

# Injury Prevention for the Throwing Athlete

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# Overview

- Risk Factors
- Preventing Injuries
- Throwing Mechanics
- Interval Throwing and Hitting Programs
- Resources for Clinicians and Patients

# Risk Factors

- Overuse
- Sport Specialization
- High Pitch Count
- Fatigue
- High Pitch Velocity

# Injury Prevention

- REST
- Limit Overuse
- Proper Warmup and Cooldown
- Mechanics
- Strength and Flexibility Throughout the Chain

# Phases of Throwing

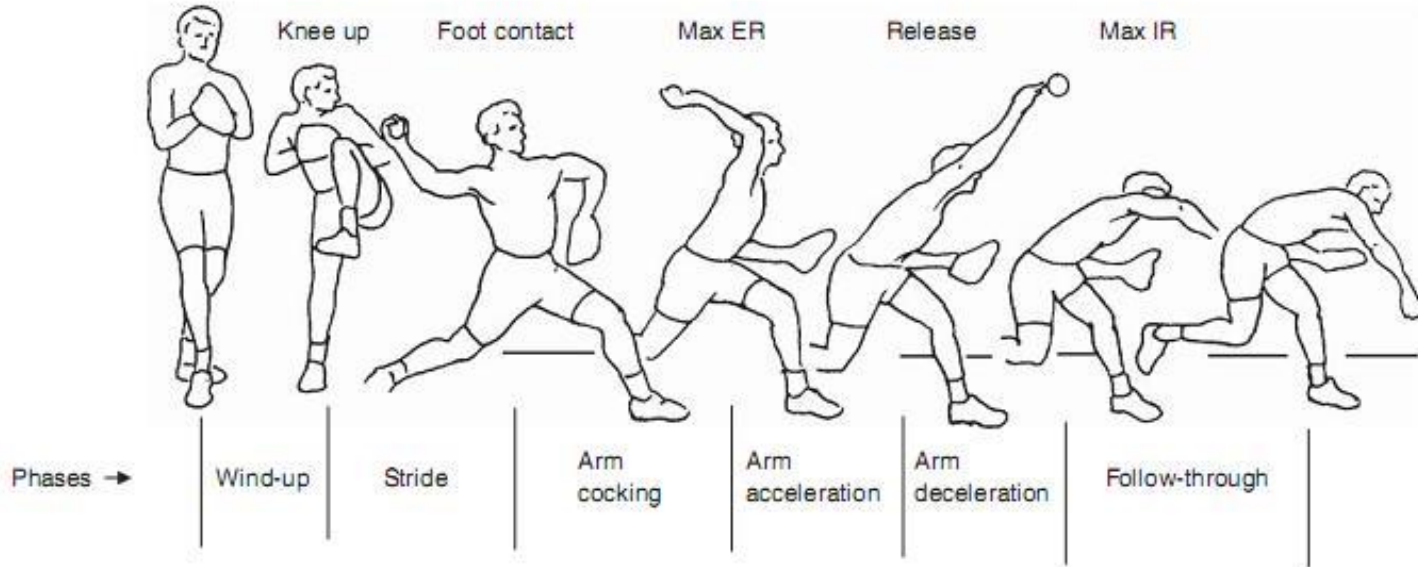
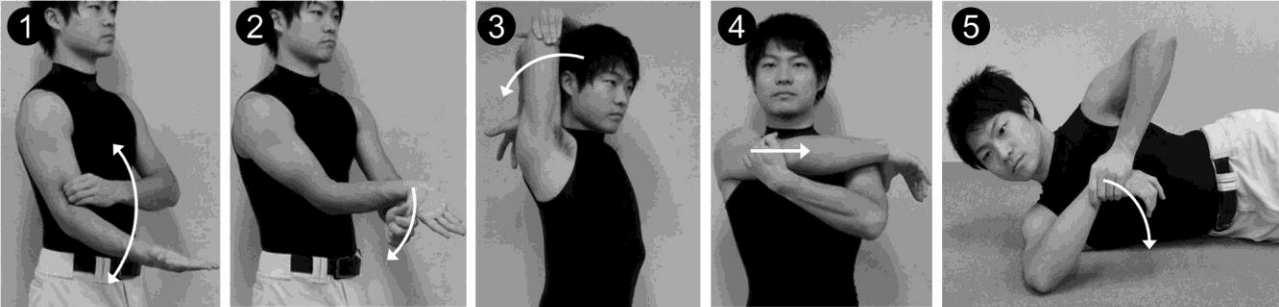


