

Summary of current knowledge on bruxism and therapeutical interventions

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Bruxism is a frequently occurring phenomenon in the population and has been extensively researched and reviewed (Lavigne et al. 2008). The following text provides a short summary on the various techniques and methods used to interfere with bruxism.

Indeed, a survey of the literature shows a wide range of intervention or treatment methods which have been proposed over the last several decades to modify or decrease the level of bruxism (Lobbezoo et al. 2008). These methods include physiotherapy, muscle relaxation exercises, acupuncture, biofeedback, hypnosis, occlusal adjustments, occlusal splints and pharmacology (Lobbezoo et al. 2008). Today, the most common treatment of bruxism involves protection of the teeth by occlusal splints (Dao et al. 1998; Macedo et al. 2007). Although occlusal splints may be beneficial in protecting the dentition from attrition, the efficacy of intra-oral appliances in reducing nocturnal jaw muscle activity and the report of craniofacial pain upon awakening is still an open question. When the efficacy of occlusal splints in the management of sleep bruxism is considered at the individual level, some studies have shown a decrease, no effect at all, or even an increase in muscle activity (Harada et al. 2006; van der Zaag et al. 2005). It is a common clinical observation that occlusal splints will be worn suggesting that a significant amount of jaw muscle activity will continue to be present. Polysomnographic studies have documented that occlusal splints in patients with sleep bruxism are associated with great variability and found that approximately two thirds of the subjects treated with appliances demonstrate either no change or an increase in masticatory muscle EMG activity (Lobbezoo et al. 2008). One polysomnographic study showed that occlusal splints reduced the muscle activity associated with sleep bruxism in tooth-grinding subjects 2 weeks after the insertion (Dubé et al. 2004). However, this particular study evaluated the short-term effect of occlusal splints on sleep bruxism with a onetime measurement. Another recent study reported that occlusal splints reduced muscle activity associated with sleep bruxism but this effect was only temporary and there were no significant differences between baseline EMG activity and EMG activity after 6 weeks (Harada et al. 2006). We have shown that different variations of occlusal splints like the Nociceptive Trigeminal Inhibitory (NTI) splint may be able to reduce the EMG activity during sleep but without significant effects on TMD pain complaints (Baad-Hansen et al. 2007). There is evidence that a special type of splint,

the so-called mandibular advancement device (MAD) as well as the drug clonidine have effect on sleep bruxism and can be considered promising experimental treatments (Huyh et al. 2007). However, both treatments are associated with side effects such as discomfort for the MAD and REM suppression and morning hypotension for clonidine (Hyunh et al. 2007).

It has previously been emphasized that "mono-therapy" with occlusal appliances in order to reduce the muscle activity associated with bruxism may not result in predictable improvement of symptoms (Lavigne et al. 2008; Lobbezoo et al. 2008). Comprehensive reviews have concluded that occlusal splints are useful adjuncts in the management of sleep bruxism, but are not definitive or "curative" treatment (Dao et al. 1998; Lavigne et al. 2008; Lobbezoo et al. 2008). So far no definitive conclusions can be given in relation to the effects of occlusal splints on craniofacial pain because either the included patients in the above cited studies were free of pain or there were no specific information on this important outcome parameter (Svensson et al. 2008ab). Another important point is illustrated in Fig. 1 (Svensson et al. 2008b). This figure shows the short-term effect (1 week) of an occlusal splint in 11 subjects. There is a significant decrease in the total number of EMG episodes / hour sleep compared to baseline recordings in accordance with the outcome described above. However, a further detailed analysis shows that there is a differential effect on the phasic EMG episodes, but no effect on the tonic or mixed EMG episodes according to the criteria proposed by Lavigne et al. (1996). This finding raises the fundamental question if it is the total amount of EMG activity or if it is a particular type of EMG activity (phasic, tonic, mixed) that is the most important for a treatment effect.

Biofeedback techniques appear to be promising treatment options for patients with sleep bruxism. For example, EMG-activated alarms have been tested (Cassisi et al. 1987). Although the EMG suppression induced by auditory stimulation is interesting, a consistent return to pre-treatment bruxism levels has been reported in all studies that have monitored bruxism after stopping the feedback (Lobbezoo et al. 2008). Aversive gustatory stimuli have also been attempted to modify bruxism. However, the disadvantage of auditory (and gustatory) feedback is that they may interfere with sleep stage and quality because of arousal reactions.

