American Sports Medicine Institute
Biomechanical Analysis of Pitching Delivery

The following results are based on a computerized quantitative analysis of the throwing motion. Results from your analysis are compared to a normative database of professional and collegiate pitchers tested at the American Sports Medicine Institute. Any parameters outside the normative range are indicated.

Summary ASMI Biomechanics Evaluation 1

Name: Xxxx Xxxxx Test Date: January 10, xxxx Test #: 2305

General Comments:

Pitching is a kinetic chain that works from the ground up. If a movement in the beginning stages of your delivery is "off", then either the rest of the delivery will be off or your body has to do something to compensate for the mistake. In order to prevent this from occurring, the same amount of attention must be given to each stage of the pitching motion.

There are just a few areas which are outside of our normative range for elite pitchers, but we don't feel it is necessary to make any of those adjustments. You should continue pitching using the mechanics you have now, as they are very good.

You should continue to work with your pitching coach to keep your mechanics fluid and under control. If there are any questions or comments about the evaluation, please feel free to call us for explanation.

Stride - ASMI Biomechanics Evaluation

Q1: Are you balanced when your knee has reached it maximum height? **YES**
Q2: Are your hands in front of your chest at this point? **YES**
Q3: Do you begin the lateral move towards home plate when the stride knee starts to move down and towards the plate? **YES**
Q4: Do both arms smoothly break down, swing apart, and then up? **YES**

*** STRIDE LENGTH**

Q5: Is your stride length slightly less than your height?

[A] Stride Length (rubber to lead ankle)

Your Results (A)
(FB) 83 % Ht
(CB) 85% Ht

Normative Range
77 to 87

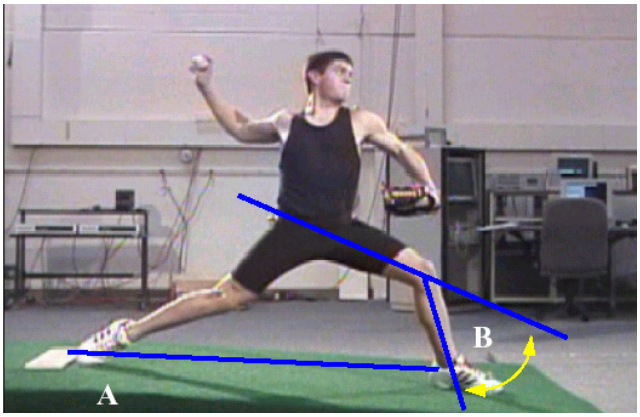
***LEAD KNEE ANGLE**

Q6: Is your lead knee properly bent at foot contact?

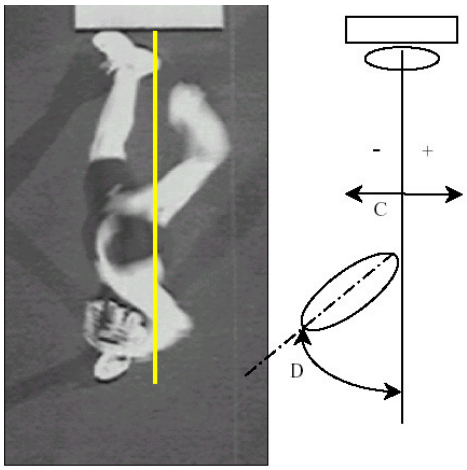
[B] Lead Knee Angle

Your Result [B]
(FB) 48 Degrees (CB) 44 Degrees

Normative Range
35 to 54



Foot Contact
ASMI Biomechanics Evaluation



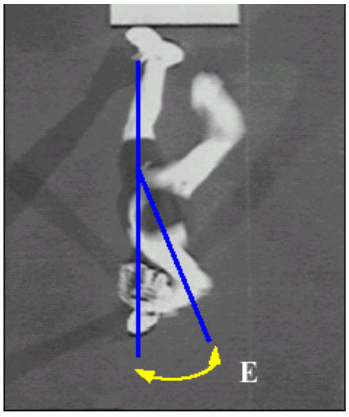
***Lead Foot Placement At Foot Contact**
Q7: Do you stride directly towards home plate?
[C] Lead Foot Placement

Your Results (C)	**Normative Range**
(FB) -27 cm	-31 to 0
(CB) - -28 cm	

***Lead Foot Orientation at Foot Contact**
Q8: Does your stride foot land with toes pointing in?
[D] Lead Foot Orientation
(-means pointing in; + means pointing out)