Fig. 1. Pitching phases and key events (adapted from Fleisig et al.,<sup>[12]</sup> with permission). ER=external rotation; IR=internal rotation; max=maximum.

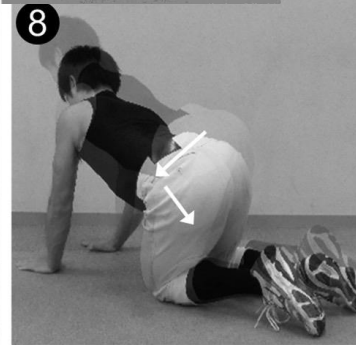
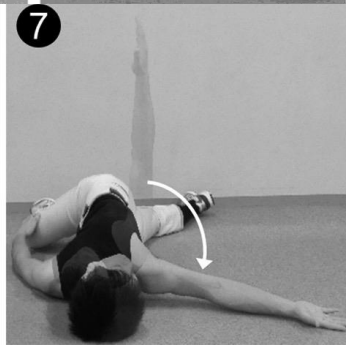
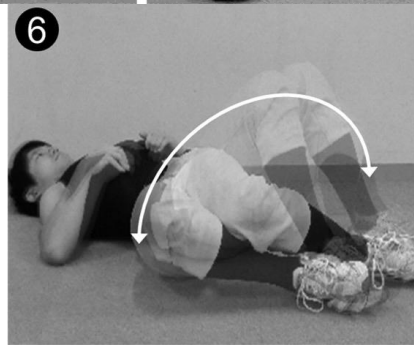
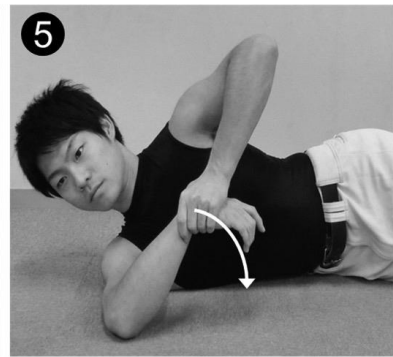
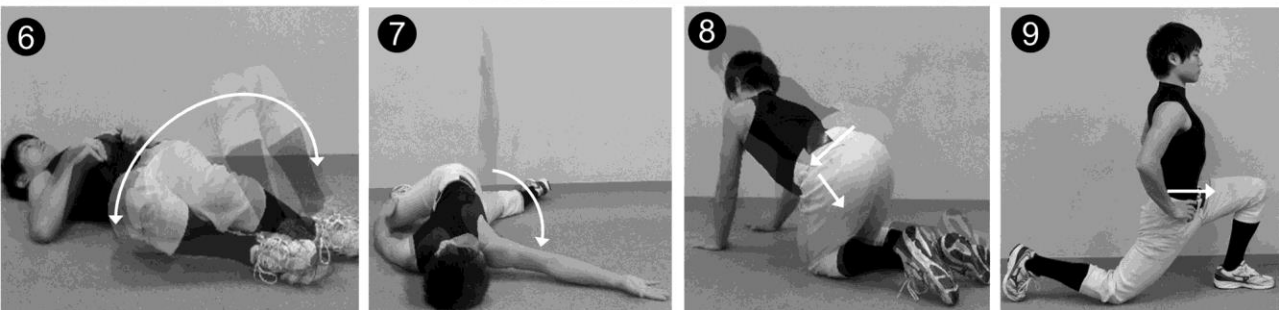
Stride, Pelvis Rotation, Upper Torso Rotation, Elbow Extension, Shoulder IR, Wrist Flexion

