Biofeedback A Novel Approach For Treating Bruxism: A Narrative Review

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Abstract: Bruxism is a disorder of jaw-muscle activity characterised by repetitive clenching or grinding of the teeth which results in discomfort and damage to dentition. Bruxism may occur while awake, which is then called awake or diurnal bruxism, and during sleep, known as sleep or nocturnal bruxism. The main cause of bruxism has not yet been determined, but it is believed to be multifactorial. The two clinical manifestations of the condition (sleep and awake bruxism) are thought to have unrelated aetiologies but are palliated using similar techniques. General treatment approaches include behavioural strategies, pharmacotherapy and intra- oral devices; however, the control of bruxism is exceedingly difficult and, unfortunately, none of the techniques can permanently "cure" or "stop" it. The lack of a definitive treatment has prompted renewed interest in biofeedback, a behaviour change method that uses electronic detection to provide a stimulus whenever bruxism occurs. It is a process of using one's own biological signals to achieve a change in physiological functioning. By providing individuals with clear information about their bodily processes, it is believed that the individual can learn to modify their behaviour to his or her benefit. Feedback systems can be created by measuring bruxism events and providing converted signals as auditory, gustatory, vibratory or electrical stimulations to a patient. This technology works on the presumption that bruxers can "unlearn" their behaviour when a stimulus makes them aware of their excessive jaw muscle activity. The clinical goal is to decrease the level of bruxism in addition to alleviating or entirely eliminating related symptoms and generating a learned response that persists even after the treatment cessation.

Keywords: Bruxism, Biofeedback, Biofeedback devices, Clenching, Occlusal splint, Temporomandibular disorders.

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Introduction: Bruxism, or clenching and grinding of teeth, is the most prevalent parafunctional activity in the masticatory system. Bruxism is caused by a complex combination of factors, including central nervous system function, genetics, and behaviour.

Bruxism can be defined as:

1. **Ramfjord (1966):** Defined bruxism as a habitual grinding of teeth where individual is not chewing or swallowing.
2. **Rubina (1986):** Defined the term bruxism to indicate nonfunctional contact of teeth which may include clenching, gnashing, grinding and tapping of teeth.
3. **Vanderas (1995):** Defined bruxism as non-functional movement of mandible with or

without an audible sound occurring during day or night.

Types:

1. **Awake/ Diurnal bruxism:** It is the conscious or subconscious grinding of teeth usually during the day.
2. **Sleep/Nocturnal bruxism:** It is the subconscious grinding of teeth characterized by rhythmic patterns of masseter activity.

Causes: The main cause of bruxism has not yet been determined, but it is believed to be multifactorial.

1. Stress / Anxiety
2. Occlusal Discrepancies
3. Sleep Apnea

Clinical features:

1. Occlusal trauma
2. Headache
3. TMJ disturbances
4. Aching/Stiff Neck
5. Ridging of buccal mucosa

Prosthodontic applications: Biofeedback is based on the idea that "bruxers can unlearn their behaviors when a stimulus makes them aware of their negative jaw muscle activities." Mittelman described an EMG approach that provides daily bruxers with auditory feedback on muscle activity, indicating the degree of muscle contraction.

There is some activity or relaxation going on.[39] Nissani employed a taste stimulation to awaken a patient with sleep bruxism. In recent years, contingent electrical stimulation (CES) has been used to diminish masticatory muscle activity in sleep bruxism. CES works by inhibiting the bruxism-causing masticatory muscles by low-level electrical stimulation during an episode.

Experiments with patients with sleep bruxism and myofascial pain indicated that utilizing CES reduced EMG events per hour of sleep, but did not affect pain or muscle tension scores.

