The Influence of Mound Height on Baseball Movement and Pitching Biomechanics

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MAJOR LEAGUE BASEBALL

MLB Runs per Game

- Mound lowered in 1969 to create offense

Lower the Mound Again?

- Would lowering the mound increase run scoring?
  (Background: 1969 MLB Season)

- Would lowering the mound affect pitcher injury rates?
  (Background: 2018 youth baseball study)

Do Mound Height and Pitching Distance Affect Youth Baseball Pitching Biomechanics?

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Investigation performed at The American Sports Medicine Institute, Birmingham, Alabama, USA

Background: Pitching injuries continue to be a serious problem, with adolescents now representing the group with the most injuries. Some have proposed that lowering or eliminating the pitching mound in youth baseball may reduce joint stress and subsequent injuries. Another potential risk factor is advancing from youth to adult pitching distance without an intermediate distance.

Hypotheses: It was hypothesized that for a group of young pitchers, pitching kinetics and kinematics would change with mound height. It was also hypothesized that pitching kinetics and kinematics would change with pitching distance.

Study Design: Controlled laboratory study.

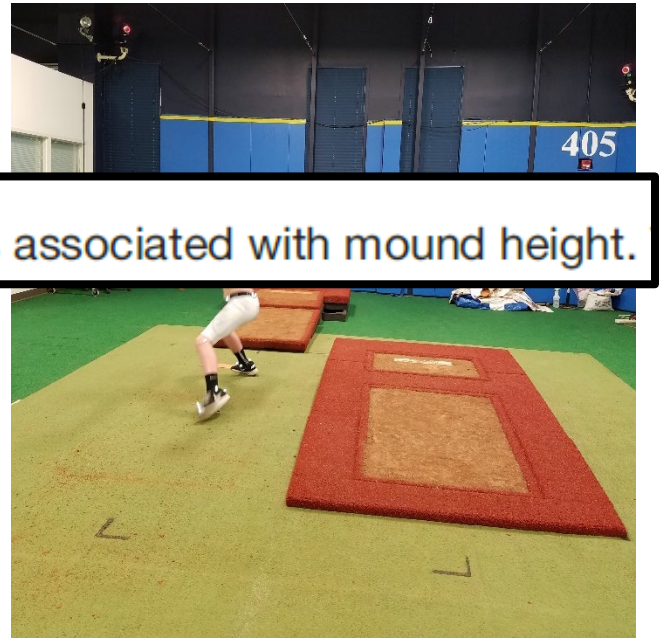
Methods: Twenty-one young (12.6 ± 0.5 years) baseball pitchers pitched 5 full-effort fastballs each from 5 different conditions, in random order: 14.02-, 16.46-, and 18.44-m distances from a 25 cm–high mound, 16.46-m distance from a 15 cm–high mound, and 16.46-m distance from flat ground. Pitching biomechanical values were collected with a 12-camera automated motion capture system. Ball velocity and 31 other parameters were computed for each pitch. Data were compared between the 3 mound heights at 16.46 m by use of repeated-measures analysis of variance and paired post hoc *t* tests ($P < .05$). Similarly, data were compared between the 3 distances from the 25-cm mound via repeated-measures analysis of variance and paired post hoc *t* tests ($P <$ .05).

Results: No differences were found in ball velocity, shoulder kinetics, or elbow kinetics associated with mound height. Several kinematic differences were found, but the majority were at lead foot contact before the rapid, dynamic phases of pitching. Change in pitching distance was associated with slight increase in shoulder kinetics as well as a few kinematic differences. Several kinematic differences were found, but the majority were at lead foot contact before the rapid, dynamic phases of pitching. Change in pitching distance was associated with slight increase in shoulder kinetics as well as a few kinematic differences.

Conclusion: The hypothesis that shoulder and elbow kinetics would change with mound height was not supported by the data. Several kinematic differences were found, but the majority were at lead foot contact before the rapid, dynamic phases of pitching. Change in pitching distance was associated with slight increase in shoulder kinetics as well as a few kinematic differences.

Clinical Relevance: Lowering or eliminating pitching mounds in youth baseball would not significantly decrease joint stress and injury risk to young pitchers. However, when available, transition from 14.02-m to 16.46-m to 18.44-m pitching distance may reduce stress on the young throwing shoulder.