# Kinetic Chain

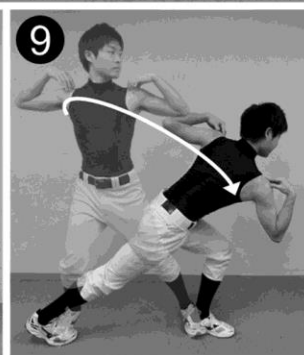
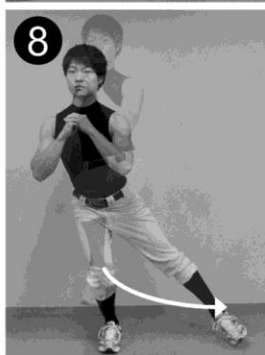
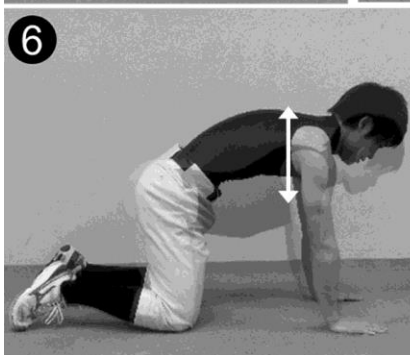
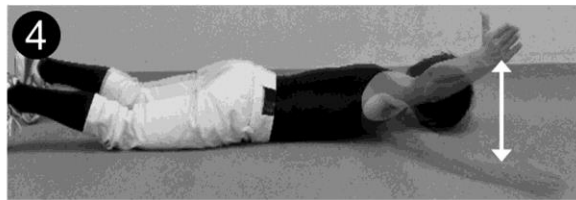
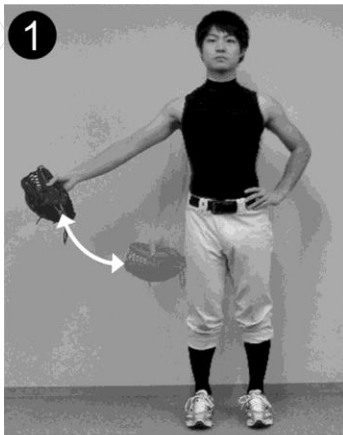
- Wind-Up, Stride
  - Balance
  - Eccentric Oblique, Core Stability
  - Lead Hip ER, Stance Hip IR Strength
  - Lead Hamstring and Stance Hip Flexor Flexibility
  - RTC, Scapular Stabilizers
- Late Cocking
  - Eccentric Internal Rotators, RTC
  - Flexor-Pronator Muscle Mass
- Acceleration
  - Serratus Anterior Provides Stability
- Deceleration, Follow-Through
  - Eccentric External Rotators
  - Internal Rotation Flexibility, Shoulder and Hip



# Stretches



# Yokohama Baseball-9 Exercises





# Pitch Count

Age	Daily Max (Pitches in Game)	0 Days Rest	1 Days Rest	2 Days Rest	3 Days Rest	4 Days Rest	5 Days Rest
7-8	50	1-20	21-35	36-50	N/A	N/A	N/A
9-10	75	1-20	21-35	36-50	51-65	66+	N/A
11-12	85	1-20	21-35	36-50	51-65	66+	N/A
13-14	95	1-20	21-35	36-50	51-65	66+	N/A
15-16	95	1-30	31-45	46-60	61-75	76+	N/A
17-18	105	1-30	31-45	46-60	61-80	81+	N/A
19-22	120	1-30	31-45	46-60	61-80	81-105	106+

# Breaking Pitches

- Little League Recommends 14+
- Lack of Biomechanical Support
- Curveball = Shoulder Pain, Slider = Elbow Pain
- Overuse and Bad Mechanics are Worse

# Components of a Throwing Program

- Graded Return Over 4-6+ Weeks
- Warm-up, Stretch, Cooldown, Rest
- Pain-Free Throwing with Good Mechanics
- Throw TO the Target
- Supplemented with Therapeutic Exercises

