Student Name
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Longwood Senior Thesis Program Proposal

The Effect of Mouthguard Use on Throwing Velocity

Introduction

During the process of the throwing motion, there are many thing that can affect the outcome velocity, such as the mechanics of the motion, the strength and flexibility of the athlete, power, intent, and fatigue (Boggs, 2016). A combination of all these factors results in end velocity after the ball is thrown. The throwing motion is very powerful, violent, complex and abnormal to the normal range of motion of the body.

Mouthguards have shown to significantly increase power production during a countermovement vertical jump with and without arms in college aged males (Busca, 2017). There are also data showing significant power production differences between the mouthguard wearing subject vs the non mouthguard wearing subject in bench throw power in both men and women (Dunn-Lewis, 2012). A study has also shown that clenching down on a customized mouthguard results in a bigger boost in plyometric press power and force production than an over the counter mouthguard (Arnet, 2010). Mouthguard use has also been associated with changes in minute ventilation and VO2peak during maximal exercise in addition to a significant increase in power production in the mouthguard wearing group (Martins, 2018). Further work has shown reductions in post-exercise lactate levels between groups of subjects wearing mouthguards when running (Garner et al. 2009).

Mouthguard use has also been associated with increases in strength during the same exercise bout. Handgrip strength was measured in a group of subjects when wearing, and not wearing a mouthguard. A significant increase was found in hand grip peak force in the mouthguard wearing group versus the non mouthguard group. In this same study, there was also a significant increase in scores for back row isometric force in the mouthguard group vs the non mouthguard group as well as s significant increase in vertical countermovement jump in the group with a mouthguard in place (Busca, 2016).

The goal of the present study is to determine if maximum and average throwing velocity is increased when wearing a mouthguard. It is hypothesized that mouthguard use will increase average and maximal throwing velocity with the same mechanics, intent, strength, flexibility, and fatigue levels in the athlete, and that this increase in end velocity at ball release will be due to an increase in power production. The rationale behind the project is that the mouthguard would act as a buffer between the maxilla and mandible allowing for a greater contraction of the maxilla and mandible muscles during the throwing motion. In theory this would allow a greater overall force production during the process of throwing allowing for a greater exit velocity of the ball from the hand because of concurrent activation potentiation. Concurrent activation potentiation occurs when muscles that are not directly involved in the movement are contracting during the movement which aids in the overall force production within or during the movement (Ebben, 2006).

Subjects

Subjects will be recruited from the Longwood club baseball team, the Hampton Sydney Baseball team (the coach has already agreed that his players can be asked to volunteer), and other subjects with a history of performance in throwing sports. All subjects will be informed of the purpose and risks and asked to provide voluntary written informed consent. It will be made clear to the subjects that coaches will not be provided with individual data and that their participation is voluntary. All subjects will have the option to opt out of the test at any point during the process with no repercussions.

Protocol

Each athlete that is participating in the study will be given and fitted for a Wilson Adult Best Mouthguard, this mouthguard is noninvasive and will be molded on the upper teeth according to manufacturer's instructions (typically immersion in boiling water then placed in the jaw for molding. Each athlete will then begin their own team issued warm up plan that consists of a submaximal aerobic warm up, resistance band work, plyometric balls, multiple dynamic stretches, team issued throwing program, start throwing submaximally at a short distance and gradually increase distance and intent until at desired length, decrease the distance keeping the same intent when throwing, throw until completely

warm and ready to participate in maximum velocity testing. Each athlete will be given the opportunity to practice throwing with while wearing the mouthguard and will be given velocity feedback. Throwing velocity will be measured using a handheld radar gun according to manufacturer's instructions.

Once warmed up the athlete will complete five maximal throws with or without the mouthguard. Velocity feedback will not be provided during the test throws. Order of testing will be randomized. After the testing has concluded, the athlete will proceed into a team issued cool down program that consists of resistance band work, dynamic stretches, plyometric balls, and an aerobic warm down.

Statistics

The highest throwing velocity recorded in each condition will be used for data analysis. Data will be presented as mean ± SD and differences between group means will be tested using a paired t-test. Significance will be set at $p<0.05$.

Resources Requires

- Radar Gun for measuring throwing velocity. The Kinesiology faculty have access to a radar gun if the team equipment is not available.
- Wilson Adult Best Mouthguards – An application will be made with the Dean of CEHS and the Office of Student Research to fund purchase of the mouthguards. The subjects will keep the mouthguard after the study.
- Warm up and throwing area – baseball and softball fields are available for use.
- Baseballs – provided by the team as a regular part of practice.

Timeline for completion - Fall and Spring semesters

IRB submission/approval *prior* to leaving for summer

Fall Semester	
Week 1	Subject recruitment
Week 2	Data collection
Week 3	Data collection
Week 4	Data collection
Week 5	Data collection and analysis
Week 6	Data analysis
Week 7	Data analysis
Week 8	SEACSM abstract submission
Week 9	Data analysis
Week 10	Data analysis
Week 11	National ACSM abstract submission
Week 12	Manuscript preparation
Week 13	Manuscript preparation
Week 14	Manuscript preparation
Week 15	Manuscript preparation
Spring Semester	
Week 1	Manuscript preparation
Week 2	Manuscript preparation
Week 3	Manuscript preparation
Week 4	Poster preparation
Week 5	SEACSM meeting – Poster presentation
Week 6	Manuscript preparation
Week 7	Manuscript preparation
Week 8	Manuscript submission
Week 9	Presentation preparation
Week 10	Presentation preparation
Week 11	Presentation preparation
Week 12	Presentation preparation
Week 13	Poster preparation
Week 14	Poster preparation for spring symposium (and National ACSM)
Week 15	Spring symposium

Committee members

Jo Morrison
Tim Coffey
Laura Jimenez

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Sources

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