

Are the Current Little League Pitching Guidelines Adequate?

A Single-Season Prospective MRI Study

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Background: Little League throwing guidelines have recently been implemented in an attempt to lessen the growing number of elbow injuries occurring in youth baseball players.

Hypothesis/Purpose: The purpose of this study was to examine pre- and postseason changes seen on magnetic resonance imaging (MRI) in youth baseball players' elbows in an attempt to identify risk factors for pain and MRI abnormalities, with a particular focus on the current Little League guidelines. We hypothesized that MRI abnormalities would be common in pitchers with high pitch counts and poor guideline compliance.

Study Design: Cohort study; Level of evidence, 2.

Methods: A prospective study of Little League players aged 10 to 13 years was performed. Players were recruited prior to the start of the season and underwent bilateral elbow MRI as well as a physical examination and completed a questionnaire addressing their playing history and arm pain. At the end of the season, a repeat MRI and physical examination were performed. MRIs were read by blinded radiologists. During the season, player statistics including innings played, pitch counts, and guideline compliance were recorded. Physical examination findings and player statistics were compared between subjects with and without MRI changes utilizing chi-square and analysis of variance techniques.

Results: Twenty-six players were enrolled. Despite 100% compliance with pitching guidelines, 12 players (48%) had abnormal MRI findings, and 28% experienced pain during the season. There was a significant difference in distal humeral physeal width measured pre- to postseason (1.54 vs 2.31 mm, $P < .001$). There was a significant loss of shoulder internal rotation during the season, averaging 11°. While pitch counts, player position, and throwing curveballs/sliders were not significantly associated with changes seen on MRI, year-round play was associated with abnormalities ($P < .05$). Much lower compliance (<50%) was observed with nonenforced guidelines, including avoidance of single-sport specialization, year-round play, and throwing curveballs/sliders.

Conclusion: Arm pain and MRI abnormalities of the medial elbow are common in Little League baseball players who comply with the Little League throwing guidelines, especially those playing year-round.

Keywords: youth baseball; Little League elbow; medial epicondylitis; magnetic resonance imaging

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While Little League participation provides many benefits for the young athlete, youth baseball is also responsible for a growing number of overuse injuries.^{9,10,15} In a survey of youth baseball players, only 26% reported that their arm never hurt while throwing.¹¹ Pitching, in particular, is a common mechanism of injury in baseball.^{3,12} Olsen et al¹² found that pitchers with injuries to the shoulder and elbow pitched significantly more months per year, games per year, innings per game, pitches per game, pitches per year, and warm-up pitches per game. The injured group was also found to be taller and heavier.¹² Other known risk factors include pitching for more than 1 team, pitch velocity, and a loss of shoulder internal rotation.^{2,14}

In an effort to protect young athletes, Little League pitching guidelines have been established. These guidelines

outline the number of pitches a pitcher can throw in a game, stratified by age and number of rest days a pitcher should have after throwing a given number of pitches.⁷ Recently, USA Baseball, in conjunction with Major League Baseball (MLB), has developed recommendations that can be applied to both pitchers and field players; the program is known as Pitch Smart.¹³ To date, few studies have evaluated the effectiveness of these guidelines in the prevention of throwing injuries in Little League pitchers.

The primary aim of the current study was to evaluate the incidence and progression of elbow abnormalities over the course of a single Little League season, as seen on magnetic resonance imaging (MRI). Secondary aims were (1) to assess risk factors for MRI abnormalities based on the athlete's preseason baseball history, in-season statistics, and physical examination; (2) to determine the incidence and risk factors for arm pain; and (3) to assess compliance with the Little League pitching guidelines and their influence on arm pain and MRI abnormalities. We hypothesized that MRI abnormalities would be common in pitchers with high pitch counts, poor guideline compliance, and a history of elbow pain.

