

코킹 초기단계에서 팔의 과외전 자세가 야구 투수에게 정말 위험한가?

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Is Hyperabduction Arm Position in Early Cocking Phase Really Dangerous for Baseball Pitchers?

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Purpose: Certain pitching mechanics is thought to lead pitchers in danger of surgical risk and decrease performance. The objective of this study is to analyze the effect of shoulder hyperabduction position during early cocking phase in association with surgical risk and performance in professional baseball players.

Methods: From 2009 to 2013, total of 93 candidates reached minimum inning qualification. After exclusion criteria (overlapped players, foreign players, age over 31 years, proceed to other league and retirement), 19 players were analyzed with slow-motion pitching video for hyperabduction of the shoulder and hyperpronation of forearm in cocking-phase. Also players were analyzed with innings pitched, earned run average (ERA), walks and hits divided by innings pitched (WHIP) and surgical history with database offered by official Korean Baseball Organization website.

Results: Out of total 19 players, nine players had hyperabduction arm movement and 10 players did not. Group with hyperabduction had average age of 24.3 years old, average inning/ERA/WHIP for 5 years were 55 innings/yr, 6.52 ERA/yr and 1.33 WHIP/yr, respectively, and seven players (77%) had surgeries eventually. Group without hyperabduction arm movement had average age of 25.4 years old; average inning, ERA/WHIP for 5 years were 127 1/3 innings/yr, 4.84 ERA/yr, and 1.32 WHIP/yr, respectively and five players (50%) went for surgeries. Player performance (ERA, $p=0.66$; WHIP, $p=0.14$) was not statistically influenced by the certain arm position at cocking phase but average inning pitched was statistically affected ($p<0.01$).

Conclusion: Hyperabduction of shoulder in early cocking phase of throwing motion does not lead to decrease in performance (ERA, WHIP) but will result in tremendous decline of average IP. Also, risk of surgery is not associated to hyperabduction motion of the shoulder.

Keywords: Baseball, Hyperabduction, Inverted W, Pitching, Shoulder

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Introduction

Upper extremity injuries in baseball players, has been a major issue^{1,2} and it is well known that with better pitching mechanics there will be a lesser chance of injury for players³. O'Leary⁴ mentioned about inverted W pitching mechanics. According to the author⁴, hyperabduction of pitching arm side shoulder above 90° (horizontal to ground) or "inverted W" pitching motion during early cocking phase can cause a timing problem. In those players, pitching arm side forearm is not at the proper position due to excessive shoulder abduction and internal rotation during foot contact of the glove side (end of stride pitching motion)⁴.

Aguinaldo, also supports the timing problem by describing that pre-foot contact players (trunk rotation before the glove side foot contact) exhibited significantly more elbow valgus torque⁵. On the other hand, Douoguih et al.⁶ reported that the inverted W pitching motion was not significantly associated with greater risk of upper extremity injury requiring surgery in MLB (Major League Baseball) pitchers. But they also concluded that the early trunk rotation statistically increases the risk of surgery. The purpose of this study was to analyze the effect of hyperabduction shoulder position during early cocking phase in association with surgical risk and performance in professional baseball players.

Methods

From 2009 to 2013, total of 93 candidates reached minimum inning qualification. Overlapped players (players who achieved minimum inning qualification for several years), foreign players, age over 31 years, previous surgery history (shoulder and elbow), players proceeding to other leagues (MLB or NPB [Nippon Professional Baseball]) and retirements (due to prosecution, gambling issues) were excluded. Approval was obtained from the Institutional Review Board of Konyang University Hospital (IRB No. KYUH 2019-01-002-002).

Final 19 pitchers were enrolled in this study, and slow motion video was obtained from each professional baseball team. Two observers analyzed the presence of hyperabduction of shoulder during early cocking phase (Fig. 1), hyperpronation (full forearm pronation state at late cocking phase) (Fig. 2) and flat-arm (forearm parallel to ground at late foot contact during stride motion) (Fig. 3) with the obtained video. During early cocking phase, if elbow of the pitching arm side was placed above the shoulder, it was defined as hyperabduction. Hyperpronation of forearm in cocking phase was defined as full forearm pronation at late cocking phase (or hand with the ball facing second base) and flat-arm of forearm in early cocking phase was defined as pitching arm side forearm parallel to the ground at late foot contact during stride motion. Two investigators are medical doctors who are involved in national