Keywords: shoulder; elbow; kinematics; kinetics; force; torque



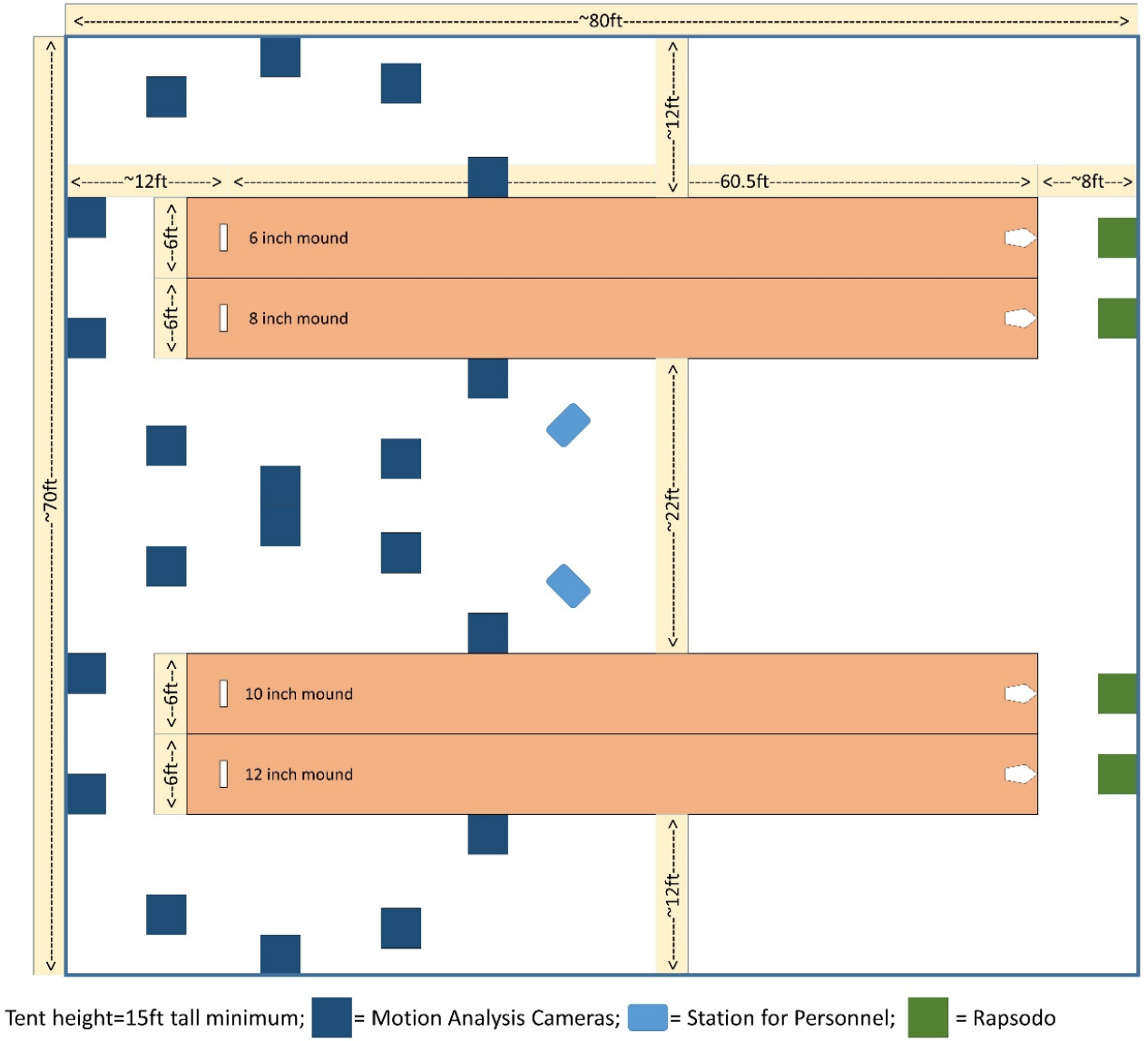
Current Study

Diffendaffer AZ, et al. The influence of mound height on baseball movement and pitching biomechanics. *J Sci Med Sport* 2019.