METHODS

After institutional review board approval was obtained, 26 Little League baseball players were prospectively recruited for this study. A signed statement of informed consent was obtained from each player per institutional review board protocol. Players were recruited from a single Little League district in Southern California after the team rosters were created but prior to the start of any games. Players of all positions were recruited from the "major division," or highest league within the district. Four teams existed within the major division, each with 10 to 12 players. Participation was on a first-come, first-served basis, and our budget enabled the recruitment of 30 subjects. Participants ranged in age from 10 to 13 years. Subjects were excluded if they had a contraindication to MRI, if they were unable to tolerate either the pre- or postseason MRI, or if they had an injury that prevented them from completing the season. Participants were given a \$50 gift card to a local sporting goods store at the end of the season in exchange for their participation in the study.

A thorough history was taken for each player prior to the start of the season. The throwing history focused on several key factors, including years of play, primary position(s) played, months of play per year, number of teams each played on, private coaching history, and age at which various pitches (change-ups, sliders, and curveballs) were initiated. Each player was queried as to having a prior history of arm pain or a history of throwing injury. Additionally, participants were asked whether they were familiar with the Little League throwing guidelines and whether they had ever exceeded these guidelines prior to the start of the season (Table 1). A detailed physical examination of both dominant and nondominant upper extremities including the shoulder and elbow was performed both at the beginning as well as the conclusion of the season. Pre- and

TABLE 1
Preseason Demographic/Baseball
History Data (N = 26)

Mean age, y	11.5
Mean years playing	6.0
Primary position, %	
Fielder	50
Catcher	12
Pitcher	38
Hand dominance, %	
Right handed	80
Left handed	20
Aware of guidelines, %	
Yes	68
No	28
Exceeded guidelines, %	
Yes	23
No	77
Year-round players, %	
Yes	68
No	32
History of arm pain, %	
Yes	28
No	72
Utilization of private coach, %	
Yes	28
No	72

postseason tests were performed by 1 of 2 board-certified orthopaedic surgeons and focused on tenderness to palpation, passive range of motion (ROM), strength, and stability testing. Prior to the examination, the surgeons standardized their testing approach. All angular measurements were performed with an electronic inclinometer. Manual strength testing was performed bilaterally and graded on a scale of 1 to 5. Shoulder instability was defined as a positive physical examination finding for any of the following: apprehension test, Jobe relocation test, and/or posterior load and shift testing. Elbow instability was defined as a side-to-side difference with valgus or varus stress.

MRI Examination

At the beginning of the season, each athlete underwent bilateral elbow MRI using a GE HdxT 1.5-T MRI machine with the following sequences: axial T1 (echo time [TE], 12-13 ms; repetition time [TR], 580-610 ms), axial inversion recovery (IR) (TE, 45-50 ms; TR, 3475-3500 ms), sagittal T2 multiple-echo recombined gradient echo (MERGE) (TE, 13.5-14 ms; TR, 600-650 ms), coronal IR (TE, 45-50 ms; TR, 3475-3500 ms), and coronal T2 fat-saturated (TE, 64-70 ms; TR, 2020-2070 ms). At the completion of the season, the athlete underwent a second MRI on the dominant extremity elbow only. Two radiologists with a clinical focus on pediatric musculoskeletal imaging read all the MRI images; both were blinded as to any history of arm pain or the arm dominance of the player. A data sheet with dichotomized responses was filled out, with only positive or negative responses allowed regarding the presence or absence of each abnormality. In cases where a discrepancy existed, the

radiologists met in person and came to a consensus as to the “official read.” One player did not return for the follow-up MRI so he was excluded from the analysis.

Data Collection

The Little League season was 12 weeks long. During the season, statistics on each player were recorded, including number of games played, innings played, and pitch counts. These statistics were recorded by a designated score keeper for each team. Any violations of the Little League pitching guidelines were recorded. Players filled out a postseason questionnaire at the conclusion of the season. The questionnaire focused on whether the subject pitched during the season, whether they experienced any elbow pain during the season, and whether they missed any games as a result of pain or an injury. Additionally, players were asked about the use of a radar gun, pitching coaches, or participation on other teams during the season (Table 2).