Your Results (D)	**Normative Range**
(FB) -28 degrees	-25 to -8
(CB) -26 degrees	

***Trunk Position at Foot Contact**
Q9: Is your pelvis slightly open?
[E] Pelvis Orientation

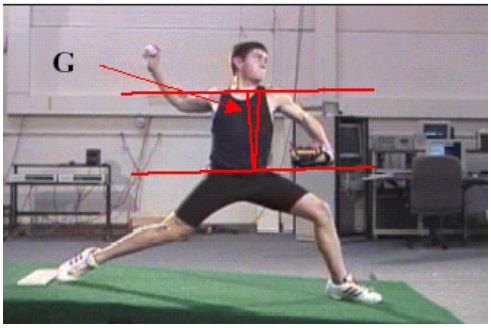


Your Results (E)	**Normative Range**
(FB) 32degrees	19 to 43
(CB) 30 degrees	

Q10: Is your trunk slight closed?
[F] Pelvis to Trunk Separation

Your Results (F)	**Normative Range**
(FB) -46 degrees	-57 to -38
(CB) -46 degrees	

Q11: Are your shoulders level?
[G] Trunk Lateral Flexion
(+ means leaning up; -means laying down)

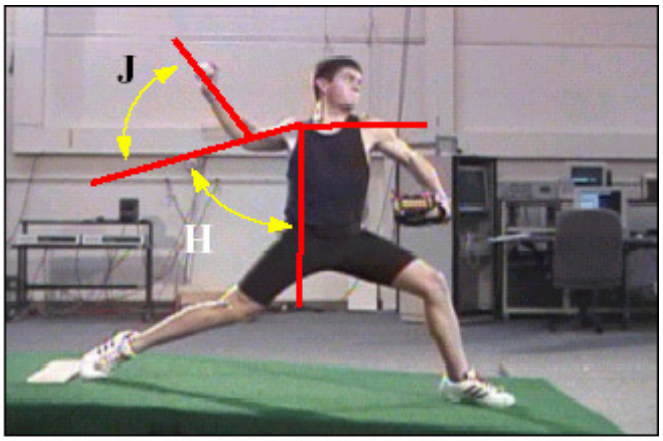


Your Results (G)	**Normative Range**
(FB) 11 degrees	-4 to 9
(CB) 8 degrees	

Arm Position at Foot Contact
ASMI Biomechanics Evaluation

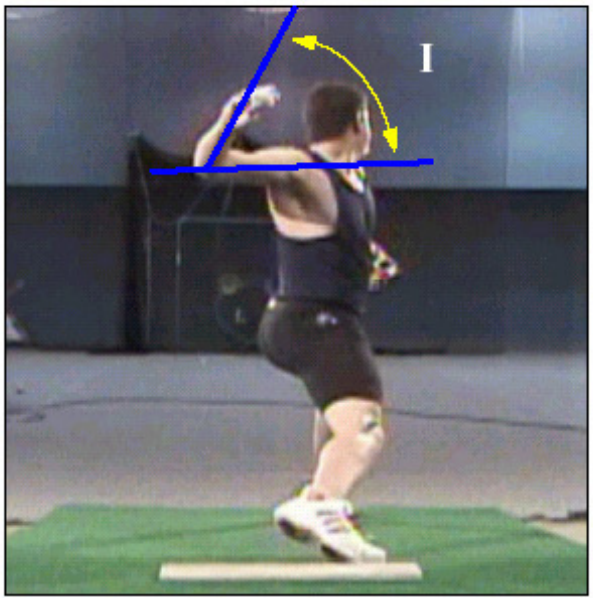
Q12: Is your upper arm even with your shoulders?
[H] Shoulder Abduction Angle

Your Results (H)	**Normative Range**
(FB) 86 Degrees	80 to 101
(CB) 90 degrees	



Q13: Is your forearm rotated to a semi-cocked position?
[I] Shoulder External Rotation (ER)

