**

The anatomy and architecture of the masticatory muscles are different from those of the limb and trunk muscles. First, the fibers of the masticatory muscles are four to five times smaller and do not have long tendons. The type II (fast) fibers are often smaller than the type I (slow) fibers, whereas in limb and trunk muscles the opposite is true. Second, many of the fibers are hybrid, having the ability to change from one fiber type into another, especially in the jaw-closing muscles. Hybrid fibers have contractile properties that are intermediate between those of the myosin heavy-chain (MyHC) isoforms they express. Normally, the conversion of fiber types follows a strict order, from type I to type IIA to type IIX to type IIB, or vice versa. Contraction velocity increases successively, while fatigability decreases in that order. This means that the fibers change from a pure fiber type into another pure fiber type via hybrid fiber types, so there seems to be continuous switching. The jaw-closing muscles contain 40% hybrid fibers, while the jaw-opening muscles contain only 10%. Thus, the jaw-closing muscles seem better adapted to perform slow, tonic movements and the jaw-opening muscles seem to be better adapted to produce faster, phasic movements.

The motor unit territories of the masticatory muscles appear to be smaller than those of the limb muscles, and their cross-sectional area is variable, which explains the large variability in force generated (ie, the ability to perform a variety of motor tasks). Since a smaller cross-sectional area facilitates the diffusion of oxygen and nutrients, it might improve resistance to fatigue, especially in the fast fibers.

**Muscle Damage and Repair**

Because the fibers of the masticatory muscles are smaller than those of the limb/trunk muscles, the effect of mobilization or stretching will be greater, as will the risk of damage. Injured masseter muscles exhibited increased fibrous connective tissue in the region of damage, evidence of ineffective muscle regeneration. This decreased regenerative capacity of masseter muscles is due to differences in the intrinsic myoblast populations compared to limb muscles. As the regenerative capacity of masticatory muscles is less than that of the larger skeletal muscles, overstretching could be a problem due to microtrauma of the muscle fibers. This has practical consequences—the applied stretch should not be so intense as to cause muscle damage.

**Oral Motor Behavior, Proprioception, and Neuroplasticity**

This article proposes the concept that a dysfunction in proprioception may be a factor in bruxism etiology. Proprioception plays a key role in identifying the position of the mandible when the teeth are not in occlusion. In individuals with bruxism, the rest position of the jaw is changed from a position with some space between the maxillary and mandibular teeth into a situation with the teeth clenched together. This changes the person’s body image (knowledge of the shape and position of different parts of the body), but as the person does not perceive this situation as being abnormal, the brain is not alerted that something needs to be changed. This concept can be explained by thixotropy and the associated increased intrafusal tension. Muscle thixotropy is defined as the history-dependent changes in the so-called short-range elastic component (SREC). This means that after a conditioning contraction, such as bruxism, a high level of background discharge remains and subjects make position errors in the rest position. Thus, bruxism could be the consequence of altered proprioception. Bruxism may lead to muscle fatigue. This in turn leads to the body’s perception that greater force is needed to achieve muscle activity, which could lead to a vicious circle of repeated muscle activity.

The authors propose that bruxism may be not only a motor dysfunction but a sensorimotor dysfunction. Insight into cortical neuroplasticity (changes in neural pathways and synapses in response to changes in behavior, environment, neural processes, thinking, and emotion) is crucial for understanding how humans learn or relearn oral motor behaviors and for developing even better rehabilitative strategies to exploit these mechanisms in people with orofacial sensorimotor dysfunction. Several studies have shown that aspects of neurologic representations of inputs and actions can be modified by appropriate neurobehavioral training as a result of brain plasticity. This raises the question whether bruxism can in part be seen as a sensorimotor dysfunction (ie, neuroplasticity-induced behavior) and if muscle stretching can meet the characteristics of neurobehavioral training.