Statistical Analysis

Pre- and postseason MRI findings were compared, and statistical analysis was performed to compare players with and without new or worsened abnormalities on their dominant arm on postseason MRI. Clinical examination results, questionnaire responses, and in-season data were evaluated. A similar analysis was also performed comparing players with any postseason MRI abnormality (even if unchanged from preseason) to those with no MRI abnormality. The difference between the dominant and nondominant arm was calculated for all ROM data, and postseason side-to-side differences were compared. The change in this side-to-side difference from pre- to postseason was also compared.

Analyses were completed utilizing the chi-square test for categorical variables and analysis of variance (ANOVA) for continuous data as appropriate. Repeated-measures ANOVA (pre- to postseason) was performed for the entire cohort, followed by repeated-measures ANOVA with a 2-level between-subjects factor (postseason MRI abnormality, yes vs no). Exact binomial probabilities were also calculated for categorical variables. Anatomic quantitative MRI measures (pre, post, change) were correlated with quantitative changes in ROM measures using Spearman rho correlation analysis. All continuous data were checked for normality and homogeneity of variances prior to application of parametric statistics. Alpha was set at $P < .05$, and all analyses were performed using SPSS version 12 (IBM Corp).

RESULTS

At the conclusion of the Little League season, 48% (12/25) of players had an abnormal MRI. Compared with preseason MRIs, 8 of these 12 abnormalities represented new findings or progression of a previously visualized abnormality. The majority of players with an abnormal MRI had a single finding, but 4 players (16%) were noted to have multiple new or worsened abnormalities. The abnormalities

TABLE 2
In-Season/Postseason Data

In-season data, mean \pm SD	
Team practices throwing	19 \pm 1
No. of games played	28 \pm 2
No. of pitches in season	297 \pm 293
No. of Innings pitched	16 \pm 15
Postseason questionnaire data, positive responses, %	
Elbow pain throwing arm	20
Shoulder pain throwing arm	16
Missed games due to pain	4
Medical treatment for arm during season	4
Play on other teams during season	8
Pitching coach during season	20
Radar gun in season	20
Pitch this season	92
Curveball or slider	56

TABLE 3
Range of Motion Data

Range of Motion	Mean \pm SD, deg		P Value
	Preseason	Postseason	
Shoulder ^a			
Internal Rotation	-5 \pm 11	-17 \pm 15	.001 ^b
External Rotation	5 \pm 7	5 \pm 11	.892
Elbow ^a			
Flexion	-2 \pm 4	-2 \pm 4	.694
Extension	0 \pm 2	1 \pm 3	.139
Pronation	1 \pm 5	0 \pm 7	.508
Supination	2 \pm 5	1 \pm 5	.731

^aSide-to-side difference; positive values indicate dominant arm greater.

^bStatistically significant.

primarily affected the medial side of the elbow, including 2 cases of fragmentation of the medial epicondyle, 5 cases of edema within the medial epicondyle apophysis, 4 cases of edema of the distal humeral metaphysis, and 1 partial disruption of the ulnar collateral ligament (UCL). MRI assessment revealed significant widening of the distal humeral physis during the season (1.54 mm preseason vs 2.31 mm postseason, $P < .001$), whereas no significant thickening of the UCL was observed (1.34 mm preseason vs 1.41 mm postseason, $P = .41$).

The postseason physical examination revealed that players lost an average of 11.2° of shoulder internal rotation ($P < .001$), gained an average of 0.4° of external rotation ($P = .892$), and lost 10.8° of total arc of motion during the season ($P = .02$) (Table 3). Additionally, players developed 1.4° of elbow hyperextension compared with their preseason assessment ($P = .139$). A significant positive correlation was observed between total arc of motion change from pre- to postseason and distance of the UCL to the medial epicondyle physis (Spearman $\rho = 0.57$; $P = .004$). No other physical examination findings were noted to change during the season, including shoulder and elbow stability.