Your Results (I)	**Normative Range**
(FB) 62 Degrees	27 to 84
(CB) 66 degrees	

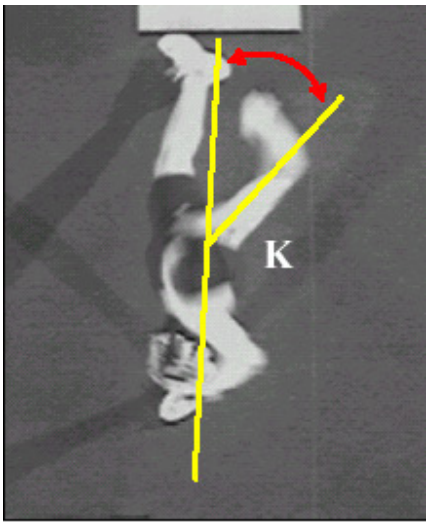


Q14: Is your elbow properly flexed?
[J] Elbow Angle

Your Results (J)	**Normative Range**
(FB) 88 Degrees	73 to 105
(CB) 84 degrees	

Q15: How far back does your shoulder flex?
[K]] Elbow Angle

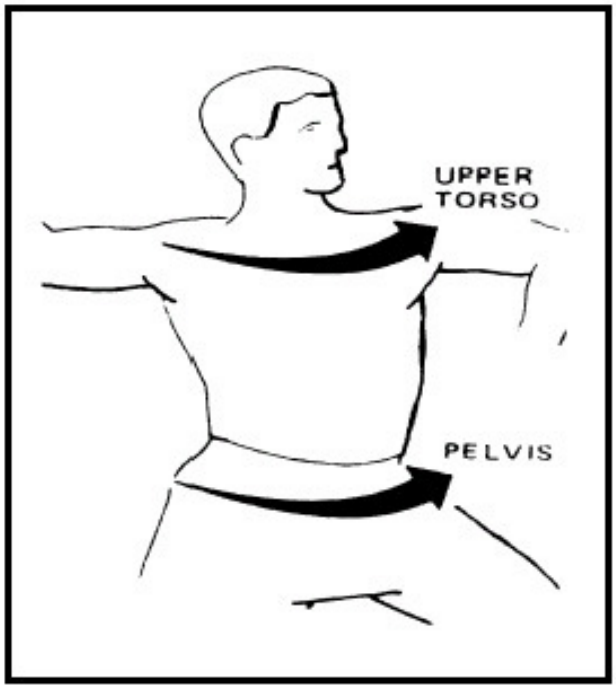
Your Results (K)	**Normative Range**
(FB) 17 Degrees	33 to 12
(CB) 84 degrees	



Trunk Rotation During Delivery
ASMI Biomechanics Evaluation

Q16: Does your pelvis rotate at the right speed?
[L]] Maximum Pelvis Rotation Velocity

Your Results (L)	Normative Range
(FB) 668 deg/sec	538 to 724
(CB) 690 deg/sec	



Q17: Does your pelvis rotate shortly after foot contact?
(0% is at foot contact; 100% is at ball release)

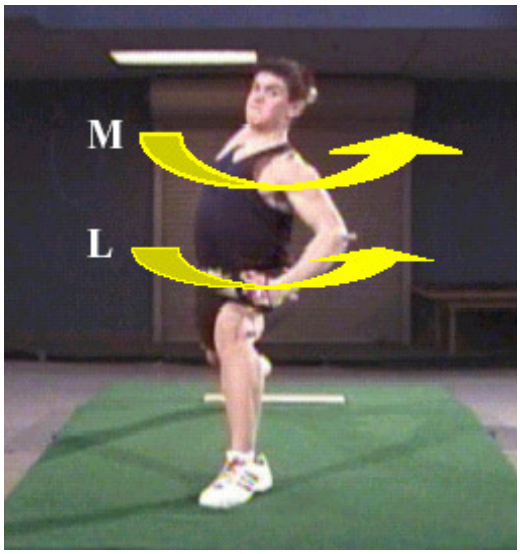
Your Results	Normative Range
(FB) 29 %	12 to 45
(CB) 32 %	