# Interval Throwing Program



## Interval Throwing Program for Baseball Players: Phase I

<b>45' Phase</b> Step 1: A) Warm-up Throwing B) 45' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 45' (25 Throws) Step 2: A) Warm-up Throwing B) 45' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 45' (25 Throws) F) Rest 5-10 min. G) Warm-up Throwing H) 45' (25 Throws)	<b>60' Phase</b> Step 3: A) Warm-up Throwing B) 60' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 60' (25 Throws) Step 4: A) Warm-up Throwing B) 60' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 60' (25 Throws) F) Rest 5-10 min. G) Warm-up Throwing H) 60' (25 Throws)	<b>90' Phase</b> Step 5: A) Warm-up Throwing B) 90' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 90' (25 Throws) Step 6: A) Warm-up Throwing B) 90' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 90' (25 Throws) F) Rest 5-10 min. G) Warm-up Throwing H) 90' (25 Throws)	<b>120' Phase</b> Step 7: A) Warm-up Throwing B) 120' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 120' (25 Throws) Step 8: A) Warm-up Throwing B) 120' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 120' (25 Throws) F) Rest 5-10 min. G) Warm-up throwing H) 120' (25 Throws)
<b>150' Phase</b> Step 9: A) Warm-up Throwing B) 150' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 150' (25 Throws) Step 10: A) Warm-up Throwing B) 150' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 150' (25 Throws) F) Rest 5-10 min. G) Warm-up Throwing H) 150' (25 Throws)	<b>180' Phase</b> Step 11: A) Warm-up Throwing B) 180' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 180' (25 Throws) Step 12: A) Warm-up Throwing B) 180' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 180' (25 Throws) F) Rest 5-10 min. G) Warm-up Throwing H) 180' (25 Throws) Step 13: A) Warm-up Throwing B) 180' (25 Throws) C) Rest 5-10 min. D) Warm-up Throwing E) 180' (25 Throws) F) Rest 5-10 min. G) Warm-up Throwing H) 180' (20 Throws) I) Rest 5-10 min. J) Warm-up Throwing K) 15 throws progressing from 120 → 90' Step 14: Return to respective position or progress to step 14 below.		<b>All throws should be on an arc with a crow-hop</b>  <b>Warm-up throws consist of 10-20 throws at approximately 30 feet</b>  <b>Throwing Program should be performed every other day, 3 times per week unless otherwise specified by your physician or rehabilitation specialist.</b>  <b>Perform each step _____ times before progressing to next step</b>

# Interval Pitching Program



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**Stage 1: Fastballs Only**

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- Step 1: A) Interval throwing<sup>‡</sup>  
B) 15 throws, 50%
- Step 2: A) Interval throwing<sup>‡</sup>  
B) 30 throws, 50%
- Step 3: A) Interval throwing<sup>‡</sup>  
B) 45 throws, 50%
- Step 4: A) Interval throwing<sup>‡</sup>  
B) 60 throws, 50%
- Step 5: A) Interval throwing<sup>‡</sup>  
B) 70 throws, 50%
- Step 6: A) 45 throws, 50%  
B) 30 throws, 75%
- Step 7: A) 30 throws, 50%  
B) 45 throws, 75%
- Step 8: A) 10 throws, 50%  
B) 65 throws, 75%
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**Stage 2: Fastballs Only**

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- Step 9: A) 60 throws, 75%  
B) 15 throws, batting practice
- Step 10: A) 50–60 throws, 75%  
B) 30 throws, batting practice
- Step 11: A) 45–50 throws, 75%  
B) 45 throws, batting practice
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**Stage 3**

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- Step 12: A) 30 throws, 75%  
B) 15 throws, 50%, begin breaking balls  
C) 45–60 throws, batting practice, fastball only
- Step 13: A) 30 throws, 75%  
B) 30 breaking balls, 75%  
C) 30 throws, batting practice
- Step 14: A) 30 throws, 75%  
B) 60–90 throws, batting practice, gradually increase breaking balls
- Step 15: A) Simulated game: progressing by 15 throws per work-out (pitch count)
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\* Represents percentage effort.

