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BASIC SCIENCE

Kerlan-Jobe Orthopaedic Clinic overhead athlete scores in asymptomatic professional baseball pitchers

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Background: The Kerlan-Jobe Orthopaedic Clinic (KJOC) Shoulder and Elbow score is a subjective questionnaire that has been validated and been shown to be more specific in overhead athletes than the American Shoulder and Elbow Surgeons scale. The purpose of this study was to determine a mean KJOC score and reasonable range of KJOC scores within which a healthy asymptomatic professional baseball pitcher will fall. It was hypothesized that healthy professional baseball pitchers would have very high KJOC scores.

Materials and methods: KJOC questionnaires were given to all healthy pitchers before the start of the season at all levels in 1 professional Minor League system. Pitchers were asked to complete the questionnaire upon reporting to their AAA, AA, or A affiliate team. Any pitcher starting the season on the disabled list was excluded from the study.

Results: KJOC scores were returned by 44 pitchers. The mean score for all pitchers was 94.82 (95% confidence interval, 92.94-96.70). The mean score for each question was greater than 9 of 10. The mean score for the AAA affiliate was significantly higher than that for the AA affiliate ($P = .015$). No other significant differences in scores were found between class levels or groups based on professional playing experience.

Conclusion: Only 7 of 44 healthy asymptomatic pitchers (16%) had a KJOC score below 90. Therefore, we believe that the KJOC score is an accurate assessment for overhead athletes and normal values should be greater than 90. Anything below this value could be a potential cause for concern for team physicians.

Level of evidence: Basic Science, Survey Study, Healthy Subjects.

Keywords: KJOC score; asymptomatic; professional baseball pitcher; overhead athlete

The Kerlan-Jobe Orthopaedic Clinic (KJOC) Overhead Athlete Shoulder and Elbow score was initially developed in 2010 as a useful shoulder and elbow questionnaire to supplement existing validated questionnaires but was designed specifically for overhead athletes. It has been validated with the Disabilities of the Arm, Shoulder and Hand score, as well as the Disabilities of the Arm, Shoulder and Hand sports/performing arts module,[1,2] and has been shown to be more sensitive in overhead athletes than the American Shoulder and Elbow Surgeons scale.[4] In addition, the KJOC score has been shown to effectively distinguish among professional baseball players playing

The Thomas Jefferson University Institutional Review Board granted approval for this study (control No. 11E.183).

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Table I Mean scores and ranges for each KJOC question

Question	Score of 1	Score of 10	Mean	Range
How difficult is it for you to get loose or warm prior to competition or practice?	Never feel loose	Normal warm-up time	9.30	1-10
How much pain do you experience in your shoulder or elbow?	Pain at rest	No pain with competition	9.20	3-10
How much weakness and/or fatigue (ie, loss of strength) do you experience in your shoulder or elbow?	Weakness/fatigue preventing any competition	No weakness, normal competition fatigue	9.27	6-10
How unstable does your shoulder or elbow feel during competition?	"Popping out" routinely	No instability	9.70	7-10
How much have arm problems affected your relationship with your coaches, management, or agents?	Significant effect	Not at all	9.75	6-10
How much have you had to change your throwing motion due to your arm?	Completely changed	No change in motion	9.48	5-10
How much has your velocity and/or power suffered due to your arm?	Lost all velocity	No change in velocity	9.30	4-10
What limitation do you have in endurance in competition due to your arm?	Significant limitation	No endurance limitation	9.66	8-10
How much has your control suffered due to your arm?	Unpredictable control on all pitches	No loss of control	9.59	4-10
How much do you feel your arm affects your current level of competition in your sport (ie, is your arm holding you back from being at your full potential)?	Cannot compete	Desired level of competition	9.57	7-10

without pain, those playing with pain, and those not playing because of pain.[1,2]

The KJOC questionnaire has also been used to evaluate Little League baseball players with recent medial-sided elbow pain with overhead throwing.[5] A mean score of 60.3 of 100 was measured for these players. In another study, professional or collegiate overhead athletes who filled out a KJOC questionnaire at least 1 year after superior labral anterior-posterior (SLAP) lesion repair showed a mean score of 76.9 (range, 63.5-92.5).[3] Finally, a study comprising an assortment of overhead athletes after SLAP lesion repair measured a mean KJOC score of 73.6 (range, 39-100) at a mean follow-up time of 3.5 years.[4] However, no study has measured the KJOC scores of healthy overhead athletes.

The purpose of this study was to determine a mean KJOC score and reasonable range of KJOC scores within which a healthy professional baseball pitcher will fall. We hypothesized that healthy overhead athletes should score greater than 90 and this score could serve as a baseline for future evaluations of professional pitchers to determine how significant a particular injury may be.

Materials and methods

KJOC questionnaires were given to healthy pitchers in 1 professional baseball Minor League system at the start of the 2011 season. A healthy pitcher was defined as any pitcher starting the regular season at his assigned Minor League level who did not have any acute injury affecting complete unrestricted participation in baseball. All athletes underwent a preseason physical examination.

All pitchers were asked to complete the questionnaire after completion of spring training but before the start of the season. All KJOC scores were then tabulated. An overall mean score for the entire study group, as well as scores for each Minor League level and level of professional baseball experience, was determined.

Because we were unable to find any previously published studies on KJOC scores exclusively in healthy professional baseball pitchers, we did not believe it would be appropriate to perform a power analysis before study initiation. Analysis of variance (ANOVA) and Student t tests were performed to determine significant differences in KJOC scores among groups based on Minor League level and professional playing experience. Confidence intervals were calculated by mean score $\pm t \times (\sigma/\sqrt{n})$. $P < .05$ was considered statistically significant.