**Psychosomatic Aspects**

A question that cannot be omitted when it comes to exercise or any kind of intervention where a practitioner or medical device is involved is whether the effect of the exercise is really due to the therapeutic effects or also to secondary aspects, such as attention, expectations, or the patient-therapist relationship.
As already described, the placebo effect is partly associated with the dopamine system. The dopamine system is also involved in sleep bruxism and thus might be a common pathway through which a placebo could have physiologic influence on sleep bruxism. Moreover, it is already known that attention and mood influence pain. Attention and mood may influence the intensity of bruxism, increasing (by increasing the involved brain area) as well as decreasing it (by positive expectations/context). Research into the placebo effect in Parkinson disease suggests that the mechanisms of Parkinson disease and bruxism overlap to a certain extent, so that it might be possible to induce a placebo effect via conscious conditioning in patients with bruxism. In bruxism as in Parkinson disease, there may also be an imbalance between the output pathways of the basal ganglia, a group of nuclei that play an important role in the coordination of movements. Moreover, controlled polysomnographic studies show that the conventional drugs used in Parkinson disease appear to have an inhibitory effect on bruxism activity.

A critical evaluation of the available literature on the masticatory muscles, bruxism, and muscle stretching has led to a new concept in bruxism. Bruxism may be not only a motor dysfunction, as the current definition suggests, but a sensorimotor dysfunction with an important role for proprioception. When introducing a new management strategy (ie, muscle-stretching exercises), several differences in the muscle architecture and muscle damage and repair of the masticatory muscles compared with limb and trunk muscles should be taken into account. Therefore, the authors propose the use of muscle-stretching exercises in the management of sleep bruxism with several practical considerations.

Proposal for Jaw Muscles Stretching Protocol

Certain conclusions can be drawn about the dosimetry of the applied muscle stretch on the basis of the literature. First, stretching exercises should be done frequently and repetitively to bring about changes in neuroplasticity and muscle fiber type and to consolidate the acquired motor skill. Although several articles have been published about aspects of the dosimetry, it remains unclear whether a specific stretching protocol is superior to another and whether outcomes are affected by the type of stretching, duration, repetitions, and intensity.

Second, the exercises should not be done too intensively (ie, too forcefully), to prevent overstretching and therefore microtrauma of the muscle fibers. On the other hand, a certain amount of (over)stretch is needed to attain sarcomerogenesis.

Third, stretch duration should not be too long. Studies of the limb muscles show that stretching for longer than 60 seconds can be detrimental. The general recommendation, based on the hamstring muscles, is that a stretch should last at least 30 seconds. Shorter times will not allow the muscle fibers to release tension and reach an optimum sarcomere length.

Fourth, the type of stretching (static, dynamic, or ballistic [ie, bouncing]) and whether it is applied directly on the muscle or within the kinetic chain, is important. On the basis of findings for the limb and trunk muscles (see Table 1), acute static stretching and hold-relax stretching would seem most appropriate for reducing bruxism and/or its musculoskeletal consequences. Since the jaw-closing muscles, due to their fiber composition, seem better adapted to perform slow, tonic movements, a low intensity type of stretching should be considered. Furthermore, to avoid eliciting jaw reflexes, the stretch should not be too abrupt. Another approach would be to include vibration to the stretching exercise. Vibration activates the muscle spindle and causes a feeling of muscle relaxation due to desensitization (ie, reduced proprioception and reduced excitability).

Finally, the mentioned parameters of muscle stretching may have to be modified if the patient experiences pain, which affects muscle activity.

Conclusions

This topical review aimed to provide insight into the role of muscle stretching in the management of bruxism. Understanding bruxism as a repetitive jaw-muscle activity allows it to be seen as a musculoskeletal problem or at least a phenomenon with musculoskeletal involvement.

The authors suggest approaching bruxism as a sensorimotor dysfunction instead of a motor dysfunction. This concept is based on the altered proprioception that results from bruxism. The positive physical and psychologic effects of exercise therapy for musculoskeletal problems of limb and trunk muscles support muscle stretching in the management of bruxism. Although several differences between limb muscles and jaw muscles have to be considered, the use of muscle stretching in the management of bruxism looks promising.

Specific studies of the effect of stretching of the masticatory muscles on bruxism are needed, with attention on effectiveness for bruxism and subsequently on the dosimetry of stretching. A randomized controlled trial design with two arms, with traditional care versus traditional care plus stretching, would neutralize nonspecific aspects (placebo effect) while allowing...
assessments of the additional value of muscle stretching. Studies of more fundamental aspects, such as the changes induced in muscle by stretching exercises, would provide further insight into the potential benefits of stretching exercises.

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Bruxism and Indication for Muscle-Stretching Exercises

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