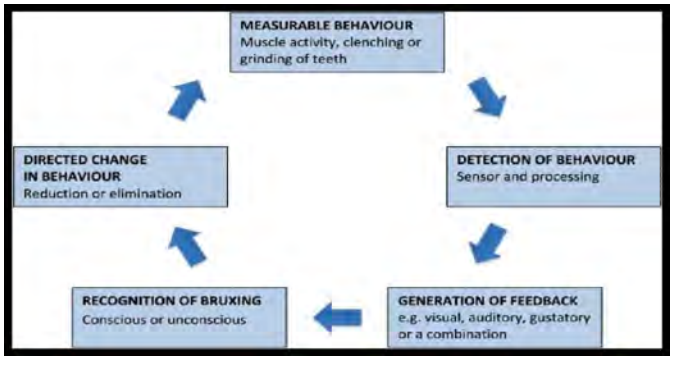
Biofeedback:

1. It is a behaviour change method that uses electronic detection to provide a stimulus whenever bruxism occurs.
2. Feedback systems can be created by measuring bruxism events and providing converted signals as auditory, gustatory, vibratory or electrical stimulations to a patient.
3. This technology works on the presumption that bruxers can "unlearn" their behaviour when a stimulus makes them aware of their excessive jaw muscle activity.
4. The clinical goal is to decrease the level of bruxism in addition to alleviating or entirely eliminating related symptoms and generating a learned response that persists even after the treatment cessation.

Mode of action:

1. Whenever any measurable behaviour such as muscle activity(grinding or clenching) as in the case of bruxism takes place, is detected by the sensors incorporated in the biofeedback device.
2. This sensor than processes the information and generates a feedback which can be either visual, auditory, gustatory or a combination.
3. This feedback alerts the patient of his/her bruxing activity.Thus the patient becomes aware and there is reduction or elimination of the activity.

Different biofeedback devices:

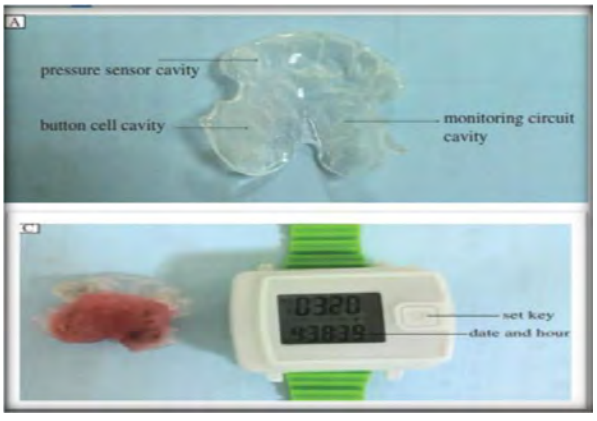


1) Biofeedback Splint:

1. This splint was made of two soft thermoformed full-coverage maxillary dental plates
2. A pressure-sensitive sensor was integrated along the entire occlusal surface, with electronic components housed in the palatal area, including a rechargeable battery, a vibrating motor, and a microcontroller.
3. The microcontroller continuously monitored the resistance level in the sensor.
4. Occlusal pressure on the sensor reduced the electrical resistance.
5. When the resistance fell below a predetermined threshold level, the microcontroller classified this as the start of a bruxing event (burst) and simultaneously switched on the vibrating motor.
6. Releasing the occlusal pressure reversed the process, which the microcontroller recognized as the end of the burst and stopped the vibrating.

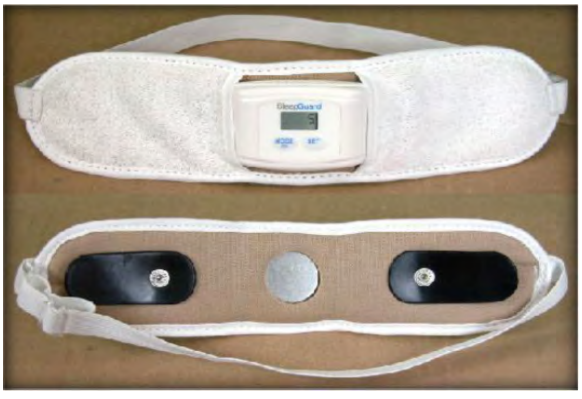
2) Mini Wireless Biofeedback Device:

1. A pressure sensor was embedded 0.5-1 mm below the surface of a maxillary biofeedback splint the point contacted by the mandibular canine in the intercuspal position.
2. A stabilization splint, which covers the maxillary or mandibular full dental arch, is rather large.
3. The design of a biofeedback splint is different from a traditional anterior or stabilization splint. An anterior splint is small and covers some of the anterior teeth.
4. Because the button cell) and mini monitoring circuit are designed to be packed into the splint, it is essential to extend the margin of the splint to the lingual surface of bilateral maxillary premolars.
5. The wireless transmitter sends the signals of bruxism events per second and the signals were received by a watch style device. When the value exceeded the thresh old, as clenching or grinding of teeth occurred during sleep, the watch vibrated to inform the bruxer of the abnormal movement of teeth and induce voluntary relaxation of the masticatory muscles and nervous system.