TABLE 4
MRI Data on the 12 Little League Players With Any Postseason MRI Abnormality^a

Study Data	Study Variables	Abnormal MRI Finding		
		No (n = 13)	Yes (n = 12)	P Value
Preseason	Pitcher/catcher, %	38	58	.08
	Year-round play, %	54	83	.002 ^b
	Private coach, %	15	42	.07
In season	Games played, median (range)	29 (26-29)	26 (24-29)	.204
	Innings pitched, mean ± SD	12 ± 14	20 ± 17	.252
	No. of pitches, mean ± SD	230 ± 262	377 ± 320	.231
	Pitchers throwing curveballs/sliders? %	54	64	.69
Postseason	Any arm pain self-report, %	23	36	.66
	Shoulder pain self-report, %	15	18	.9
	Elbow pain self-report, %	23	18	.99
ROM (dominant-to-nondominant difference)	Internal rotation postseason (shoulder), mean ± SD, deg	-14 ± 15	-19 ± 15	.41
	Internal rotation change, mean ± SD, deg	11 ± 13	14 ± 14	.58
	External rotation postseason (shoulder), mean ± SD, deg	8 ± 12	2.3 ± 10	.245
	External rotation change, mean ± SD, deg	-4 ± 14	3 ± 13	.266
	Arc of motion postseason (shoulder), mean ± SD, deg	-6 ± 18	-17 ± 14	.115
	Arc of motion change, mean ± SD, deg	7 ± 16	17 ± 20	.21
	Elbow flexion postseason, mean ± SD, deg	-2 ± 5	-3 ± 4	.721
	Elbow flexion change, mean ± SD, deg	2 ± 5	-1 ± 7	.37
	Elbow extension postseason, mean ± SD, deg	2 ± 3	0.4 ± 3	.17
	Elbow extension change, mean ± SD, deg	-2 ± 3	-1 ± 3	.418
	Pronation postseason, mean ± SD, deg	-2 ± 5	1 ± 8	.395
	Pronation change, mean ± SD, deg	2 ± 7	-0.25 ± 7	.4
	Supination postseason, mean ± SD, deg	2 ± 6	1 ± 3	.659
Supination change, mean ± SD, deg	0.5 ± 10	0.6 ± 5	.979	
Other postseason examination	Tenderness to palpation of shoulder in dominant arm only, %	17	8	.54
	Tenderness to palpation of elbow in dominant arm only, %	17	8	.54
	Ulnar nerve subluxation dominant arm only, %	8	8	.99
	Carrying angle side-to-side difference, mean ± SD	-0.4 ± 2	-0.08 ± 3	.729
MRI quantitative data	Humeral retrotorsion (side-to-side difference, assessed by ultrasound), mean ± SD	-6 ± 7	-2 ± 9	.24
	UCL thickness postseason, mean ± SD, mm	1.3 ± 0.4	1.5 ± 0.5	.36
	UCL thickness change, mean ± SD, mm	0.06 ± 0.3	0.08 ± 0.5	.91
	Distance UCL to ME physis postseason, mean ± SD, mm	4.6 ± 2	4.1 ± 1	.44
	Distance UCL to ME physis change, mean ± SD, mm	-0.5 ± 0.6	-0.2 ± 1.4	.47
	Distal physeal humeral width postseason, mean ± SD, mm	2.2 ± 0.6	2.4 ± 0.5	.47
	Distal physeal humeral width change, mean ± SD, mm	0.8 ± 0.7	0.7 ± 0.6	.62

^aME, medial epicondyle; MRI, magnetic resonance imaging; ROM, range of motion; UCL, ulnar collateral ligament.

^bStatistically significant.

Over the course of the season, 7 of 25 (28%) of players experienced arm pain, and 1 player's symptoms were severe enough that he sought medical attention. Arm pain was localized to the shoulder in 2 of 25 (8%) players, the elbow in 3 of 25 (12%), and both locations in 2 of 25 (8%). Preseason variables, in-season variables, and physical examination findings were not found to be significantly correlated with arm pain ($P > .05$).