<sup>‡</sup> All throwing off the mound should be done in the presence of a pitching coach or sport biomechanist to stress proper throwing mechanics (use speed gun to aid in effort control).

<sup>‡</sup> Use interval throwing 120-ft (36.6-m) phase as warm-up.

# Little League Throwing Program



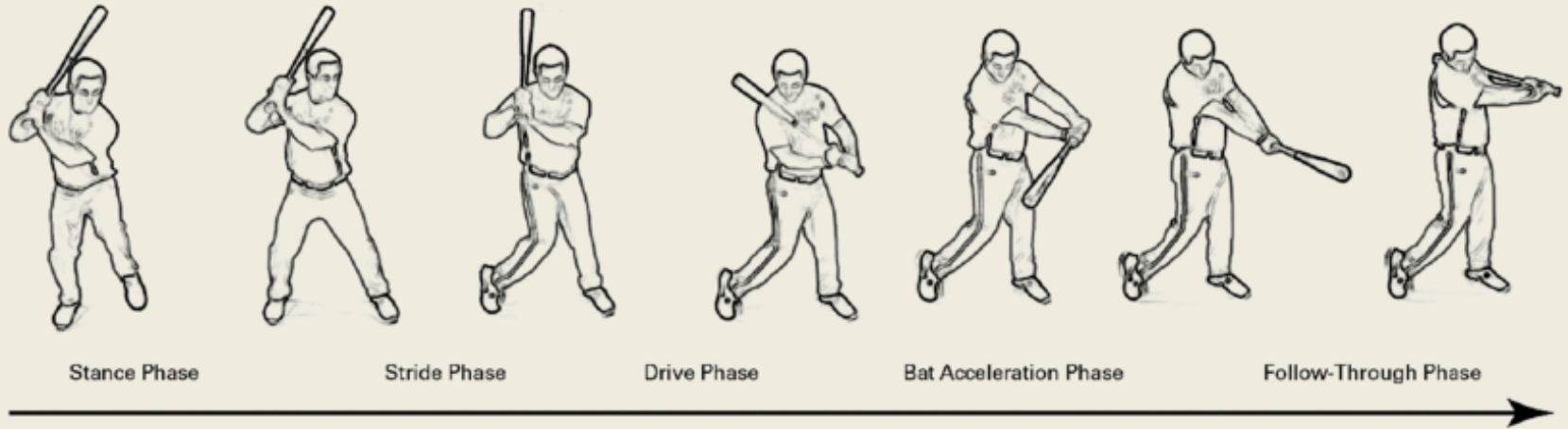


TABLE 5. Little league interval throwing program.\*

30-Ft Phase		45-Ft Phase	
<b>Step 1:</b>	A) Warm-up throwing B) 30 ft, 25 throws C) Rest 15 min D) Warm-up throwing E) 30 ft, 25 throws	<b>Step 3:</b>	A) Warm-up throwing B) 45 ft, 25 throws C) Rest 15 min D) Warm-up throwing E) 45 ft, 25 throws
<b>Step 2:</b>	A) Warm-up throwing B) 30 ft, 25 throws C) Rest 10 min D) Warm-up throwing E) 30 ft, 25 throws F) Rest 10 min G) Warm-up throwing H) 30 ft, 25 throws	<b>Step 4:</b>	A) Warm-up throwing B) 45 ft, 25 throws C) Rest 10 min D) Warm-up throwing E) 45 ft, 25 throws F) Rest 10 min G) Warm-up throwing H) 45 ft, 25 throws
60-Ft Phase		90-Ft Phase	
<b>Step 5:</b>	A) Warm-up throwing B) 60 ft, 25 throws C) Rest 15 min D) Warm-up throwing E) 60 ft, 25 throws	<b>Step 7:</b>	A) Warm-up throwing B) 90 ft, 25 throws C) Rest 15 min D) Warm-up throwing E) 90 ft, 25 throws
<b>Step 6:</b>	A) Warm-up throwing B) 60 ft, 25 throws C) Rest 10 min D) Warm-up throwing E) 60 ft, 25 throws F) Rest 10 min G) Warm-up throwing H) 60 ft, 25 throws	<b>Step 8:</b>	A) Warm-up throwing B) 90 ft, 20 throws C) Rest 10 min D) Warm-up throwing E) 60 ft, 20 throws F) Rest 10 min G) Warm-up throwing H) 45 ft, 20 throws I) Rest 10 min J) Warm-up throwing K) 45 ft, 15 throws

\* 30 ft = 9.1 m; 45 ft = 13.7 m; 60 ft = 18.3 m; 90 ft = 27.4 m.