1) Biofeedback Headband:

1. This device is in the form of a headband which consist of sensors in the temporal region
2. These sensors detect the tension in the temporal muscle when the bruxism activity takes place.
3. It notifies the patient for the same and thus makes the patient aware of the activity and relaxing the muscles.



2) Biofeedback Earplugs/ Intra-aural device:

1. These devices are fitted inside the ear canal.
2. During bruxism, the ear canal tightens due to muscle activity, resulting in an unpleasant feeling.
3. The device provides feedback based on this physiological change, prompting users to stop their bruxing habit.

3) Biofeedback Earpiece:

1. This device consist of a sensor covering the masseter and the temporal region and a earpiece.
2. Whenever the patient clenches the muscle activity is detected by the sensor which transmits the signals and generates an auditory feedback making the patient aware.
3. It also notifies the patient through a message sent on the phone.This helps the patient to maintain a record of his/her bruxing acitivity as well.

4) Contingent Electrical Stimulation (CES):

1. In contingent electrical stimulation (CES) used mainly for managing sleep bruxism, the device detects the need for electrical stimulation based on muscle activity.
2. The CES device typically uses single-channel surface electromyography (EMG).
3. The electrode is placed on the anterior temporalis muscle.
4. Baseline Monitoring:

- Initially, during the baseline phase, the CES device monitors electromyographic (EMG) activity of the anterior temporalis muscles1.
- The device records the baseline level of muscle activity without delivering any electrical stimuli.

5. Threshold Detection:

- Once the baseline is established, the CES device sets an individualized threshold for muscle activity.
- When the EMG activity of the anterior temporalis muscles exceeds this threshold, it indicates that the patient is clenching or grinding their teeth during sleep.

6. Intervention:

- At this point, the CES device switches to the treatment mode.
- It emits a nonpainful electrical pulse to the temporal region (where the anterior temporalis muscles are located) to suppress the jaw-muscle activity.

Advantages:

1. Allows small changes in correct direction &

gradually build up into larger changes

2. Useful when patient has wrong perception of what they are doing which can be rectified
3. Encourages & motivate the patient
4. Reduces sense of helplessness
5. Serves as coping response to reduce symptoms of stress
6. Increases self efficacy by increasing confidence

Disadvantages:

1. Painful & expensive procedure
2. Useful only with other clinical measures
3. Not feasible in all kind of set ups
4. Can cause infection (invasive procedure)

Future scope:

1. The future scope of biofeedback devices in bruxism holds immense promise for personalized treatment approaches and long-term management.
2. Enhanced sensor technology coupled with advanced data analytics will enable real-time monitoring and tailored interventions, empowering individuals to effectively manage their bruxism.
3. Furthermore, integration with wearable technology and telehealth platforms will facilitate remote monitoring and intervention, improving accessibility and outcomes for patients worldwide.

Conclusion: Bruxism is an uncontrollable oral motor condition characterized by clenching, bracing, gnashing, and grinding of the teeth. The cause of bruxism is complex, contentious, and multi-factorial. Sleep bruxism has been linked to several causes, including peripheral, psychological, and central pathology. Effective management requires a comprehensive strategy that includes clinical skills and an understanding of the underlying issues. Due to the lack of a specific therapy, it is crucial to take all possible precautions to avoid negative consequences. In the lack of definitive proof, bruxism can be managed with occlusal equipment, counseling, lifestyle changes, and pharmaceutical interventions. When considering prosthetic therapy, it's important to limit occlusal loading on all components to maintain the prosthesis' integrity.

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