Exploring the Impact of Ball Size on Pitching Kinetics: A Pilot Study.

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Summary

A ball specifically scaled in size and mass to age group anthropometrics (i.e. hand size) did not significantly reduce throwing arm kinetics. A lack of difference might be attributed to the scaled ball being thrown faster than the standard-sized ball (~1.7m.s^{-1}), resulting in joint kinetics of similar magnitudes on a throw-by-throw basis. Nevertheless, advantages concerning cumulative load reduction could benefit younger players, especially at 9-10 years old.

Introduction

Throwing arm injuries have become increasingly prevalent in youth baseball. Many are classified as "overuse", wherein, throwing volume exceeds the capacity of shoulder or elbow structures to cope with the induced stress. As a result, microtrauma accumulates, joint architecture may alter, and the potential for acute failure increases [1].

With a clear need to address this issue, many have sought to establish best practices to protect arm health in youth baseball. Most common amongst these is monitoring throwing volume; however, recent research has sought to adjust the ball itself (the baseball currently remains the same regardless of playing level). Preliminary findings suggest that joint kinetics can be reduced with a smaller/lighter ball [2,3], potentially providing an additional approach to mitigate upper-extremity stress.

Whilst findings are encouraging, these previous studies have not considered the specific anthropometric variations among youth players [4]. Given that younger athletes are not the same size as adults, simply implementing a lighter ball that retains the same dimensions as the standard baseball may not be adequate. Therefore, the purpose of this study was to explore how joint kinetics are impacted by reducing the size and mass of a baseball to better suit youth players. We expected joint kinetics to reduce with the smaller ball, which would go some way to preserve arm health.

Methods

Kinematic data for 13 youth baseball pitchers (1.40 ± 0.10m; 44.5 ± 14.3kg; 10 ± 1y) were collected using an electromagnetic motion capture system (240Hz). Kinetics were subsequently calculated from kinematic data. Each pitcher threw 15 game-intensity fastballs towards a target strike zone: five with a regulation leather baseball (Reg), five with a 3D printed ball matching the regulation size and mass (ST), and five with a 3D printed ball scaled to average hand size for the age group (SC) [4]. All data processing, and statistical analyses were performed in R Studio (Posit PBC, Boston, MA).

Results

Mean (± sd) joint torques for each ball and age group can be found in Table 1. Despite small fluctuations between SC, ST, and Reg balls, torque magnitudes we comparable. This suggests that shoulder and elbow joint kinetics did not change across balls (all *p*s > .05) regardless of age group.

Table 1. Joint torques and ball velocity by ball type.

		SC	ST	Reg
Shoulder Rotation	*9-10*	5.5 (3.1)	8.5 (7.2)	7.6 (3.8)
	11-12	6.8 (9.5)	4.7 (2.5)	7.0 (5.1)
Shoulder H Adduction	*9-10*	22.7 (1.7)	22.2 (1.9)	22.9 (2.0)
	11-12	32.4 (3.5)	32.7 (1.6)	32.8 (4.4)
Elbow Varus	*9-10*	8.1 (1.2)	8.8 (1.5)	9.2 (1.2)
	11-12	12.4 (2.4)	11.8 (2.7)	12.0 (1.9)
Ball Velocity	*9-10*	23.0 (0.6)	21.3 (0.5)	21.7 (0.5)
	11-12	24.0 (0.5)	23.0 (0.5)	23.3 (0.4)

Note: Reported torques are negative; ball velocity is in metres per second (m.s^{-1}); SC = scaled 3D, ST = standard 3D, Reg = regulation.

Discussion

Contrary to our initial assumptions, and that of previous research [3,4], arm kinetics were not reduced with a smaller ball. While there was some variation between SC, ST, and Reg balls, no consistent differences were observed across ball types on a trial-by-trial basis. However, when cumulative load (i.e. the work done across multiple throws) is considered, results suggest that ball scaling may be beneficial to reducing workload. For the 9-10 group especially, 20 throws with the SC ball would be equivalent to throwing 5.5 fewer times (shoulder rotation torque) and 2.4 fewer times (elbow varus torque) compared to the regulation baseball. More evidence is required, though, to determine if similar trends would be observed in the 11-12 group.

Conclusions

On a throw-by-throw basis, joint loads were not sufficiently reduced with a scaled ball. However, a smaller, lighter ball might prove advantageous in terms of cumulative load, with younger athletes benefitting most owing to the comparative difference in size/mass with a regulation baseball.

References

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