# Phases of Hitting



# Return to Hitting

- Phase 1: Normal Weighted Bat
- Phase 2: Hitting off a Tee
- Phase 3: Soft Toss
- Phase 4: Simulated Hitting

# Interval Hitting Program



Phase 1 – Normal weight bat	
Step 1	Step 2
No ball	No ball
50% effort	50% effort
20 dry swings	20 dry swings
REST	REST
20 dry swings	20 dry swings
	REST
	20 dry swings

Phase 2 – Hitting off a Tee		
Step 1	Step 2	Step 3
Tee at waist height	Tee at waist height	Tee at waist height
50% effort	50% effort	75% effort
10 dry swings	10 dry swings	10 dry swings
25 swings middle of the plate	15 swings middle of the plate	15 swings middle of the plate
	REST	REST
	10 dry swings	10 dry swings
	15 swings inside half of plate	15 swings inside half of plate
	REST	REST
	10 dry swings	10 dry swings
	15 swings outside half of plate	15 swings outside half of plate

Phase 2 – Hitting off a Tee	
Step 4	Step 5
Tee height and distance from batter varies	Tee height and distance from batter varies
75% effort	90% effort
10 dry swings	10 dry swings
20 swings middle of the plate	20 swings middle of the plate
5 at chest height	5 at chest height
10 at waist height	10 at waist height
5 just above knee height	5 just above knee height
REST	REST
10 dry swings	10 dry swings
20 swings inside half of plate	20 swings inside half of plate
5 at chest height	5 at chest height
10 at waist height	10 at waist height
5 just above knee height	5 just above knee height
REST	REST
10 dry swings	10 dry swings
20 swings outside half of plate	20 swings outside half of plate
5 at chest height	5 at chest height
10 at waist height	10 at waist height
5 just above knee height	5 just above knee height

Phase 3 – Soft Toss		
Step 1	Step 2	Step 3
Partner 45° from hitter	Partner 45° from hitter	Partner 45° from hitter
50% effort	50% effort	75% effort
Warm-up swings	Warm-up swings	Warm-up swings
25 waist high swings from partner	10 swings waist high, middle of the plate	10 swings waist high, middle of the plate
	REST	REST
	Warm-up swings	Warm-up swings
	10 swings chest high, middle of the plate	10 swings chest high, middle of the plate
	REST	REST
	Warm-up swings	Warm-up swings
	10 swings just above knee, middle of the plate	10 swings just above knee, middle of the plate

Phase 3 – Soft Toss	
Step 4	Step 5
Partner 45° from hitter	Partner 45° from hitter
75% effort	90% effort
Warm-up swings	Warm-up swings
30 swings middle of the plate	30 swings middle of the plate
10 waist high	10 waist high
10 chest high	10 chest high
10 just above knee	10 just above knee
REST	REST
Warm-up swings	Warm-up swings
10 swings inside half of plate	15 swings inside half of plate
10 swings outside half of plate	15 swings outside half of plate

\*Phase 3 warm-up swings = 10 dry swings, 10 tee swings.

Phase 4 – Simulated Hitting			
Step 1	Step 2	Step 3	Step 4
Partner behind “L” screen	Partner behind “L” screen	Partner behind “L” screen	Partner behind “L” screen
50% effort	75% effort	75% effort	90%-100% effort
Warm-up swings	Warm-up swings	Warm-up swings	Warm-up swings
30 swings at fastball	25 swings at fastball with random placement	25 swings at fastball with random placement	25 swings at fastball with random placement
10 middle	REST	REST	REST
10 chest high	Warm-up swings	Warm-up swings	Warm-up swings
10 above knee	15 swings at change-up with random placement	15 swings at change-up with random placement	15 swings at change-up with random placement
		REST	REST
		Warm-up swings	Warm-up swings
		15 swings at curveball with random placement	15 swings at curveball with random placement

\*Phase 4 warm-up swings = 10 tee swings, 10 soft toss swings.

