

Scientific Evidence on Effect of Mouthguards and Sports Drinks (Summary of the 1st International Sports Dentistry Workshop, 2016)

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Introduction

The 1st International Sports Dentistry Workshop took place in Honolulu, Hawaii, July 26-27, 2016. It was composed of sixteen sports dentists from Japan, Korea, Australia and the USA, who began their work months before the workshop by dividing up into four small groups and developing questions about their assigned topic.

The topics were:

- What do we know about mouthguards?
- What do we know about mouthguards and impact force?
- What do we know about mouthguards and performance enhancement?
- What do we know about sports drinks and nutrition?

The group searched the literature for current scientific evidence-based articles to try to find answers to questions

that they had developed. The body of the work was then reviewed at the Hawaii workshop.

There appears to be much confusion or misinformation worldwide regarding mouthguards and their use in sports. In an effort to clarify where the international dental community stands on mouthguards and mouthguard research, our group looked at some important questions.

Our goal is to one day formulate consensus statements related to these questions, which will be based on current scientific evidence-based research, to motivate the international community of the importance of dentally fitted laminated mouthguards and the wearing of them by athletes of all sports.

Overall, the group shared the following concerns about some of the topics:

- the age of the research could have been more current
- there was a general lack of scientific evidence-based research
- there were conflicting results from researchers on similar topics.

It is the intention of the group to continue to meet and search for new scientific evidence-based literature so that consensus statements can eventually be formulated for these topics.

Call to action

Our purpose with this workshop is a call to action regarding the importance of encouraging current scientific evidence-based research which could be used to motivate the international community of the importance of dentally fitted laminated mouthguards and the wearing of them by athletes of all sports.

The more grants that can be issued to study the effects of the topics that we have reviewed, the more we'll be able to get sports to mandate the wearing of dentally fitted laminated mouthguards.

If we can get others to see where we need more research, then we feel that those who are doing the research can achieve faster progress.

What do we know about mouthguards?

According to the Australian Dental Association a mouthguard is a protective device normally worn on the upper jaw, to reduce injuries to the teeth, jaws and surrounding soft tissues.⁽¹⁾ Mouthguards have a definite role in preventing injuries to the teeth and face and for this reason they are strongly recommended for all sporting activities where there is a risk of trauma to the teeth and associated structures.⁽²⁾

Dentally fitted laminated mouthguards offer the best protection. 'Boil and bite' type mouthguards are not recommended for any level of play as they can dislodge during play and block the airway.

The required mechanical properties of mouthguards are currently not well defined, but there are recommended specifications, which should be followed to provide adequate service.⁽³⁾

Mouthguard design and construction should consist of the following:

- Coverage to the distal of the maxillary first permanent molar, with a thickness of 3mm labially, 3mm occlusally, and 2mm palatally. The thickness of these

areas is strongly recommended.

- Occlusion should be bilateral and balanced.
- All sporting activities where there is a risk of trauma to the teeth and associated structures, such as rugby, football, kick boxing, taekwondo, boxing, basketball, 'bat and ball' sports such as ice hockey, field hockey and lacrosse should wear dentally fitted laminated mouthguards.

What do we know about mouthguards and impact force?

Wearing a dentally fitted laminated mouthguard of at least 3 mm thickness can be effective in reducing impact force to the teeth, and is superior to over-the-counter mouthguards.⁽⁴⁾

Clenching while wearing a mouthguard can enhance the effectiveness of reducing impact force.

No significant difference was observed in reduction of impact force to the head with or without wearing a mouthguard.

Recommended areas for further study include:

- increasing the number of cohort studies
- use of SCAT3 for concussion recognition when researching cohort study
- explore the relationship between concussion and impact forces.

What do we know about mouthguards and performance enhancement?

1) Relationship between changing of the stomatognathic function related to either static or dynamic balance in postural control (different jaw relations, unilateral or bilateral crossbite, no back teeth, etc.).

- For static balance (standing still) 11 articles said 'Yes'⁽⁵⁾ there is a relationship, 2 articles said 'No'⁽⁶⁾
- For dynamic balance (movement) – all 7 articles said 'Yes'⁽⁷⁾

The articles predominantly said that there is a relationship between stomatognathic functions as it relates to static or dynamic balance in postural control.

