A METHODOLOGY TO INVESTIGATE THE PITCHER-GROUND INTERACTION IN YOUTH AND COLLEGIATE BASEBALL PLAYERS

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INTRODUCTION

While research studies have been performed regarding baseball, there is a lack of data surrounding pitching. Most studies focus on kinematic properties related to the pitching arm and some have studied kinetics related to the upper extremity. However, few studies have investigated the contribution of the pitcher-ground interaction in baseball pitching. Studies have shown that the body follows the pattern of a kinetic chain, with the ground reaction force (GRF) and the lower extremity contributing highly to upper body motions during an overhead throw [1]. While GRF is a contributor to arm motion and successful pitching, it is not the only component of the pitcher-ground interaction that can affect pitching; the GRF moments (GRFMs), pivoting moments, and foot contact moments may also contribute to pitching motion, but have yet to be studied in pitching.

Therefore, the purpose of this study is to create an appropriate method of data collection to compute the variables related to the pitcher-ground interaction. This method may then be used to provide a comprehensive overview of the pitcher-ground interaction contribution to the upper body motion and pitching.

METHODS

Ignoring air resistance, the GRFMs and the ground reaction moments (GRMs) are the only external moments acting on the pitcher. The total external moment is a combination of the GRF moment, generated by the combined GRF about the whole body center of mass, the pivoting moment, generated by the horizontal GRF components about the combined center of pressure, and the foot contact moment, generated by each foot due to contact with the ground. GRFs and GRFMs contribute to the momentum of the pitcher, which is an important component to higher pitching speeds [2].

Fifteen youth and collegiate baseball pitchers will be recruited for participation. This study will utilize 10 motion capture cameras (Qualisys) sampling at 500 Hz, 2 force plates (AMTI) sampling at 1000 Hz, a pitching mound, baseballs, and a 56 marker body model. Participants will be asked to wear spandex clothes and their normal pitching cleats. Data collection will be over the instrumented pitching mound. The pitching mound will consist of a level, elevated force plate (10 inches above the ground), attached to a ramp. Within the ramp will be second force plate, and both plates will be covered with artificial turf. The participant will start at the top of mound, with the back foot on the center of the elevated force plate. The participant will then be asked to perform 10 successful fastball pitches, directing the ball to hit a target on the wall, while stepping on the embedded force plates (Fig 1).

After collection, data will be processed using Kwon3D 5.1 and pitcher-ground interaction variables (i.e. GRFs, GRFMs, foot contact moments) will be extracted for group characteristics.

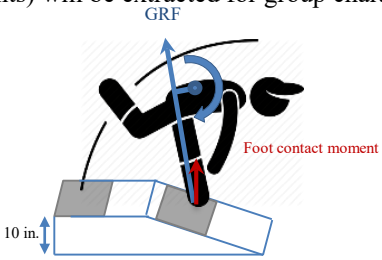

Figure 1: Proposed mound set-up for collection of fastball pitching data.

RESULTS AND DISCUSSION

This study will attempt to determine the relationship between the pitcher-ground interaction and pitching mechanics (i.e. pitching arm segmental velocities). It is hypothesized that higher velocity will be associated with increased external moments related to the pitcher-ground interaction. Correlations will be run to determine if this relationship exists.

SIGNIFICANCE

This study aims to create an appropriate methodology to answer the following question: how does the pitcher-ground interaction contribute to pitching mechanics? By answering this question, a better understanding of how the ground contributes to pitching outcome may be found. It has been shown via the golfer-ground interaction that increased external moments were correlated with a higher clubhead speed [2]. This study expects to find similar results with the pitcher-ground interaction related to increased arm. Because faster thrown balls are harder to hit, due to the required changes in the timing of opposing batters, increasing the external moments could lead to improvements in pitching. By creating a methodology to investigate this relationship, improved and safer methods of training to improve pitching skills in developing pitchers may be created.

Professional organizations contribute significant amounts of money to developing players without an understanding of how to improve pitching mechanics in a safe way. The created methodology and findings may benefit professional organizations in keeping their young pitchers healthy while developing their abilities. The information found in this study may also be used to promote future studies related to higher level pitching.

REFERENCES

[1] MacWilliams, et al. (1998). *Am. J. Sports Med.*
[2] Han, et al. (2019). *Sport Biomech.*

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