Risk factor assessment was performed on all players demonstrating any MRI abnormality at the end of the season (Table 4). The in-season data, including games played, position(s) played, pitch counts, innings pitched, pitch types, and private coaching were not associated with an MRI abnormality ($P > .05$). When assessing preseason variables, year-round play, as defined by more than 8 months a year, was the only factor found to be associated with a postseason MRI abnormality ($P = .002$), and this finding was only

found to be significant when a binomial probability calculation was performed. No physical examination findings were found to be a risk factor for an abnormal MRI at the end of the season ($P > .05$).

Risk factor assessment was performed only on players demonstrating a new or worsened MRI abnormality over the course of the season (Table 5). For this cohort, no association was observed between MRIs and any of the in-season data. Additionally, the preseason variables and physical examination findings were not found to correlate with the worsened MRIs.

Players demonstrated excellent compliance with the Little League pitch count limits and mandatory rest days, with no violations occurring (Table 6). Much poorer compliance was documented with respect to Little League's non-mandatory, nonenforced recommendations. In our cohort, 56% of athletes threw off-speed pitches (curveballs and

TABLE 5
MRI Data on the 8 Little League Players With a New or Worsened Postseason MRI Finding

Study Data	Study Variables	New/Worsened MRI Finding			
		No	Yes (n = 8)	P Value	
Preseason	Pitcher/catcher, %	47	50	.27	
	Year-round play, %	65	75	.26	
	Private coach, %	29	25	.3	
In season	Games played, median (range)	29 (24-29)	26 (26-29)	.49	
	Innings pitched, mean ± SD	15.5 ± 15	15.8 ± 18	.8	
	No. pitches, mean ± SD	295 ± 281	304 ± 344	.62	
	Pitchers throwing curveballs/sliders? %	53	71	.19	
Postseason	Any arm pain self-report, %	24	43	.16	
	Shoulder pain self-report, %	12	29	.16	
	Elbow pain self-report, %	24	14	.61	
ROM (dominant-to-nondominant difference)	Internal rotation postseason (shoulder), mean ± SD, deg	-16 ± 16	-18 ± 14	.75	
	Internal rotation change, mean ± SD, deg	13 ± 14	12 ± 11	.84	
	External rotation postseason (shoulder), mean ± SD, deg	7 ± 12	2 ± 10	.4	
	External rotation change, mean ± SD, deg	-2.5 ± 14	3 ± 13	.37	
	Arc of motion postseason (shoulder), mean ± SD, deg	-10 ± 18	-16 ± 15	.451	
	Arc of motion change, mean ± SD, deg	10.5 ± 19	15 ± 19	.612	
	Elbow flexion postseason, mean ± SD, deg	-2 ± 5	-4 ± 4	.39	
	Elbow flexion change, mean ± SD, deg	1 ± 6	0.13 ± 8	.831	
	Elbow extension postseason, mean ± SD, deg	2 ± 3	0.4 ± 3	.31	
	Elbow extension change, mean ± SD, deg	-2 ± 3	-1 ± 4	.74	
	Pronation postseason, mean ± SD, deg	-2 ± 7	2.5 ± 5	.146	
Other postseason examination	Pronation change, mean ± SD, deg	2 ± 7	-0.75 ± 6	.39	
	Supination postseason, mean ± SD, deg	1.25 ± 5	1.25 ± 4	.99	
	Supination change, mean ± SD, deg	-0.13 ± 8	0.13 ± 6	.93	
	Tenderness to palpation of shoulder in dominant arm only, %	13	13	.99	
	Tenderness to palpation of elbow in dominant arm only, %	13	13	.99	
	Ulnar nerve subluxation dominant arm only, %	13	0	.536	
	Carrying angle side-to-side difference, mean ± SD, deg	-0.41 ± 2	0.13 ± 2.4	.56	
	Humeral retrotorsion (side-to-side difference, assessed by ultrasound), mean ± SD, deg	-4.8 ± 8	-3.2 ± 11	.718	
	MRI quantitative data	UCL thickness postseason, mean ± SD	1.3 ± 0.3	1.6 ± 0.6	.12
		UCL thickness change, mean ± SD	0.1 ± 0.4	0.21 ± 0.5	.28
		Distance UCL to ME physis postseason, mean ± SD	4.5 ± 1.4	3.9 ± 1.6	.41
Distance UCL to ME physis change, mean ± SD		-0.2 ± 1	-0.8 ± 1	.24	
Distal physeal humeral width postseason, mean ± SD		2.3 ± 0.6	2.4 ± 0.5	.69	
Distal physeal humeral width change, mean ± SD	0.8 ± 0.7	0.5 ± 0.4	.19		

“ME, medial epicondyle; MRI, magnetic resonance imaging; ROM, range of motion; UCL, ulnar collateral ligament.