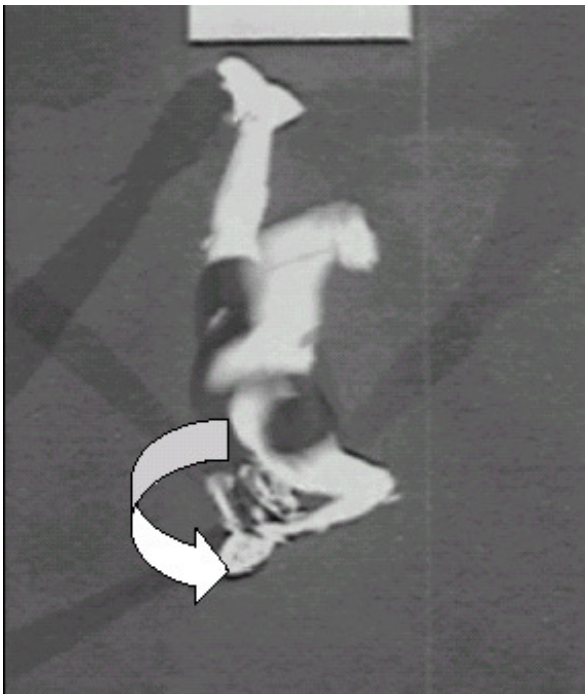
Q18: Does your upper trunk rotate fast than your pelvis?
[M] Maximum Upper Trunk Angular Velocity

Your Results (M)	Normative Range
(FB) 1,220 deg/sec	1,092 to 1,289
(CB) 1,220 deg/sec	

Q19: Does your upper trunk rotate shortly after your pelvis?
(0% is at foot contact; 100% is at ball release)
** The delivery phase is from foot contact to ball release. The total time of this phase is converted to 100% and events are related to this interval.

Your Results	Normative Range
(FB) 46%	39 to 58
(CB) 39 %	

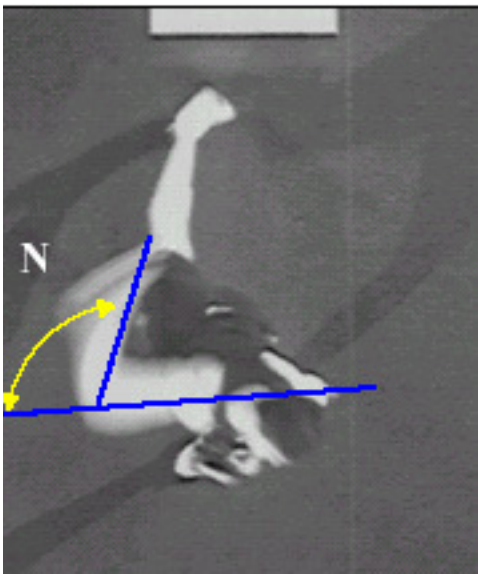




Arm Position at Maximum External Rotation (MER)
ASMI Biomechanics Evaluation

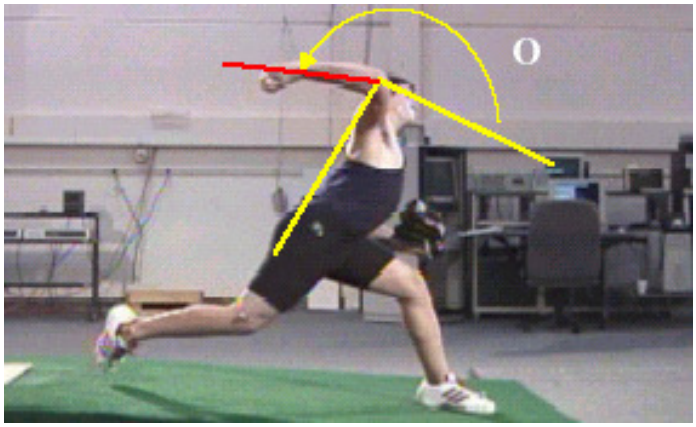
Q20: What is the maximum amount that your elbow bends?
[N] Maximum Elbow Flexion

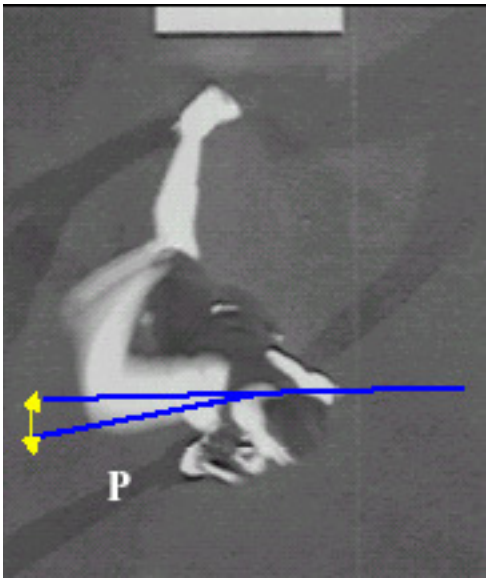
Your Results (N)	Normative Range
(FB) 110 degrees	89 to 114
(CB) 101 degrees	



