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Clinical Viewpoint

The Safety and Efficacy of Weighted Baseballs

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One of the most common methods of training to enhance pitching velocity is the use of weighted baseballs. As with anything else, the excitement and popularity often proceed our scientific understanding.

While there is still a lot to learn, our understanding of the science and efficacy of weighted baseball training has grown in recent years. The purpose of this clinical viewpoint is to summarize our current scientific understanding.

Despite the increased attention in the medical community, baseball injury rates continue to rise at an alarming rate.[1–5] This rapid increase is not just at the elite professional level, but more alarmingly in the youth and high school age groups.[2] The current state of the sport has placed an emphasis on pitching velocity that has spread to the youth and amateur levels.[6]

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DO WEIGHTED BASEBALLS ENHANCE VELOCITY?

The general consensus to this question will likely be that, yes, weighted balls enhance velocity. But this deserves more attention.

In our 6-week prospective study, we showed that a group of high school athletes using weighted balls had a significantly greater improvement of 3.3% in pitching velocity compared to a control group.[6]

But when analyzing the data, we showed that not everyone increases velocity and that many people in the control group also improved. Eighty percent of people in the weighted ball group enhanced velocity, with 8% showing no change, and 12% showing a decrease in velocity. Furthermore, 67% of people in the control group also improved their velocity, with 19% showing no change, and 14 showing an actual decrease.

A similar 6-week study by Marsh et al.[7] reported no significant change in velocity in collegiate and professional pitchers after a 6-week program. A recent meta-analysis by Caldwell et al.[8] also noted several studies that concluded with no significant change in velocity.

Thus, it appears that while weighted balls may help some enhance their velocity, not everyone will see improvement and some will even see a decline. This may have a lot to do with the wide variety of definitions of a "weighted ball" training program. Variations in the weights of the ball, the amount of throwing, and the drills performed can all impact results. Going forward, future research should attempt to delineate the variables associated with performance enhancement and to determine if a specific population may find more benefit than others.

THE BIOMECHANICS OF WEIGHTED BASEBALLS

Very little information is known about the biomechanics of weighted balls. Fleisig et al.[9] showed no significant kinematic changes when throwing balls weighing between 4-7oz, but did note a significant increase in peak varus torque at the elbow with underload balls, and a general increase in elbow torque across all ball weights when comparing weighted ball drills and pitching off a mound. Okoroha et al.[10] showed a significant increase in varus torque that increased as the weight of the ball increased from 3-6 oz in youth.

While those studies are helpful, they only look at a small piece of weighted ball training. It's very common for athletes to include throws from various positions with balls weighing from 2oz to 2lbs and more.

But more importantly, peak torque may not be the only relevant metric to observe. The total amount of torque over

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the course of the throw and the contribution of muscular fatigue should not be overlooked. Both could theoretically stress both the static and dynamic stabilizers of the shoulder and elbow.

Future research should continue to look at the biomechanics as programs evolve.

THE MECHANISM OF VELOCITY ENHANCEMENT

As we continue to study weighted ball programs, there is still some uncertainty as to why they may help enhance velocity. However, recent research from our group has shed some light on this that may explain both the mechanism of efficacy, as well as the potential injury risk.

Subjects in our 6-week program study showed a significant increase in shoulder external rotation of 5 degrees at the conclusion of the study, which did not occur in the control group. This finding surprised us and led to our next study on the acute effects of weighted ball throwing on shoulder range of motion (ROM).[11]

In this study, we showed that subjects that threw overload weighted balls had a significant increase in shoulder ROM that increased as the weight of the ball increased. Throwing 16-32oz balls for a total of 27 throws at largely submaximal intensities resulted in an 8-degree increase in passive shoulder external rotation. It should be noted that in a past study of ours, we showed that professional pitchers that threw a 45 pitch session off the mound at full intensity did not show a change in external rotation ROM.[12]

Past studies have shown that pitching velocity is correlated to shoulder external rotation, however, this also correlated to increased stress.[13–16] Based on these studies, it appears that the gain in external rotation ROM from throwing weighted balls is likely the contributing factor to velocity improvements.

THE SAFETY OF WEIGHTED BALL PROGRAMS

While performance enhancement is important for athletes, doing so in a way that does not significantly increase injury risk is also important. In our prospective study on weighted ball training, we showed that almost 25% of subjects sustained an injury to their shoulder or elbow. Most injuries occurred in the subsequent baseball season, not during the program. To date, this is the only study to follow players after a program. This matches our anecdotal experience and of others.

Based on what we have learned, this seems to make sense. We know that throwing weighted balls is an added stress to the joints. We know that they increase shoulder external rotation. We know that this can enhance velocity, but also increase stress on the arm.

THE FUTURE OF WEIGHTED BALL TRAINING

While we have learned so much over the last several years, there is still much more to learn. Future research should continue to explore the safest and most effective use of weighted balls for training.

It all comes down to physics. Weighted balls aren't evil and aren't the cause of injuries. They just change the stress. They also aren't magical and don't work to enhance velocity with everyone. If we are going to try to find ways to enhance performance without sustaining injuries, we need to understand this simple fact and build programs based on science.

We are also overdosing some of our athletes if we don't plan these programs appropriately. Taking a break from throwing off a mound is important to reduce overuse injuries. Olsen et al. previously showed that pitching less than 8 months out of the year can reduce injuries by 500%.[17] The previous thought process in the baseball community was that these weighted ball programs can be used without consequence. However, it appears that weighted balls are equal to or more stressful than throwing off a mound.

RECOMMENDATIONS

Based on our current understanding of the science, we recommend the following:

- Moving away from generic programs used by a variety of athletes, or entire groups of pitching staff, towards a more individualized program is imperative.
- Strict inclusion and exclusion criteria need to be established prior to initiating a program.
- Programs with extreme weights or volume should be avoided in the skeletally immature athlete until a proper physical base is established
- Programs should be scaled based on the level and experience of the player.
- Different programs should be designed based on the time of the year and specific goals of the athlete.
- Workloads should be monitored to assure weighted balls are included in throw counts and overall program design
- Monitoring the athlete must be included to assure they are handling the added stresses that are involved.

In summary, when the activity being performed approaches the limits of soft tissue integrity, we need to assure we are dosing the program accordingly. More is not better. If we're going to utilize a program that pushes our physiological limits, then we need to be much more careful, follow the science, and be specific with the application.

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