TABLE 6
Pitch Smart Guidelines and Cohort Compliance

Pitch Smart Guidelines for Athletes Aged 9-12 y	% Compliance
Set and follow pitch-count limits and required rest periods	100
Pitchers once removed from the mound may not return as pitchers	100
Avoid pitching in multiple games on the same day	96
Avoid playing catcher while not pitching	96
Avoid playing for multiple teams at the same time	92
Avoid throwing pitches other than fastballs and change-ups	44
Play other sports during the course of the year	36
Take at least 4 months off from throwing every year, with at least 2-3 of those months being continuous	32
Focus on athleticism, physical fitness, and fun	Not documented
Focus on learning baseball rules, general techniques, and teamwork	Not documented
Do not exceed 80 combined innings pitched in any 12-month period	Not documented
Make sure to properly warm up before pitching	Not documented
Monitor for other signs of fatigue	Not documented

sliders), 68% failed to rest from baseball for 3 months a year, and 8% played on multiple teams during the same season, all against Little League recommendations. Of the 12 players with a postseason MRI abnormality, 83% violated at least 1 of these 3 guidelines compared with 62% of those without a postseason MRI abnormality ($P = .08$). In the subset of 8 players with new/worsened postseason MRI abnormalities, 88% violated at least 1 guideline compared with 65% with no new/worsened finding ($P = .14$). Of the 7 players who complained of postseason arm pain, 71% violated at least 1 guideline, similar to 70% in those with no self-report of arm pain ($P = .32$).

DISCUSSION

At the conclusion of the Little League season, nearly half of the players (48%) had a documented MRI abnormality, and approximately one-third (32%) of players saw worsening of their preseason MRI or had developed a new MRI abnormality. These abnormalities primarily affected the medial side of the elbow, including fragmentation of the medial epicondyle, edema of the medial epicondyle apophysis, and disruption of the UCL. The factor most associated with an abnormal MRI finding was year-round play. Additionally, despite documented compliance with Little League pitch count limits and rest day requirements, 28% of players experienced arm pain during the season. Much poorer compliance (less than 50%) was observed with the nonenforced recommendations, such as avoidance of single-sport specialization, year-round play, and throwing sliders and curveballs.

In 2007, Little League Baseball became the first national youth baseball organization to institute pitching regulations based on age. These regulations were developed in collaboration with the USA Baseball Medical & Safety Advisory Committee and restricted the number of pitches a player could throw in a game based on age.⁸ Additionally, they dictated the number of rest days a pitcher needed before being allowed to throw again. Adjustments were later made, and the 2008 Regular-Season Pitching Rules for Little League Baseball saw the addition of the 7- to 8-year-old age group and adjustments to the age ranges for the mandatory rest requirements.⁷ Recently, USA Baseball and MLB paired up to establish Pitch Smart, a series of practical, age-appropriate guidelines to help parents, players, and coaches avoid overuse injuries.¹³ These guidelines and our players' compliance with them are shown in Table 4.

While the Little League pitch count limits and mandatory rest periods are meant to protect young throwers, several factors mitigate their effectiveness, including a lack of knowledge of the regulations and the absence of an effective enforcement mechanism. Fazarale et al⁴ performed a survey-based study examining youth baseball coaches' knowledge and compliance with pitch count regulations. A total of 73% of coaches reported that they followed the pitching rules, yet only 53% of coaches felt that other coaches in the leagues followed the pitching rules. When queried about guideline specifics however, coaches only answered 43% of questions correctly.⁴ A similar questionnaire-based study was performed in Kyoto, Japan, by Yukutake et al.¹⁵ Their findings

revealed that only 40% of coaches had accurate knowledge of the recommendations, and even fewer (28%) coaches reported compliance with the guidelines.¹⁵ In the current study, 100% of players reported knowledge of the pitch count limits and mandatory rest days, and this comprehension likely contributed to our finding of 100% compliance.

