Importance of Foot Function in Baseball Pitching: The Relationship between Foot Function and Players with Disabled Throwing Shoulder/Elbow

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INTRODUCTION: Pitching motion is an integrated motion of the entire body from the lower to the upper extremity. To understand pitching motion, recognizing the concept of kinetic chain is essential. It has been well known that the lower extremity and trunk must function as a stable yet dynamic base of support for efficient transfer of the ground reaction force. Functional impairment and mechanical deterioration of the body segments result in breakdown of kinetic chain, due to the reduction in efficient energy transfer. Thus, breakdown of kinetic chain consequently increases mechanical stress to the shoulder and elbow, resulting in disabled throwing shoulder and elbow. Foot is the main force generator of the kinetic chain, and integral part of pitching motion through its importance as a stable base. From our recent retrospective study, players with disabled throwing shoulder and elbow tended to have high rates of impaired foot function and floating toes in both feet, which insisted that these pathologies may have a relationship with the occurrence of throwing injuries. However, there are no reports regarding the impaired foot function and floating toes among the players without disabled throwing shoulder and elbow. The purpose of this study was to investigate the prevalence of foot function and floating toes among the players without disabled throwing shoulder/elbow and to analyze them between those with the injury.

METHODS: The study was conducted as a part of preseason medical examination. A total of 138 youth male baseball players (average age of 11.2 years) were included in the study. Among them, 121 players were right-handed. Players who complained of shoulder/elbow pain in the past was defined as the players with the history of disabled throwing shoulder/elbow and those who were able to induce shoulder/elbow pain at the examination was defined as the players with the injury. Foot function was evaluated by foot “rock paper scissors” movements, according to the previous reports. Players were laid relaxed on a table and instructed to flex all the toes to create “rock” with the ankle in plantar flexion position, followed by extending the hallux while keeping other toes flexed to create “scissors.” The evaluation was completed with the instruction to extend and spread all the toes to create “papers” (Figure 1). If the player was unable to perform one of the three movements, it was defined as impaired foot function. Floating toes were evaluated with the players standing on a solid mat on both feet, postured in static upright position. It was defined as positive if all the toes did not make contact to the mat. The prevalence of the impaired function and the relationship between the history and injury were statistically analyzed using chi-square test. *P* value of <.05 was considered to be statistically significant.

RESULTS: Prevalence of players with history of disabled throwing shoulder/elbow was 27% (37 players) and those with injury was 7% (10 players). Overall prevalence of impaired foot function of the throwing side and non-throwing side was 34% (47 players) and 30% (42 players), respectively, and those of floating toes were 33% (46 players) and 36% (50 players), respectively. Prevalence of impaired foot function of the non-throwing side among the players with the injury (60%) was significantly higher compared to those without the injury (28%) ($P< 0.001$). For the throwing side, players with the injury tended to have higher prevalence (60%) compared to those without the injury (32%). As for the floating toes, players with the history showed significantly higher prevalence in the throwing side (49%) compared to those without the history (28%) ($P< 0.001$). For the non-throwing side, players with the history tended to have higher prevalence (49%) compared to those without the history (32%).

DISCUSSION AND CONCLUSION:

The study revealed that players with disabled throwing shoulder/elbow tended to have higher prevalence of impaired foot function and floating toes compared to those without it. Since the foot is the only body part which is in contact with the ground, its function may have an importance during pitching motion. The human foot and toes play a vital role in maintaining balance, stabilizing the body, and creating propulsive force to push the body forward. In addition, during pitching motion, proper positioning and strength of both legs are required to help provide a stable base for the kinetic chain and the remainder of the motion. According to the previous study, subjects with floating toes have decreased toe muscle strength compared to those without it and fair worse in foot “rock paper scissors” movements. Our results and previously reported data suggest that functional impairments of the foot may relate to the occurrence of disabled throwing shoulder/elbow. Further study to analyze how these functional impairments affect the kinetic chain and throwing motion must be undertaken to reveal the importance of foot function during baseball pitching.

The prevalence of impaired foot function among the youth baseball players of the throwing side and non-throwing side was 34% and 30%, respectively, and those of floating toes were 33% and 36%, respectively. Players with disabled throwing shoulder/elbow tended to have significantly higher prevalence of impaired foot function and floating toes compared to those without it. Impaired foot function and floating toes may have a relationship with disabled throwing shoulder and elbow.