Observational Study: Use of mouthguard in competitive powerlifters.

Stavan R. Bhatt, MS., MEd.
Department of Health & Sports Sciences, Part-time faculty member,
University of Louisville. Bhatt’s Bodies/ProBodyworks Consulting, Louisville, KY.
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ABSTRACT

Background. The author conducted an observational study to assess the effects of a custom-fitted mouthguard on strength and power changes in powerlifters before and after use during lifts during competition and meets.

Methods. 5 physically fit subjects aged 30 through 55 years were assessed and observed for the following powerlifting lifts: Squat, deadlift and bench press prior to mouthguard use and then reassessed for the same lifts after mouthguard use during various competitions. All baseline assessments were performed at the Fitness Factory, Louisville, KY and then follow-up mouthguard use lifts were assessed at various powerlifting competitions in Louisville, region and Las Vegas meets. During the competitive meets, the lifts are performed in accordance with strict standards and criteria in comparison to non-competition training lifting programs. One male subject failed to use mouthguard during training after initial fitting for competitions and was omitted. 3 Male powerlifters and 1 female powerlifter completed the study.

Results. The results showed improvements in all 4 subjects when comparing baseline squat, deadlift and bench press without use of the mouthguard to the same competitive lifts with use of the mouthguard.

Conclusions. The study findings show that use of a custom fitted mouthguard resulted in improved power and strength performance in competitions and resulted increased breathing ability and less fatigue via surveys obtained from the subjects. The
author will be pursuing further studies at a later point to explain the mechanisms involved in the improved strength performance exhibited.

**Commercial and Athletic Implications.** Athletes both recreational, competitive and scholastic have an opportunity to pursue and utilize a device that not only enhances performance and protects but aids in recovery and efficiency. There is increasing research showing evidence and support of mouthguard use during exercise and athletic activity resulting in increased power and strength changes in anaerobic activity and resistance training.

**Introduction.**
Athletes are often required to use mouthguards during training and competition for the purpose of providing protection against facial and dental injuries. The prevalence of these types of injuries is high, not only in contact sports, but also in non-contact activities and exercises. Mouthguards function by absorbing impact stresses which results in a reduction of force transmitted to the teeth, bone structure, cranium, and surrounding soft tissue. Recently, efforts have been made to address these concerns through redesigning mouthguards using neuromuscular dentistry techniques that promote specific jaw repositioning and other technology.

Advances in mouthguard design applied the dental technique of jaw-repositioning to not only prevent negative effects but to enhance athletic performance. Improved posture and proprioception have been observed with use of jaw-repositioning appliances (5-8). Bates and Atkinson in a previous study, found a jaw-repositioning mouthguard improved muscular power in athletes (9). An advanced jaw-repositioning mouthguard has led to improved muscular power performance (10).

Arent and McKenna found that a neuromuscular dentistry-based mouthguard appears to enhance peak power output performance and repeated maximal efforts via Wingate anaerobic testing but they found no significant differences for a bench press. (10) Dunn-Lewis, Luk, and Comstock, et al found with the use of a custom-fitted Power Balance performance mouth guard bench throw power and force were significantly higher over a regular over the counter boil and bite guard and the no mouthguard group. Their conclusion was that the custom fitted mouthguard improves upper-body loaded power exercises in both men and women and lower body exercise in men without compromising performance nor any other performance parameters. (11)

Kececi and Cetlin found peak power and average power in Wingate Anaerobic Test and Hamstring Isokinetic Peak Torque significantly increased as a result of wearing a custom-fitted mouthguard. In conclusion, they suggest that tae kwon do athletes can use mouthguards without any negative effects on their strength and anaerobic performance. (12)

I utilized a custom-fitted mouthguard in the subjects that does not alter jaw repositioning but further has no occlusion but enhances air flow through the mouth as well as via the maxilla, frontal and ethmoidal sinus cavities into the nasopharynx and into the trachea.
Participants and Methods.
We recruited 5 participants (4 men and 1 women) aged 30 through 55 years for this observational study. The men and one female were competitive powerlifters often training for competitions 3-4 times per year regionally, nationally and world championship events. All participants had no prior experience nor use of the current MaxO2® Performance mouthguard.

All participants were asked whether they understood all of the study’s observational methods and procedures; and I informed them of their right to drop out of the study at any time. Each participant was asked to complete a MaxO2® Performance mouthguard user survey after use of the mouthguard and after their respective competitions.

Dental impressions. A dentist, maxillofacial physician, and myself customized the mouthguard to mold to each of the participant’s upper and lower teeth as well as the upper gum/maxilla area. The mouthguard composition consists of material provided and purchased by MaxO2® Performance Mouthguards from DuPont™ for Elvax® 210W 62 durometer mold. The Elvax® composition is 28% vinyl acetate comonomer and contains a “W” amide additive. The Elvax® resins as noted by DuPont™ can be used for molded, compounding, sealants and wax blends. Corrosion only occurs at high temperatures above 446° degrees F and has been approved by the FDA for use in contact with foods.

Powerlifting Lifts. Participants were followed and observed via their diary workbook for initial measures of strength for the squat, deadlift and bench press. The mouthguards were then provided to all participants to train, utilize, and encompass into their training modalities all the way up to their competitions. The second measures of strength was tabulated and analyzed during their respective competitions. Henceforth, pre-mouthguard strengths measures were then evaluated with mouthguard use during competition meets. The Powerlifting squat, deadlift, and bench press performed during competition were based upon the International Powerlifting Federation guidelines.