Case reports have shown that contingent vibratory stimulation delivered to the maxillary teeth via an occlusal splint can lead to a significant decrease in the number of EMG events/hour (25% reduction) and the duration of each event (44% reduction) (Watanabe et al. 2001). One potentially stronger form of afferent biofeedback is low-level electrical stimulation of the trigeminal nerve innervation area. It is well-known and well-researched that perioral electrical stimulation causes inhibitory responses in the contracting jaw muscles, the so-called exteroceptive suppression periods (Dubner et al. 1978; Lund et al. 1983, Ongerboer de Visser et al. 1990; Lund et al. 2008). Recently, a study reported the use of contingent electrical stimulation of the perioral region in 7 subjects and showed a decrease in the EMG activity by 37% over 5 nights (Nishigawa et al. 2003). We have shown that the effect of conditioning electrical stimulation during sleep is a significant decrease (53%) in the EMG events/hour sleep and the study raised the question whether learning or conditioning effects could take place over time (Jadidi et al. 2008). However, further studies will be required to determine the long-term effects on jaw muscle activity. On concern with the use of conditioning stimulation during sleep could be the potential to trigger arousal reactions. Indeed, experimental muscle pain stimulation during sleep has demonstrated subtle effects on the sleep pattern with more sleep awakenings within stage II and REM and lower, but not poor sleep quality (Lavigne et al. 2004). Longer painful stimulation (minutes) during sleep seems more capable of intruding the sleep pattern than brief stimuli (seconds) (Lavigne et al. 2000; Arima et al. 2001). We have

preliminary data from polysomnographic studies that electrical conditioning stimulation during sleep is associated with a marginal, but significant decrease in stage III and IV sleep and increase in REM sleep (Wang et al. 2008). In accordance with our clinical study (Jadidi et al. 2008), there was no main effect of electrical biofeedback stimulation on the total sleep duration (Wang et al. 2008). Finally, it also needs to be pointed out that there were no significant effects of biofeedback on craniofacial pain parameters in the Jadidi et al. (2008) study; this could be due to the low levels of painful problems at the time of inclusion, lack of statistical power or dissociation between levels of jaw muscle activity and craniofacial pain. The relation between bruxism and craniofacial pain clearly needs further studies (Svensson et al. 2008b).

In summary, the reviewed studies have shown that different therapeutical interventions have at least a temporary effect on muscle activity; however, these changes are often not directly translated into changes in craniofacial symptoms, i.e., pain and unpleasantness. It appears that EMG devices which can be used in ambulatory settings will be needed to determine the extent of sleep-related bruxism for monitoring and diagnostic purposes. Furthermore, the biofeedback principle employed for example in the Jadidi et al. (2008) study holds promise to effectively interfere with the levels of EMG activity without significant disruption of sleep. Further studies addressing the optimal treatment period and the duration of the effect will be needed.

Effect of occlusal splints

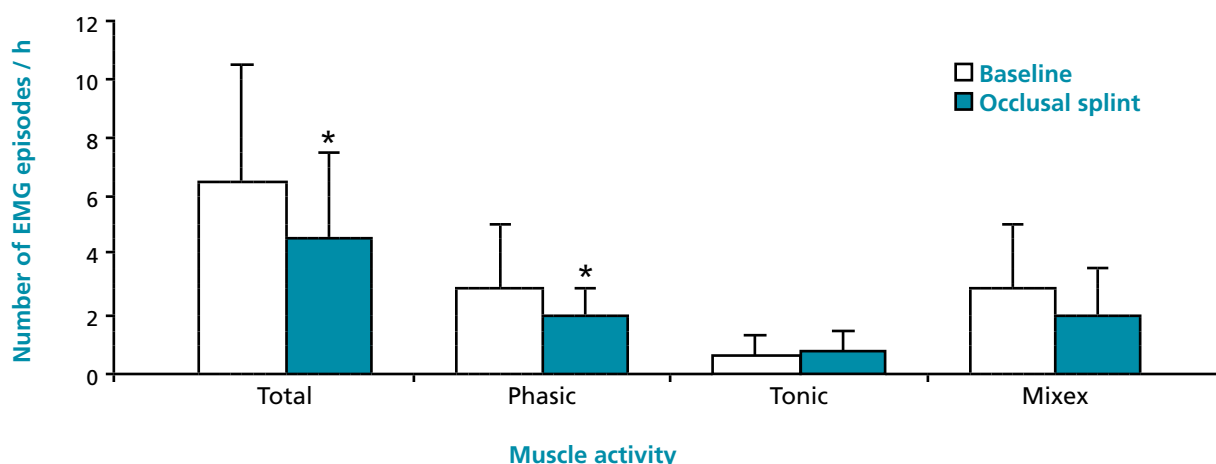


Fig. 1.

Short-term effects of occlusal splint on muscle activity expressed as total number of EMG episodes per hour sleep in 11 subjects (Mean values + standard deviations).

There is a significant (* Paired t-test: $P < 0.05$) decrease after 1 week use of the splint which mainly is due to a decrease in the phasic type of EMG episodes. Unpublished data from Drs. Toyota and Arima.

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