# Key Points

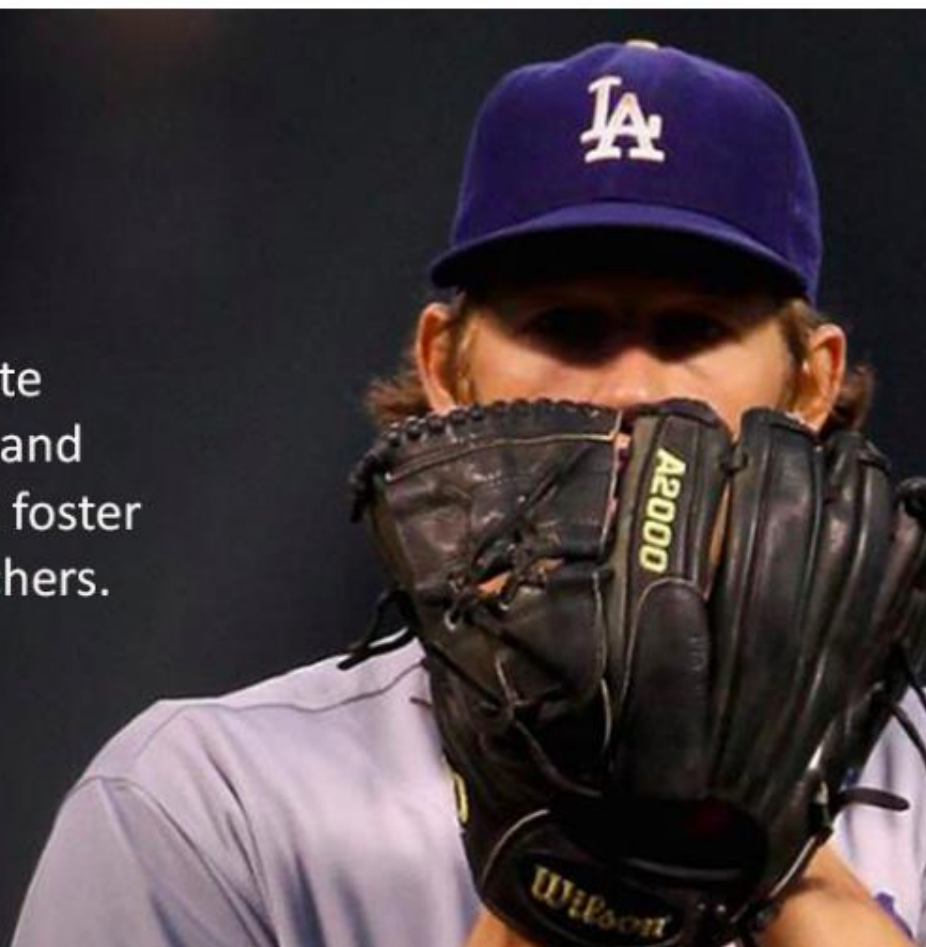
- REST
- < 8 Months Competitive Pitching per Year
- Follow Pitch Counts and Days Off
- Do Not Pitch/Throw Through Pain or Fatigue
- Gradual Return, Throw TO the Target
- Therapeutic Exercises Help

# Resources

- <https://www.mlb.com/pitch-smart>
- <http://www.andrewsinstitute.com/InjuryPrevention/Baseball/>
- Pitchers' Baseball Bat Training Program
- Critical Instant Training for Throwing Athletes
- Interval Sport Programs: Guidelines for Baseball, Tennis, and Golf
- Interval Throwing and Hitting Programs in Baseball: Biomechanics and Rehabilitation

# Pitch Smart.

A series of practical, age-appropriate guidelines to help parents, players and coaches avoid overuse injuries and foster long, healthy careers for youth pitchers.