Results

KJOC questionnaires were given to and completed by all 44 pitchers (100%) assigned to the Minor League teams. The mean score for all pitchers was 94.82 (95% confidence interval [CI], 92.94-96.70; range, 75-100). The mean score for each question was greater than 9 of 10 (Table I). Mean scores for the AAA, AA, High-A, and Low-A affiliates were 97.73 (95% CI, 95.41-100.04), 93.33 (95% CI, 90.47-96.19),

94.44 (95% CI, 88.06-100.83), and 93.92 (95% CI, 89.15-98.68), respectively (Table II). By use of the 1-way ANOVA test, no significant difference was found across groups ($P = .34$). However, the Student t test showed that the mean score for the AAA affiliate was significantly higher than that for the AA affiliate ($P = .015$). No other significant differences in scores were found between class levels by use of the Student t test.

Pitchers were also divided by the number of years of professional playing experience (Table III). Overall, the mean number of years of experience was 4.0 years (range, 1-13 years). Players with the most experience (>5 years) had the highest scores, whereas players with 2 to 3 years of experience had the lowest scores. By use of the 1-way ANOVA test, no significant difference in scores was found across the groups ($P = .28$). Furthermore, no significant difference was found between any two groups with the Student t test.

Table II Mean KJOC scores for players grouped by Minor League playing level

Minor League level	n	Mean KJOC score
AAA	11	97.73
AA	12	93.33
High-A	9	94.44
Low-A	12	93.92

Table III Mean KJOC scores for players grouped by number of years of professional playing experience

Professional experience (y)	n	Mean KJOC score
1	9	95.56
2-3	15	92.33
4-5	13	96.00
>5	7	97.00

Discussion

The KJOC Overhead Athlete Shoulder and Elbow score is an effective tool for assessing the performance and function of overhead athletes, particularly baseball pitchers. We have shown in this study that healthy professional baseball pitchers have very high KJOC scores (total mean, 94.8). Their scores were much higher than those of (1) Little League baseball players with medial-sided elbow pain with overhead throwing ($\Delta = 34.5$),[5] (2) professional or collegiate overhead athletes at least 1 year after SLAP lesion repair ($\Delta = 17.9$),[3] and (3) a mixture of overhead athletes at a mean of 3.5 years after SLAP lesion repair ($\Delta = 21.2$).[4]

Although one cannot judge the truthfulness of the players completing the survey, 7 of them did have scores below 90, indicating their true response regarding their ability to pitch. We specifically asked the pitchers to complete the survey after they were assigned to their specific Minor League level and had made the roster, in an effort to obtain the most accurate information. In addition, the specific responses were not communicated with the organization to maintain player privacy.

As noted earlier, 7 of 44 pitchers in our study (16%) had a score below 90. Therefore, we believe that an appropriate baseline score for a healthy professional baseball pitcher should be in the 90s, confirming our hypothesis. A KJOC score below 90 should alert team physicians that a pitcher may be playing with an injury or pain or to at least sense that he is not functioning at full capacity. However, 2 of the pitchers in our study had scores of 75 and 77. Of the 7 pitchers with scores below 90, only 2 (2 of 7 [29%]) were treated for any shoulder symptoms during the season. Both of these players were diagnosed with mild tendonitis of the rotator cuff or biceps tendon approximately 3 months into the season. Both responded to nonoperative treatment without missing significant playing time. Therefore, although mean scores should be in the 90s for healthy professional baseball pitchers, this will not be the case for each individual. Team physicians should consider determining baseline KJOC scores for each pitcher, particularly professional and collegiate players. This would potentially allow for the identification of an occult injury and give a comparison value should a pitcher become injured.

From our analysis, it seems that KJOC scores for professional baseball pitchers are not based on the number of years of professional playing experience. All groups based on experience had a mean score greater than 90, with the most experienced group (>5 years' experience) presenting the highest scores.

Strengths of this study include the high response rate (100%) and the incorporation of all 4 Minor League levels of a professional baseball organization. This allowed us to show that there was a very consistent, narrow range of scores between each level of play. The weaknesses of this study also should be noted. Although all pitchers in this study were asymptomatic when completing the survey, it is not necessarily true that all pitchers were playing without pain. It is certainly possible and likely that some athletes may minimize or downplay any injury or pain for fear of lack of advancement in the professional system. However, before assignment to any Minor League level, all players must have completed spring training and assessment of performance by members of the coaching staff and front office. Therefore, the purpose of this study was not to distinguish between pitchers with pain and those without pain; rather, the purpose was to determine an appropriate range of KJOC scores for "healthy" (asymptomatic) professional pitchers. Further studies should be performed to determine whether these baseline scores can be effectively compared with scores at a later time to identify occult injuries. In addition, we showed a significant difference in scores between AAA and AA players, and thus, there is the possibility of a significant difference between Minor League and Major League KJOC scores. Thus, there is the possibility that our reported mean

score may be slightly different from the ''true'' score for all healthy professional baseball pitchers. Nevertheless, we believe the score we report is a very close estimate and can serve a useful purpose for team physicians.

Conclusions

KJOC scores for healthy professional baseball pitchers are very high. However, scores are not based on class level or professional playing experience. Thus, team physicians should not assess a pitcher's KJOC score based on these demographics. In addition, although scores are generally high for professional pitchers, some healthy pitchers will have lower scores. Therefore, the most effective way of assessing a pitcher's injury or general soreness may be to look at differences between the individual's ''healthy'' score and his score after injury. However, further study would be required to determine a correlation between KJOC scores and a professional baseball pitcher's health status.

Disclaimer

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