Q21: How far back does your arm rotate?
[O] Maximum External Rotation (MER)

Your Results (O)	Normative Range
(FB) 196 degrees	170 to 187
(CB) 197 degrees	





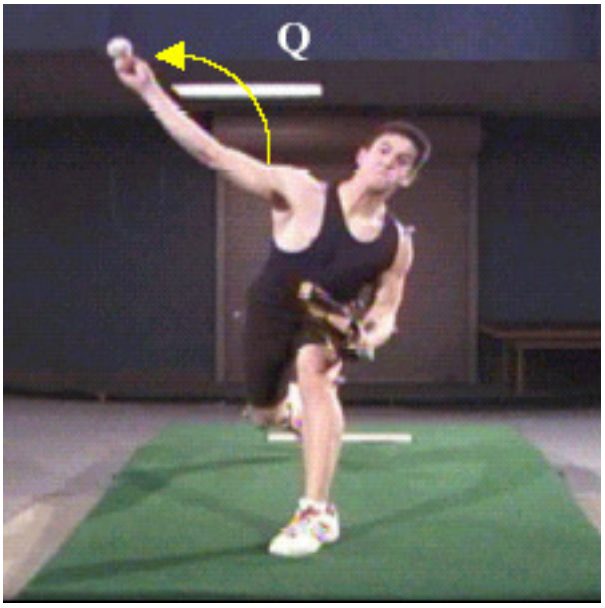
Q22: Does your elbow get only slightly in front of your trunk?
[P] Maximum Horizontal Adduction

Your Results (P)	Normative Range
(FB) 24 degrees	9 to 24
(CB) 25 degrees	

Q23: Does your upper trunk tilt forward causing your back to arch? YES

Arm Acceleration
ASMI Biomechanics Evaluation

Q24: What is the maximum speed of straightening out your arm?
[Q] Maximum Elbow Extension Velocity



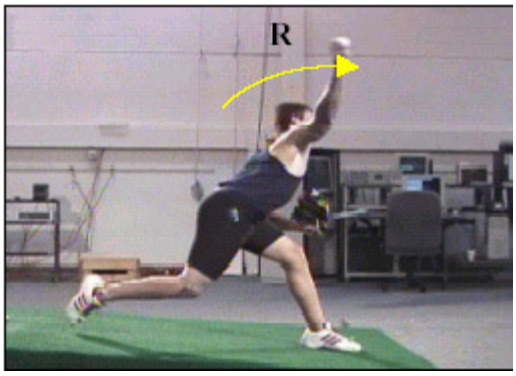
Your Results (Q)	**Normative Range**
(FB) 2,591deg/sec	2,120 to 2,728
(CB) 2,363 deg/sec	

Q25: Does your elbow open with a maximum velocity slightly before ball release?
(0% is at foot contact; 100% is at ball release

Your Results	**Normative Range**
(FB) 90%	89 to 94
(CB) 88%	

Q26: What is the maximum speed of rotating your arm at the shoulder?
[R] Maximum Internal Rotation Velocity.

Your Results [R]	**Normative Range**
(FB) 6,994 deg/sec	6,263 to 8,544
(CB) 6,386 deg/sec	



Q27: Do you stop your hip forward momentum with your front leg?
[S] Minimum Mid-Pelvis Linear Velocity
(+ means moving toward the plate; - means moving toward second base)

Your Results [S]	**Normative Range**
(FB) 0.16 m/sec	-0.23 to 0.34
(CB) 0.19 m/sec	

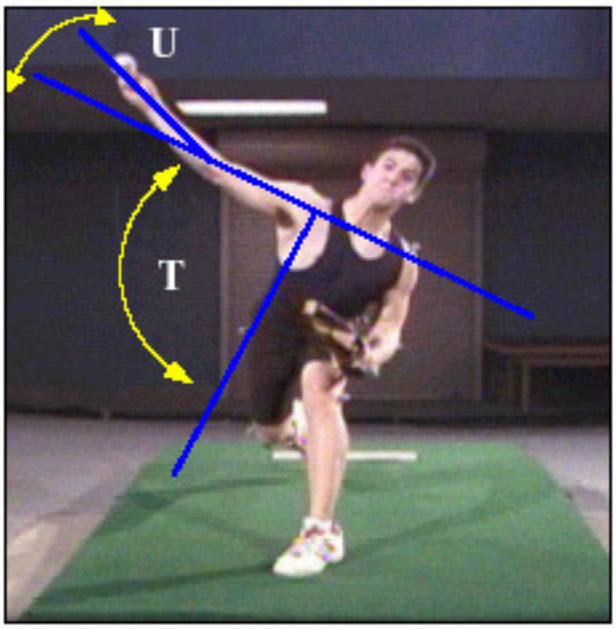
ARM POSITION AT BALL RELEASE
ASMI Biomechanics Evaluation

