EFFECTS OF A NEUROMUSCULAR DENTISTRY-DESIGNED MOUTHGUARD ON MUSCULAR ENDURANCE AND ANAEROBIC POWER

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Effects of the Pure Power Mouthguard on Muscular Endurance, Anaerobic Power, and Fatigue

The purpose of this study was to examine the effects of a new mouthguard (the Pure Power Mouthguard or PPM; PPM, Inc.) on muscular endurance and anaerobic power and capacity. The PPM was designed using the concept of neuromuscular dentistry and is purported to provide optimal jaw alignment to enhance performance and protection. The PPM was compared to a more traditional "custom fit" mouthguard that did not use the same fitting technology. Anecdotal evidence exists to support the utility of the PPM, but well-controlled empirical evidence has been lacking to this point.

Materials and Methods

Subjects

Healthy, anaerobically-trained, male professional and collegiate athletes (*N*=22; M_{weight} = 86.2 $\pm$ 3.1 kg) ages 18-34 with 2+ years of weight training experience participated in this blind, crossover study. Each subject must have been training anaerobically 4+ days per week for at least the last 2 years. Weight trained individuals were used due to their familiarity with the demands of anaerobic exercise and in order to prevent training effects from the interval training during the study that may have occurred if using novices. This study was limited to males in order to control for muscular power differences that exist between genders, even if controlling for training

history. Risks and benefits were explained to the subjects and each of them gave written informed consent prior to participation in the study. All individuals were free from current injuries, illnesses, or metabolic conditions limiting their ability to train and complete physiological testing. A health screening was completed with each subject in accordance with American College of Sports Medicine (ACSM) exercise testing procedures.

Study Design and Supplementation

A single-blind, crossover design was used for this study. Each subject completed a fitting session for the mouthguard coupled with a familiarization session to control for practice effects on the anaerobic test (Barfield et al., 2002). This was followed by two separate testing sessions (T1 and T2). During T1 and T2, participants warmed-up and then completed three different performance tests: vertical jump, bench press with a load equal to bodyweight for maximal repetitions, and a Wingate Anaerobic Test (WAnT). Subjects were required to refrain from training for 24 hours prior to each testing session. Additionally, each subject was tested at the same time of day for T1 and T2. Participants were instructed to continue with their normal exercise training during the study.

Following the familiarization session, which included the health screening, the fitting process to take dental molds to make the mouthguards, and a familiarization WAnT, the subjects were randomly assigned to order of use of the PPM (PPM, Inc., Truro, Nova Scotia, Canada) and traditional custom-fit mouthguards. The alternative mouthguard was matched for appearance and material. The initial fitting for the mouthguards first involved taking a standard dental impression for the traditional custom

mouthguard. The fitting for the PPM then involved the attachment of electrical stimulation (TENS) surface EMG electrodes (Myotronics, Inc.). A very low-voltage pulse was delivered using this device in order to facilitate muscular relaxation of the lower jaw. Following this, new fast-setting impressions were taken to capture this “optimal” bite alignment. The total fitting process took about 80-90 minutes. Following the dental impressions, subjects underwent familiarization with the tests to be used during the actual testing. This included practice attempts on the vertical jump and familiarization with the bench press weight as well as completion of the 30s WAnT using the load to be used during testing. Once the mouthguards were produced, subjects returned to the lab to complete T1 and T2, with the two trials separated by 5-7 days.

Exercise Test Procedures

For each testing day, all subjects reported to the Rutgers University Human Performance Laboratory. Subjects were asked to arrive for testing normally hydrated, have eaten a high carbohydrate meal 2 hours prior, and to refrain from ingesting substances that could affect normal physiological functioning (i.e., tea, coffee, alcohol, nicotine). At each trial, the subjects completed a 10-15 min systemic warm-up before being tested on the vertical jump followed by the bench press with a load equal to bodyweight for maximal repetitions. Vertical jump was assessed using the Vertec measuring device (Sports Imports, Columbus, OH). Subjects completed 3 trials with 45-60 sec rest between trials. The highest of the 3 jumps was recorded. After completing the vertical jump, the individuals then completed a standard upper body muscular endurance test (bench press with bodyweight for reps). After 2-3 warm-up sets, subjects

were given a 4-5 min rest before attempting the test. The score consisted of the total number of repetitions completed in good form before momentary muscular failure.

Following the vertical jump and bench press tests, subjects performed the 30s WAnT on a Monark 894E Anaerobic Test Ergometer (Monark Exercise AB, Sweden). The load was set according to each subject's weight (Üçok et al., 2005) and was equivalent to 0.10 kp/kg body weight.

Performance Measures

Peak power during the WAnT was defined as the highest mechanical power output elicited during each 30s test. Mean power was calculated based on the average mechanical power produced during the test. Maximal vertical jump height was used to establish power and the number of repetitions completed for the bench press constituted the scores for muscular endurance.

Abstract

A mouthguard is an often overlooked piece of equipment that athletes in many sports are required to wear due to the protective elements. However, recent advances in neuromuscular dentistry have led to the development of a mouthguard touted to also enhance performance through optimal jaw alignment. **PURPOSE:** To examine the effects of a neuromuscular dentistry-based mouthguard on muscular endurance and anaerobic power and capacity in competitive athletes. **METHODS**: Anaerobically-trained professional and Division I college athletes (*N*=22; M_{weight} = 86.2 $\pm$ 3.1 kg) participated in this blinded, crossover design study. Subjects were randomly assigned to order of use of either the experimental (EXP) or traditional custom-fit (CON) mouthguards, which were matched for appearance and material. Subjects first completed a fitting session coupled with a familiarization session to control for practice effects on the anaerobic tests. Fitting for EXP involved 60 min of electrical stimulation to produce lower jaw relaxation. Two separate testing sessions, approximately 7 days apart, followed the initial session. During each condition, participants completed three different performance tests: vertical jump (VJ), bench press with a load equal to bodyweight for maximal repetitions (BP), and a 30s Wingate Anaerobic Test (WAnT). Subjects refrained from training for 24 h prior to each testing session. RM ANOVAs were used for statistical analysis. **RESULTS**: VJ was significantly

higher for EXP (EXP = 67.6 $\pm$ 2.0 cm; CON = 65.3 $\pm$ 1.8 cm; P = .003). BP repetitions were not significantly different between conditions (EXP = 16.1 $\pm$ 1.1 reps; CON: 15.8 $\pm$ 1.2 reps; P = .48). Peak power on the WAnT was significantly greater while wearing EXP (EXP = 11.6 $\pm$ 0.4 $W \cdot kg^{-1}$; CON = 11.1 $\pm$ 0.3 $W \cdot kg^{-1}$; P = .038). There were no significant differences in average power during the WAnT (EXP = 8.5 $\pm$ 0.3 $W \cdot kg^{-1}$; CON = 8.4 $\pm$ 0.2 $W \cdot kg^{-1}$; P = .54).

CONCLUSIONS : A neuromuscular dentistry-based mouthguard appears to enhance peak power output and performance in explosive, short duration bouts of exercise. However, it does not appear to enhance sustainable power output or muscular endurance. There may be some practical value for athletes in power sports.

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