2) Relationship between clenching and muscle power

exertion.

- a) Muscle strength – isometric, isokinetic and eccentric.
- isometric power exertion - shoulder adduction movement and plantar flexion research showed that there was a significant positive correlation between biting force level and muscle activity increasing level (peak torque, average torque and integrated EMG).⁽⁸⁾
 - isokinetic power exertion - if done at a slow to medium angular velocity then clenching had a positive effect. If it is done at a high angular velocity, it had no effect.⁽⁹⁾ Knee extension at various velocities had little effect on isokinetic muscle strength where vertical dimension was increased by 2 mm or the inducement of occlusal stability.
 - eccentric power exertion - there is a positive correlation between biting force level and muscle activity increasing level. The harder you bite the more activity was seen (peak torque, average torque and integrated EMG).⁽¹⁰⁾
- b) Dependence on muscular fatigue - there is a positive effect of teeth clenching which was dependent on the level of muscular fatigue. The article was about repeated isokinetic knee extension. Teeth clenching on isokinetic muscular strength declined with increasing muscular fatigue.⁽¹¹⁾
- c) Relationship between greater maximum force and quicker force production and clenching your teeth - a positive relationship.⁽¹²⁾
- 3) What kind of neurophysiological changes happen during clenching, such as brain activation, excitability changes, and modulation of reflex? Articles ranged on topics of mastication⁽¹³⁾, voluntary teeth clenching, positron-emission tomography, functional MRI⁽¹⁴⁾ and transcranial magnetic stimulation and motor evoked potentials.⁽¹⁵⁾

A significant positive correlation was found between biting force level and excitability level. Teeth clenching and/or mastication contributes to stabilization of postural stance and fixation in joints. Athletes had more stability when clenching.

What do we know about sports drinks and nutrition?

Numerous sources indicate that the oral health of athletes appears to be poor across a wide range of sports, and that poor oral health may adversely affect athletic performance.⁽¹⁶⁾

Many athletes consume sports drinks which were found to typically contain electrolytes such as sodium, potassium, and chloride, and a high percentage of sugar to restore energy.

Many of the articles showed an increase in performance in using sports and energy drinks, even though they had deleterious effects on the athlete's health.

One article specifically stated that because of the stimulant content within the sports and energy drink; they would not be appropriate for children and adolescents. This intake can lead to excessive caloric consumption and an increased risk of overweight and obesity as well as dental erosion.

The Committee on Nutrition and the Council on Sports Medicine and Fitness recommends the routine ingestion of carbohydrate-containing sports drinks by children and adolescent should be avoided. The Committee advocates water instead of sports or energy drinks as the principle source of hydration for children and adolescents.⁽¹⁷⁾

Sports drinks have an effect on acid erosion, whether they are consumed before or after wearing a mouthguard. These drinks contain a lot of sugar and some have a low pH which may be the cause of dental caries and acid erosion.⁽¹⁸⁾

Summary and recommendations regarding mouthguards and their use in sports

In summary, the purpose of the international sports dentistry workshop was to formulate and answer leading questions relevant to mouthguards and their use in sports. Dentally fitted laminated mouthguards worn on the upper jaw offer the best protection when compared with the “boil and bite” design in trauma prevention. Workshop collaboration in combination with scientific evidence suggests mouthguard design requires strict adherence to specific dimensions in order to reduce the effects of impact force. On the contrary, there were not enough studies to

make evidence in effectiveness of reducing impact force to the head with or without a mouthguard without clenching teeth. Mouthguards can attribute to enhancement of postural control and muscle performance during teeth clenching. Additionally, consumption of sports drinks prior to mouthguard use increases places athletes at a higher risk for dental caries. Collectively it was felt amongst all of the participants that more current research with more uniform controls (use of a dentally laminated mouthguard) would be most beneficial in the evaluation of more current scientific evidence based research and facilitate an international consensus statement regarding mouthguards that hopefully could promote more mandated usage internationally.

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