Q28: Is your elbow slightly above your shoulder line?
[T] Arm Abduction at the Shoulder at Ball Release.

Your Results [T]	Normative Range
(FB) 100 degrees	85 to 103
(CB) 102 degrees	

Q29: Does your arm open to almost full extension?
[U] Elbow Angle at Ball Release.

Your Results [U]	Normative Range
(FB) 26 degrees	18 to 28
(CB) 27 degrees	

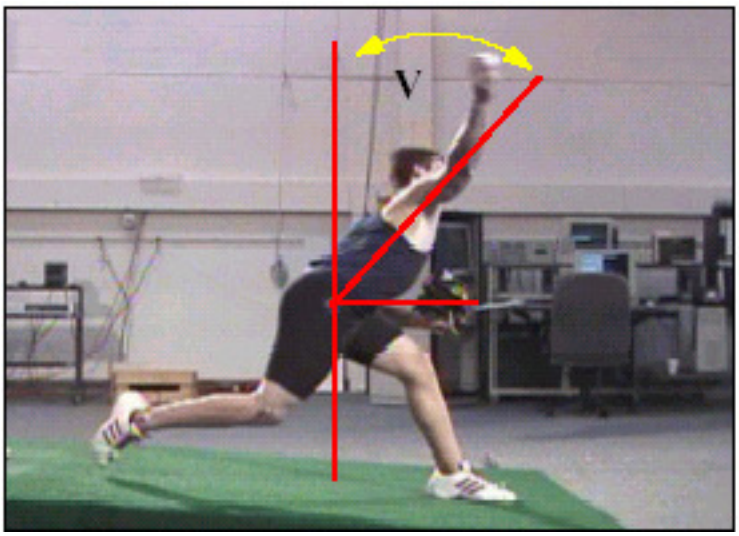


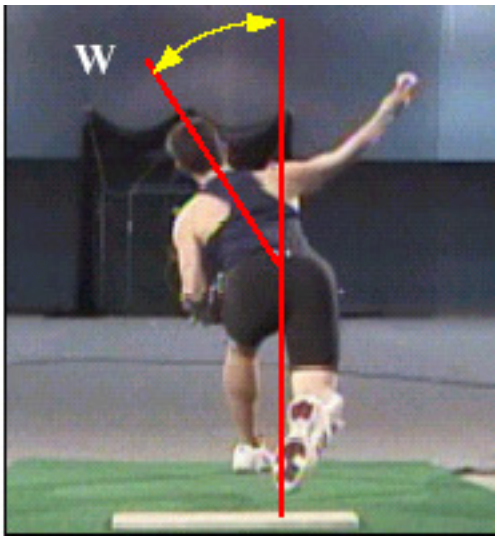
Q30: Is your trunk forward at release?
[V] Forward Trunk Tilt (relative to vertical.)

Your Results [V]	Normative Range
(FB) 43 degrees	28 to 41
(CB) 38 degrees	

Q31: Is your trunk tilted laterally at release?
[V] Lateral Trunk Tilt (relative to vertical.)