- ASMI
- MLB
- USA Baseball
- Motus

Methods

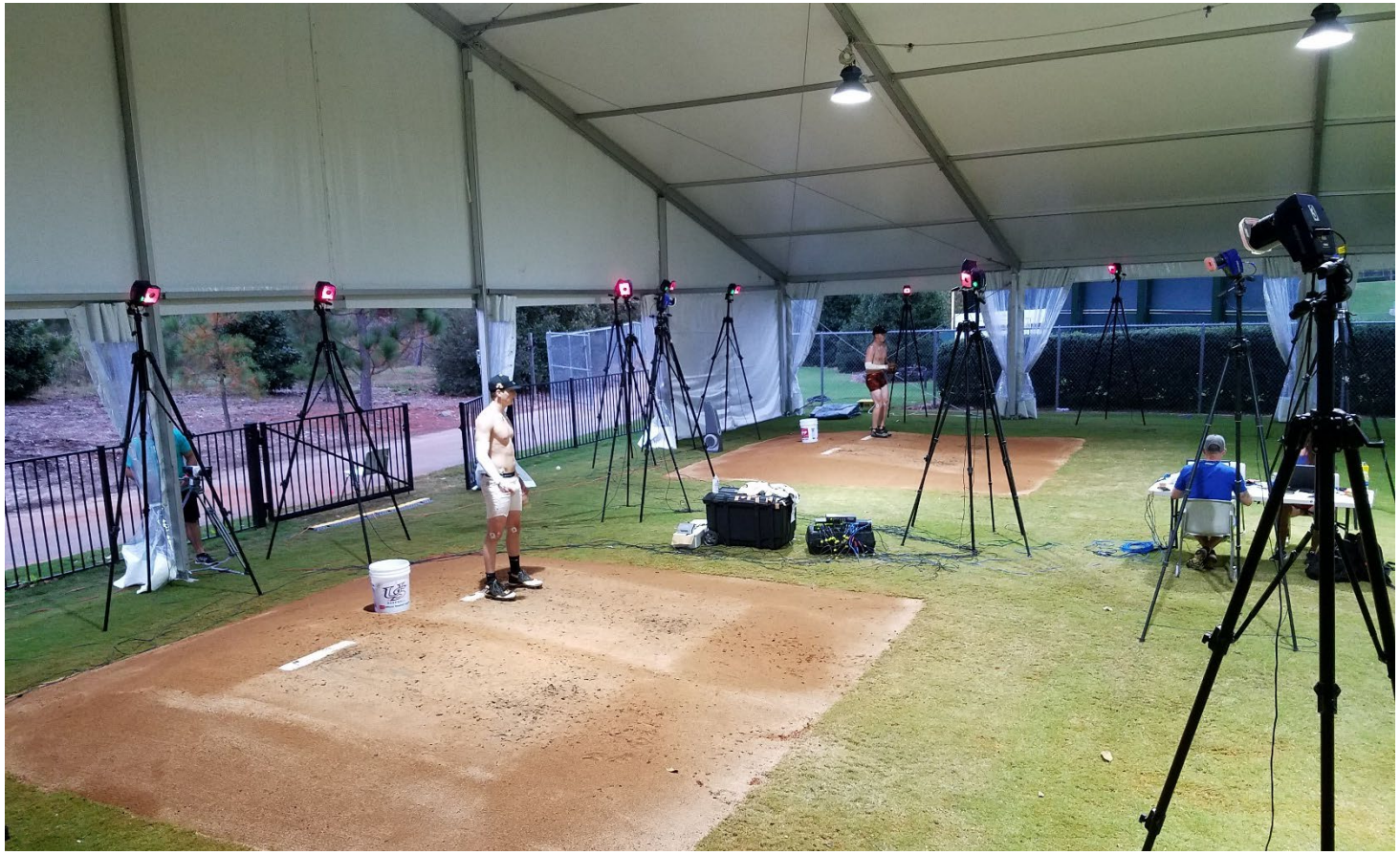
USA Baseball Complex



Tent height=15ft tall minimum; = Motion Analysis Cameras; = Station for Personnel; = Rapsodo

Methods

- Four mounds
- Two Motion Analysis systems



Methods

- Four Rapsodo ball trackers

Methods

- 4 mound heights (6”, 8”, 10”, 12”)
- 2 pitch types (fastball, curveball)
- 20 collegiate pitchers

Results

Kinetics

Fastball	6”	8”	10”	12”
Elbow varus torque (N·m)	90	90	91	91
Elbow flexion torque (N·m)	57	57	58	58
Elbow proximal force (N)	1011	1009	1023	1020
Shoulder internal rotation torque (N·m)	90	90	92	92
Shoulder anterior force (N)	360	360	367	365

Curveball	6”	8”	10”	12”
No significant differences				

Kinematics

Fastball	6”	8”	10”	12”
Foot Contact				
Stride length (% height)	82	82	81	81
Lead knee flexion (˚)	43	43	44	44
Lead foot position (in)	7.6	8.0	6.6	6.4
Shoulder abduction (˚)	93	93	92	92
Shoulder horizontal abduction (˚)	20	19	21	20
Shoulder external rotation (˚)	55	56	52	54
Elbow flexion (˚)	103	103	101	102
Ball Release				
Forward trunk tilt (˚)	34	34	33	33