Despite this compliance, a large percentage of subjects in our cohort developed an MRI abnormality or experienced pain over the course of the season. For this reason, we believe the current guidelines may not adequately protect young throwers, especially field players. Of note, in our cohort, neither position played nor pitch count correlated with MRI changes (Tables 4 and 5). Additionally, 2 of the 3 most severe abnormalities (medial epicondyle fragmentation and UCL tear) were seen in players who pitched less than 2 innings the entire season. While having limits on the number of pitches a young athlete can throw in a game is reasonable and necessary, it seems that the major contributing factor may be overlooked: year-round play. The growing trends of single-sport specialization and year-round play highlight the need for public education about the risks of year-round play. While playing throughout the year, repetitive microtrauma has a cumulative effect. Without having rest months for healing to occur, these repetitive micro-insults eventually manifest at the clinically and radiographically evident level. We believe that our data coincide with a growing body of evidence that pain and injury in the young thrower is more closely related to the cumulative number of throws throughout the course of a year rather than the number of pitches in a given game or season.^{5,6,9,10} In their position statement for youth baseball players, The American Sports Medicine Institute recommend that youth pitchers not participate in competitive pitching for at least 4 months per year, and that they should not perform overhead throwing of any kind for at least 2 to 3 months per year, with 4 being preferred.¹ In our cohort, nearly 70% of players were year-round players, violating this recommendation. We believe that strong consideration should be given to modifying the current guidelines so that 3 months of rest is no longer a nonenforced recommendation but a requirement that is enforced similar to pitch count. With the multiple baseball travel leagues that our youth are involved in, this will be a challenging endeavor, but may be the key change that will lessen the "epidemic of throwing injuries" that we are observing.

There are several limitations to our study. First, the participants in this study—players, parents, and coaches alike—were aware that we were closely monitoring pitch counts and adherence to the guidelines. It is possible that the 100% compliance level that we observed was partly due to the fact that the participants knew they were being closely monitored and therefore is not representative of the true, wider compliance rate. Second, while we collected detailed data on the athletes during the season, we lack data for the rest of the year. Perhaps if we had pitch count and games played totals for the entire year, clearer predictors of MRI abnormalities would have emerged. Further research is needed to examine the effects of year-round play on injury and MRI abnormalities in the young thrower. Third, our data were collected from a single Little League program in Southern California, where

weather permits year-round play, and it is not clear whether our results can be extrapolated both nationally and internationally. Finally, our sample size may have been too small to detect significant correlations between pitch count, positions played, and MRI abnormalities. We may be underpowered to detect subtle differences, but a post hoc power analysis showed that we would need 164 subjects to detect a difference between our pitchers and nonpitchers. Budget restraints given the cost of the serial MRIs prevented us from performing a larger study.

CONCLUSION

Our findings highlight several interesting avenues for future inquiry. Further research needs to be done looking at year-round play and its relationship to MRI abnormalities and injury rates. Second, it would be useful to perform a study similar to ours where the number of throws per game made by other position players, not just pitchers, is quantified. It is possible that the repetitive hard throws made by other positions such as outfielders in games and practices have the same deleterious cumulative effect as throws made by pitchers.

This is the first study looking at both pre- and postseason MRIs in the throwing elbow of Little League baseball players. Our results indicate that MRI abnormalities and pain are common in the youth baseball players. While compliance with the enforced portion of the current Little League guidelines (pitch count limits and mandatory rest days) was high, compliance with the nonenforced guidelines, including avoidance of year-round play, early single-sport specialization, playing on multiple teams, and throwing off-speed pitches (sliders and curveballs) was low. Based on our findings, we recommend stricter enforcement of all portions of the Little League guidelines, with a particular focus on limiting year-round play.

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