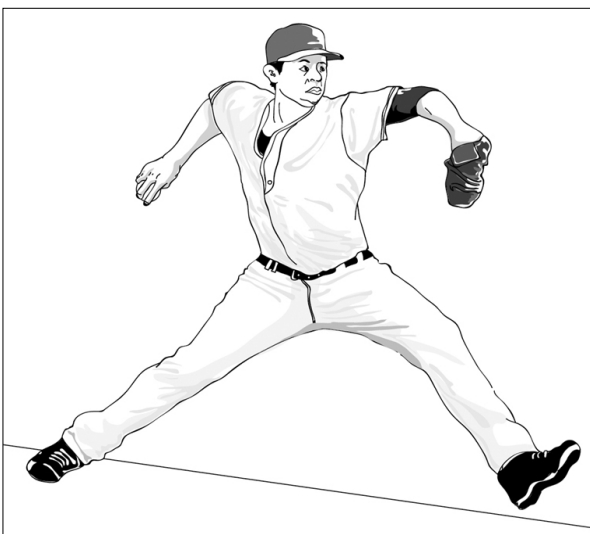


Fig. 1. Hyperabduction of shoulder in early cocking phase (elbow of the pitching arm side placing above the shoulder).

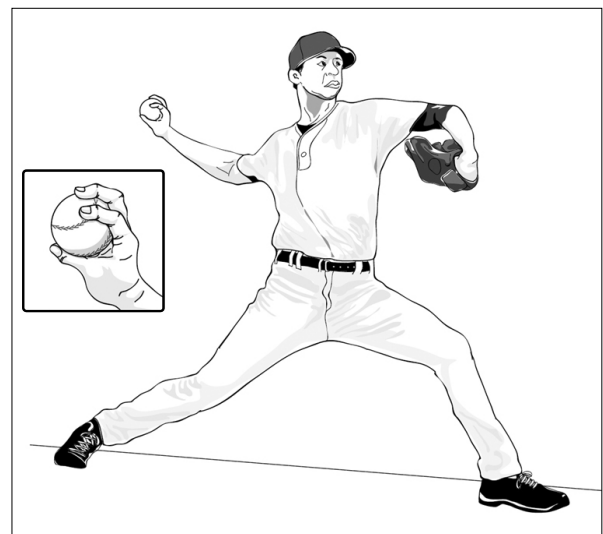


Fig. 2. Hyperpronation of forearm in cocking phase (full forearm pronation at late cocking phase).

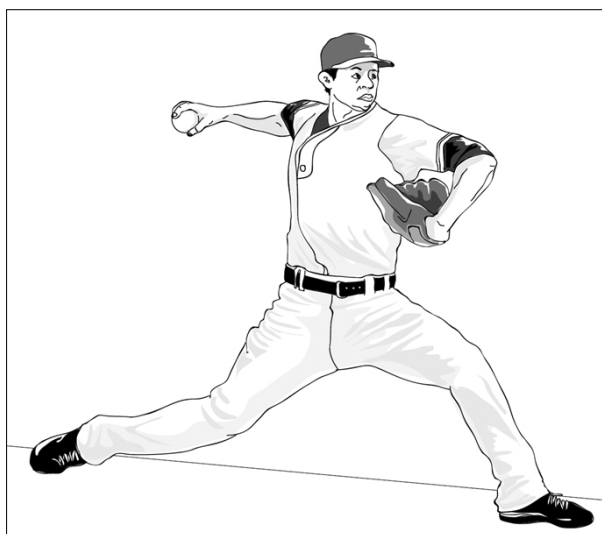


Fig. 3. Flat-arm of forearm in early cocking phase (forearm parallel to the ground at late foot contact during stride motion).

team sports physicians.

After slow motion video investigation, the players were analyzed with innings pitched (IP), earned run average (ERA), walks and hits divided by IP (WHIP) and surgical history with database offered by official National Baseball Organization website. IP/ERA and WHIP were investigated starting from next year of minimum inning qualification till next 5 years.

Statistical reliability was measured by SPSS ver. 10.1 (SPSS Inc., Chicago, IL, USA). Mann Whitney U-test was used to evaluate the statistical significance between hyperabduction of shoulder (HA) and non-hyperabduction (nHA) in correlation with other parameters (IP, ERA, WHIP) Fisher's exact test was used to identify the surgical risk. Statistical significance was set at $p < 0.05$.