Your Results [V]	Normative Range
(FB) 30 degrees	15 to 35
(CB) 20 degrees	

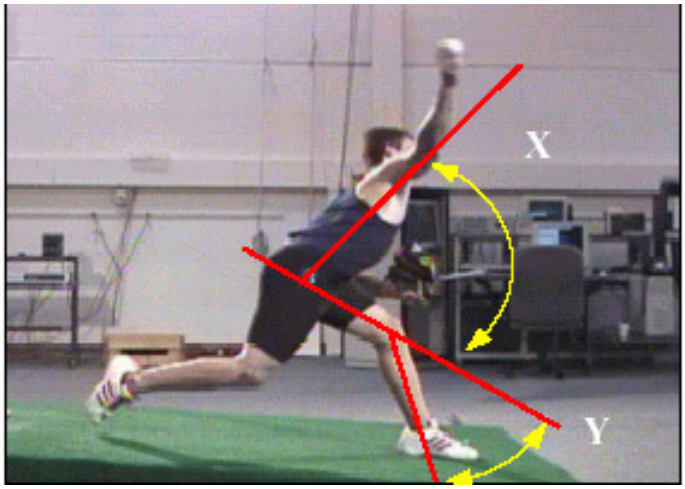




BODY POSITION AT BALL RELEASE
ASMI Biomechanics Evaluation

Q32: Does your trunk form a right angle with your right foot?
[X] Lead Pelvis Flexion

Your Results [V]	Normative Range
(FB) 84 degrees	88 to 110
(CB) 86 degrees	

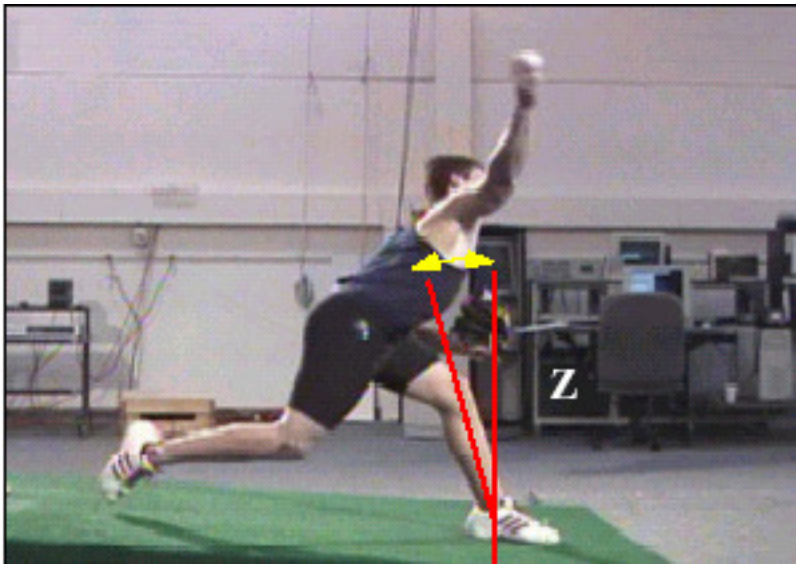


Q33: Is your lead knee slightly flexed at ball release?
[Y] Lead Knee Angle at Ball Release

Your Results [Y]	Normative Range
(FB) 35 degrees	21 to 45
(CB) 41 degrees	

Q34: Is your lower leg titled slightly back toward second base?
[Z] Shank Angle [relative to vertical]

Your Results [Z]	Normative Range
(FB) 15 degrees	10 to 22
(CB) 12 degrees	



Q35: Is your glove tucked at release? **YES**

FOLLOW THROUGH
ASMI Biomechanics Evaluation

Q36: Does y our trunk become approximately horizontal? **YES**

Q37: Does your front knee straighten out after release? **YES**

Q38: Does your arm continue far enough so that the back of your shoulder appears? **YES**

Q39: Do you leave yourself in a balanced position? **YES**

PHASES


Wind Up
From initial movement until the pitcher reaches the balance point or maximum knee height.


Stride
From balance point or end of wind up until front foot contact (FC) with the mound. This is a phase of low stress and velocities while the arm is being positioned prior to arm cocking phase.

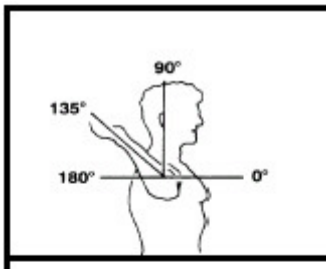

Arm Cocking
From the time of foot contact (FC) until upper arm has reached maximum external rotation (MER). This is a phase with high stress (kinetic) values on shoulder and elbow. High torques occur at the elbow to resist valgus extension load.


Arm Acceleration
From maximum external rotation (MER) until ball release (BR). This is a phase of high arm angular velocities (elbow extension, internal rotation of the upper arm).