**Table**  
**Pitcher's Baseball Bat Program**

Exercise		Resistance	Volume
1	Overhead pronation-supination	6- to 14-year-olds: 1/2 bat	6- to 14-year-olds: 2 sets of 15
		15+ year olds: 1/2–3/4 bat	15+ year olds: 3 sets of 20
2	Neutral wrist radial bat circles	6- to 14-year-olds: 1/2 bat	2 sets of 20 clockwise circles
		15+ year olds: 1/2–3/4 bat	2 sets of 20 counterclockwise circles
3	Neutral wrist ulnar bat circles	6- to 14-year-olds: 1/2 bat	2 sets of 20 clockwise circles
		15+ year olds: 1/2–3/4 bat	2 sets of 20 counterclockwise circles
4	Radial bat deviations	6- to 14-year-olds: 1/2 bat	6- to 14-year-olds: 2 sets of 15
		15+ year olds: 1/2–3/4 bat	15+ year olds: 2 sets of 25
5	Ulnar bat deviations	6- to 14-year-olds: 1/2 bat	6- to 14-year-olds: 2 sets of 15
		15+ year olds: 1/2–3/4 bat	15+ year olds: 2 sets of 25
6	Resisted bat pronation at full supination	6- to 14-year-olds: 1/2 bat	6- to 14-year-olds: 1 set of 12
		15+ year olds: 1/2 bat	15+ year olds: 2 sets of 15
7	Neutral wrist eccentric pronation	6- to 14-year-olds: 1/2 bat	6- to 14-year-olds: 1 set of 10
		15+ year olds: 1/2 bat	15+ year olds: 2 sets of 10

Objective: improve muscular resistance to valgus stress by enhancing varus torque strength. Valgus stress causes medial elbow tendinopathy, UCL damage, lateral elbow compression, and posteromedial olecranon impingement.

**Table 2**  
**Training guidelines**

<b>Critical Instant Training for Throwing Athletes</b>	
Improves transition from maximal external shoulder rotation to follow-through	
Reduces the risk of shoulder and elbow injuries	
Provides range of motion feedback and response to pitching stress	
<b>Description of Training Population and Important Training Procedures</b>	
G1—Physically mature athletes (15 years or older)	
G2—Physically immature athletes (younger than 15 years)	
Exercises are performed during the off-season and preseason conditioning platforms. During the season, the exercises are performed once per week on an appropriate day where the athlete has 48- to 72-hours rest before completion. Before all training sessions, the athlete should be adequately warmed up, and communication with the strength coach is essential in applying eccentric resistance.	
Range of motion assessments (ROMA) should be taken post-pitching and 24-hours post-pitching to address deficits in joint mobility. Communication with the sports medicine staff is important in addressing range of motion changes (>10°) for appropriate treatment.	
Sleeper stretch ROMA	G1 and G2
	● 5 sets of 20-second holds for each arm performed post-pitching and 24-hours post-pitching
Standing eccentric internal rotation	G1
	● 30, 20, 10 repetitions, slightly increasing resistance each set.
	● 1.5- to 2-minute rest between sets
	G2
	● 1–2 sets of 30 repetitions, no change in resistance
	● 1.5- to 2-minute rest between sets
Supine eccentric internal rotation	G1
	● 3 sets of 12 repetitions
	● 1.5- to 2-minute rest between sets
	G2
	● 1–2 sets of 20 repetitions
	● 1.5- to 2-minute rest between sets

## Interval Sport Programs: Guidelines for Baseball, Tennis, and Golf

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### + AFFILIATIONS

**Published:** *Journal of Orthopaedic & Sports Physical Therapy*, 2002 **Volume:**32 **Issue:**6 **Pages:**293–298 **DOI:** 10.2519/jospt.2002.32.6.293

**AJ** The American Journal  
of Orthopedics.

## Interval Throwing and Hitting Programs in Baseball: Biomechanics and Rehabilitation

*Am J Orthop.* 2016 February;45(2):157-162

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