Kinematics

Curveball	6”	8”	10”	12”
Foot Contact				
Stride length (% height)	82	82	81	81
Lead knee flexion (˚)	43	42	44	43
Lead foot position (in)	8.1	8.5	7.5	7.0
Trunk lateral tilt (˚)	10	10	11	10
Shoulder abduction (˚)	92	92	91	92
Shoulder horizontal abduction (˚)	20	20	22	22
Shoulder external rotation (˚)	55	54	51	50
Elbow flexion (˚)	102	101	100	100
Max. shoulder external rotation (˚)	159	159	158	159
Knee flexion (˚) at release	41	41	42	43
Forward trunk tilt (˚) at release	35	35	34	34

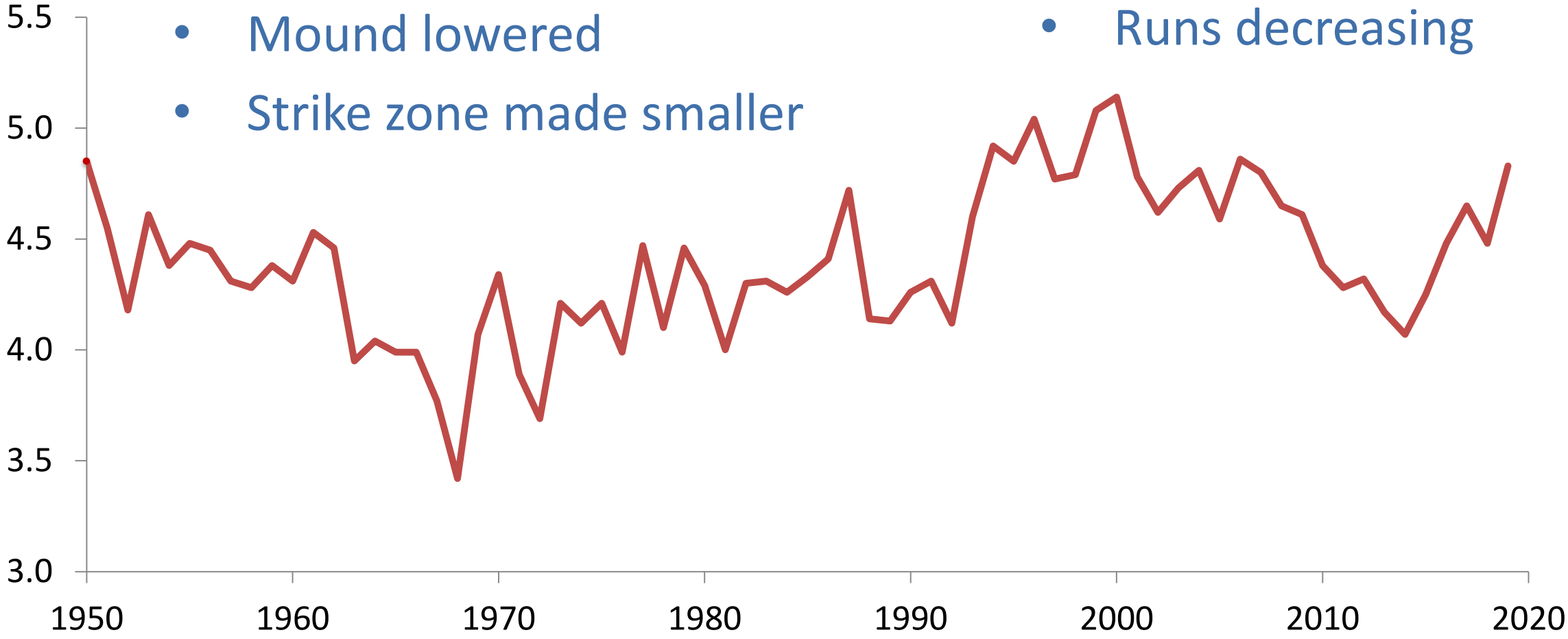
Ball movement

- No differences in ball velocity
- No differences in ball break

Discussion

MLB Runs per Game

- 1969
  - Mound lowered
  - Strike zone made smaller
- 2000 – present
  - Runs decreasing



Conclusion

- Lowering the mound may not affect run scoring, as no change in ball velocity or movement was detected.
- While just 5 years ago there seemed a need for more runs in MLB, the game seems to have corrected itself.
- Elbow and shoulder kinetics will be same or slightly less with lowered mound. Therefore lowering the mound should not increase injury risk.

Thank you

Support:

- MLB: Funding; construction and maintenance of mounds.
- USA Baseball: Space; personnel; Rapsodo systems.