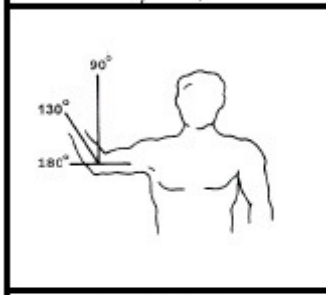

Follow Through
From maximum internal rotation (MIR) until completion of the throwing motion. A complete follow through motion may improve the ability to decelerate forces after ball release.


Arm Deceleration
From ball release (BR) until maximum internal rotation (MIR). This is a phase of high arm stress (kinetic) values on shoulder and elbow. High compressive forces are estimated as distraction of the upper arm and forearm is resisted.

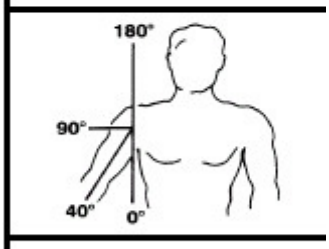
DEFINITIONS



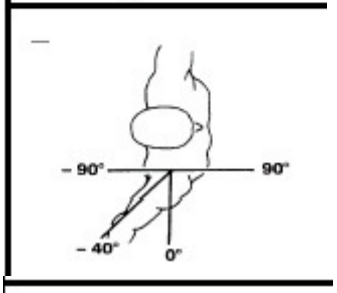
External Rotation of the Upper Arm at the Shoulder
External rotation is measurement of the amount the upper arm rotates during arm cocking prior to throwing the pitch forward. The amount of external rotation is a combination of upper arm rotation and extension of the upper back and shoulder complex. This variable is associated with amount of internal rotation velocity during acceleration and the amount of velocity imparted on the ball. Limited external rotation can be improved with proper conditioning, although this dependent on the amount of inherent flexibility.



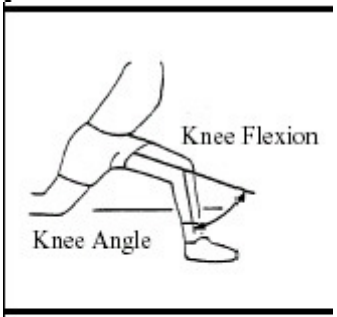
Elbow Angle/ Flexion
The elbow angle represents the angle between the upper arm and forearm. Elbow flexion represents the amount the forearm flexes from an extended position. A completely extended arm has an elbow angle of 180 degrees. Therefore, elbow flexion is equal to 180 – elbow angle. The amount of elbow flexion or the elbow angle helps determine the position of the arm during the motion.
Excessive or limited elbow flexion may compromise the ability to perform a proper throwing motion. In combination with other variables, excessive elbow flexion may indicate increased potential for elbow problems.



Upper Arm Abduction at the Shoulder
Shoulder abduction represents the position of the upper relative to the trunk. The upper arm is typically held in a position level with the shoulders during the majority of the pitching motion. This is equivalent to 90 degrees of shoulder abduction. Excessive (high) or low abduction may limit the ability to perform a proper motion and indicate the potential for shoulder problems such as
impingement.



Horizontal Adduction at the Shoulder
Horizontal adduction is a measure of the upper arm position in relation to the trunk or the shoulder line. When the upper arm is behind the trunk the value is negative or consider abduction. When the upper arm is forward of the trunk, the value is positive. Excessive adduction or abduction may limit the ability to perform a proper pitching motion. In combination with other variable, excessive horizontal adduction may indicate increased potential for injury. Excessive horizontal adduction combined with excessive elbow flexion during arm cocking is often related to the term “leading with the elbow”.



Knee Angle/Flexion
Knee angle represents the angle between the upper leg (thigh) and the lower leg (shank). Knee flexion represents the amount the lower leg flexes relative to an extended position. A completely extended leg will have a knee angle of 180 degrees. Knee flexion is equal to 180 – the knee angle. This variable helps determine the stability and movement of the lead leg during the motion. It also
determines the amount the leg extends during acceleration and ball release to optimize the transfer of momentum to the upper arm. Lead leg position and movement will have influence on follow through and deceleration.

Trunk Tilt Angle
Trunk tilt represents the trunk position during the motion with particular interest during ball release and follow- through. The trunk tilt angle is calculated relative to a horizontal line directed from the hips. Trunk flexion represents the amount of flexion relative to a vertical line directed from the hips. Trunk flexion is equal to 90 – the trunk tilt angle. This variable relates to the ability to perform proper follow through motion to decelerate the arm after ball release.