For the mouthguard use, I asked participants to bite down on the custom-fitted mouthpiece and breathe through their mouths/nose while training and performing their powerlifting lifts. (13)

Results.
Results show positive changes in overall deadlift and bench press measures in the female while a lowered result for squat in the competition meets. This can be related to a more tightly governed rules and regulations for a competitive squat during a meet over a training based squat at the fitness facility. Data from one male of the 4 male participants was omitted due to not using the mouthguard during training. In total all 3 men, saw favorable changes in the squat, deadlift and bench press from baseline to the competition after training with the MaxVO2® Performance mouthguard. (Table 1)
**TABLE 1**
Data for Male/Female Participants:

<table>
<thead>
<tr>
<th></th>
<th>Without mouthguard</th>
<th>With mouthguard</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW Female:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squat</td>
<td>405</td>
<td>385.7</td>
<td>-4.7</td>
</tr>
<tr>
<td>Deadlift</td>
<td>415</td>
<td>446</td>
<td>7.5</td>
</tr>
<tr>
<td>Bench press</td>
<td>275</td>
<td>275</td>
<td>-</td>
</tr>
<tr>
<td>MH Male:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squat</td>
<td>425</td>
<td>455</td>
<td>7.06</td>
</tr>
<tr>
<td>Deadlift</td>
<td>425</td>
<td>460</td>
<td>8.2</td>
</tr>
<tr>
<td>Bench press</td>
<td>425</td>
<td>430</td>
<td>1.2</td>
</tr>
<tr>
<td>JR Male:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squat</td>
<td>490</td>
<td>545</td>
<td>11.2</td>
</tr>
<tr>
<td>Deadlift</td>
<td>605</td>
<td>700</td>
<td>15.7</td>
</tr>
<tr>
<td>Bench press</td>
<td>305</td>
<td>320</td>
<td>4.9</td>
</tr>
<tr>
<td>SB Male:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squat</td>
<td>525</td>
<td>560</td>
<td>6.7</td>
</tr>
<tr>
<td>Deadlift</td>
<td>580</td>
<td>585</td>
<td>0.9</td>
</tr>
<tr>
<td>Bench press</td>
<td>355</td>
<td>385</td>
<td>8.45</td>
</tr>
</tbody>
</table>

**Discussion.**

Researchers previously in the area of airway dynamics have reported differences between nasal and mouth breathing during various intensities of exercise. In fact, they have found better gas exchange with mouth breathing than with nasal breathing as discussed by Garner and McDivitt (4). Garner and McDivitt measured a significant increase in VO2/kg when participants wore the mouthguard with mouth breathing and our results correlated with this data. However, Francis and Brasher, also noted that participants reported a feeling of restricted airflow with mouthguard use. (1) As with Garner and McDivitt’s results of not reporting feeling a restriction, our test subjects concurred there were no issues, restrictions and no discomfort. The key factors can be and will be the mouthguard used in each study, how it is molded, the composition, custom-fit versus stock or self-fitted mouthguards as well if the mouthguard affects mandibular condyle movement or if the mouthguard opens airway passages in the nasal and pharyngeal area of the upper jaw. Many studies in the past focused on participants wearing a custom-fitted mandibular mouthpiece that did not obstruct breathing (4) to ones that were not of custom fit and obstructed airflow. (1). For instance, Garner and McDivitt, wore a custom-fitted mandibular mouthguard that functioned by creating an opening between the maxillary and mandibular teeth. This mouthguard accordingly shifts the mandible down and into a more forward position, which they report resulted in increased airway openings. (2-4)

In our study, the MaxO2 custom fitted mouthguard does not affect a change in the mandible nor does it move the lower jaw forward. The primary focus is on the upper maxilla/jaw area, as well as the maxillary, frontal and ethmoidal sinus cavities. With the mouthguard, these sinus cavities are opened resulting in enhanced air flow through these sinus cavities into the nasopharynx (Figure 1).
The mouthguard thus opens these upper airways while promoting increased air through the nasopharynx area down into the trachea. This in turn affects the nasal, maxillary and bronchial tree as the subject is able to breathe via the mouth as well via the sinus areas. The mouthguard rarely causes irritation in the anterior region of the maxilla upper jaw. The mouthguard limits risk of bony growth in the upper maxilla jaw due to lessened friction, better fit and enhanced composite materials. The guard in turn protects the teeth as well as causes no occlusion nor restriction to breathing.

**Conclusion.**
The results of this study show improved airway performance in participants who wore a custom designed mouthguard by MaxO2®. The mouthguard delays lactate production, with increased airway openings, thereby improves oxygen kinetics such as lowered oxygen deficit and/or improves breathing working rates. (3)

The MaxVO2® Performance mouthguard is purported to increase performance in sports by improving such things as strength, speed, endurance, agility, accuracy and balance by increasing airflow, oxygen consumption and replicating current neuromuscular dentistry designed mouthguard theories. MaxVO2® Performance mouthguard developers provide a theory indicating that improved strength and balance will occur when muscles in the face and jaw are properly aligned and relaxed. The current research study correlates with previous studies showing efficacious changes in strength performance changes in powerlifting movements such as the squat, deadlift and bench press in well-trained, experienced competitive lifters with the utilization of a custom-fitted MaxVO2® Performance mouthguard. The results of this study show that the MaxO2® Performance mouthguard would aid athletes in strength and powerlifting competitions and training.

**Conflicts of Interest/Disclosure**
Mr. Bhatt has no financial disclosures nor conflict of interest.

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