Results

Out of total 19 players, nine players had hyperabduction arm movement and 10 players did not. HA group had average age of 24.3 years old; average inning, ERA, WHIP for 5 years were 55 innings/yr, 6.52 ERA/yr, and 1.33 WHIP/yr, respectively, and seven players (77%) had surgeries eventually. nHA group had average age of 25.4 years old; average inning, ERA, WHIP for 5 years were 127 1/3 innings/yr, 4.84 ERA/yr, and 1.32 WHIP/yr, respectively and five players (50%) went for surgeries (Table 1).

Table 1. Comparison of HA and nHA groups

Variable	HA	nHA	p-value
No. of players	9	10	
Age (yr)	24.3	25.4	
Average IP/yr	55	127 1/3	< 0.01
Average ERA/yr	6.52	4.84	0.66
Average WHIP/yr	1.33	1.32	0.14
Required surgery	7	5	0.35
Hyperpronation*	1	0	
Flat-arm [†]	1	2	

HA: hyperabduction, nHA: non-hyperabduction, IP: innings pitched, ERA: earned run average, WHIP: walks and hits divided by IP.

*Hyperpronation: full forearm pronation at late cocking phase; [†]Flat-arm: forearm parallel to the ground at late foot contact during stride motion.

Hyperpronation was present in one player at HA group and flat-arm was present in two players at nHA and one player at HA group. In HA group, seven players have taken surgeries (four elbows, three shoulders) and in nHA group, five players took surgeries (five elbows; $p < 0.35$) (Table 1). Player performance (ERA, $p < 0.66$; WHIP, $p < 0.14$) was not statistically influenced by the certain arm position at cocking phase but average inning pitched was statistically affected ($p < 0.01$) (Table 1).

Discussion

The pitching motion is very complicated and individualized. "What is proper throwing mechanics?" remains as a major issue in pitching biomechanics. Excessive external rotation torque delivered on shoulder and valgus torque on elbow would lead to increase risk of injury in baseball players⁷. Davis et al.³ also support the importance of proper pitching mechanism. They concluded that youth pitchers with better pitching mechanics generate lower humeral internal rotation torque and lower elbow valgus load. And they reported that proper pitching mechanics may help prevent shoulder and elbow injuries in youth pitchers. Yet, proper pitching mechanism has not been defined in any reports.

In this report, the authors could not find difference in performance scale (ERA, $p < 0.66$; WHIP, $p < 0.14$), but average IP showed statistically significant between HA group and nHA group ($p < 0.01$). Out of nine in HA group, seven players have

taken surgeries (four elbows and three shoulders) and out of 10 in nHA group, five players have taken surgeries (five elbows). Statistically, risk of surgery was not associated with presence of hyperabduction ($p < 0.35$). Also, hyperpronation and flat-arm position was not statistically significant for increasing injury risk. It is uncertain whether the hyperabduction shoulder movement during early cocking phase leads to impinge between acromion and greater tubercle of humerus. But, O'Leary⁴ explains the inverted W pitching mechanics as a timing problem.

There are reports of negative effects on early trunk rotation^{5,6}. The relation between hyperabduction of the shoulder and early trunk rotation is not sure, but with hyperabduction the players would have longer pathway to put their throwing arm into a deceleration phase, which will lead to a greater torque in shoulder and elbow. The authors concluded that the hyperabduction of the shoulder statistically increases the risk of surgery and is thought to be related with the early trunk rotation before the foot contact.

This study has some limitations. First, it was not controlled. We reviewed the statistics retrospectively to obtain IP, ERA, WHIP and analyzed the slow motion video to determine the hyperabduction position of the shoulder during early cocking phase. Second, the sample sizes were relatively small. Comparing nine subjects and 10 subjects are not enough, but authors could not widen the inclusion criteria to enlarge the sample size. But instead with the meticulous exclusion criteria to investigate, authors have reached more pure results. Third, the reasons for taking surgical procedures are unclear. It was difficult for authors to find out the reasons, since they had taken operations in numerous clinics. Fourth, comparing IP, ERA and WHIP on not considering continuous pitching, past surgical history, and pitcher's position is considered as limitations. Finally, variant factors like fatigue, muscle power and variance in pitching mechanics were not analyzed.

In conclusion, hyperabduction of shoulder in early cocking phase of throwing motion does not lead to decrease in performance (ERA, WHIP) but will result in tremendous decline of average IP. Also, risk of surgery is not associated to hyperabduction motion of the shoulder.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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