

FUNCTIONAL TRAINING

Integrated solutions for functional evaluation of the athlete

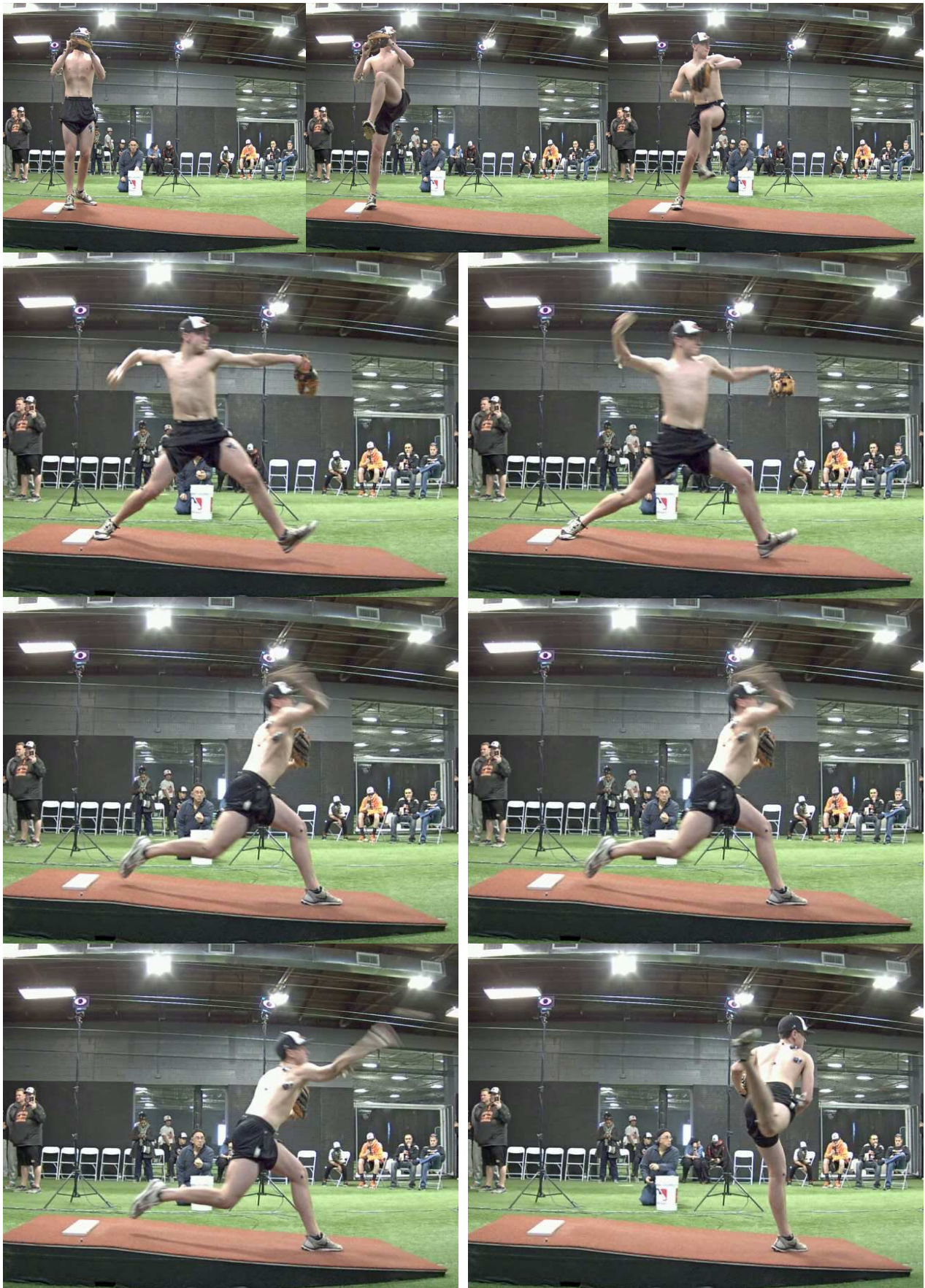


First name DEMO
Last name DUCKS
Sport BASEBALL
Session date 3/13/2017

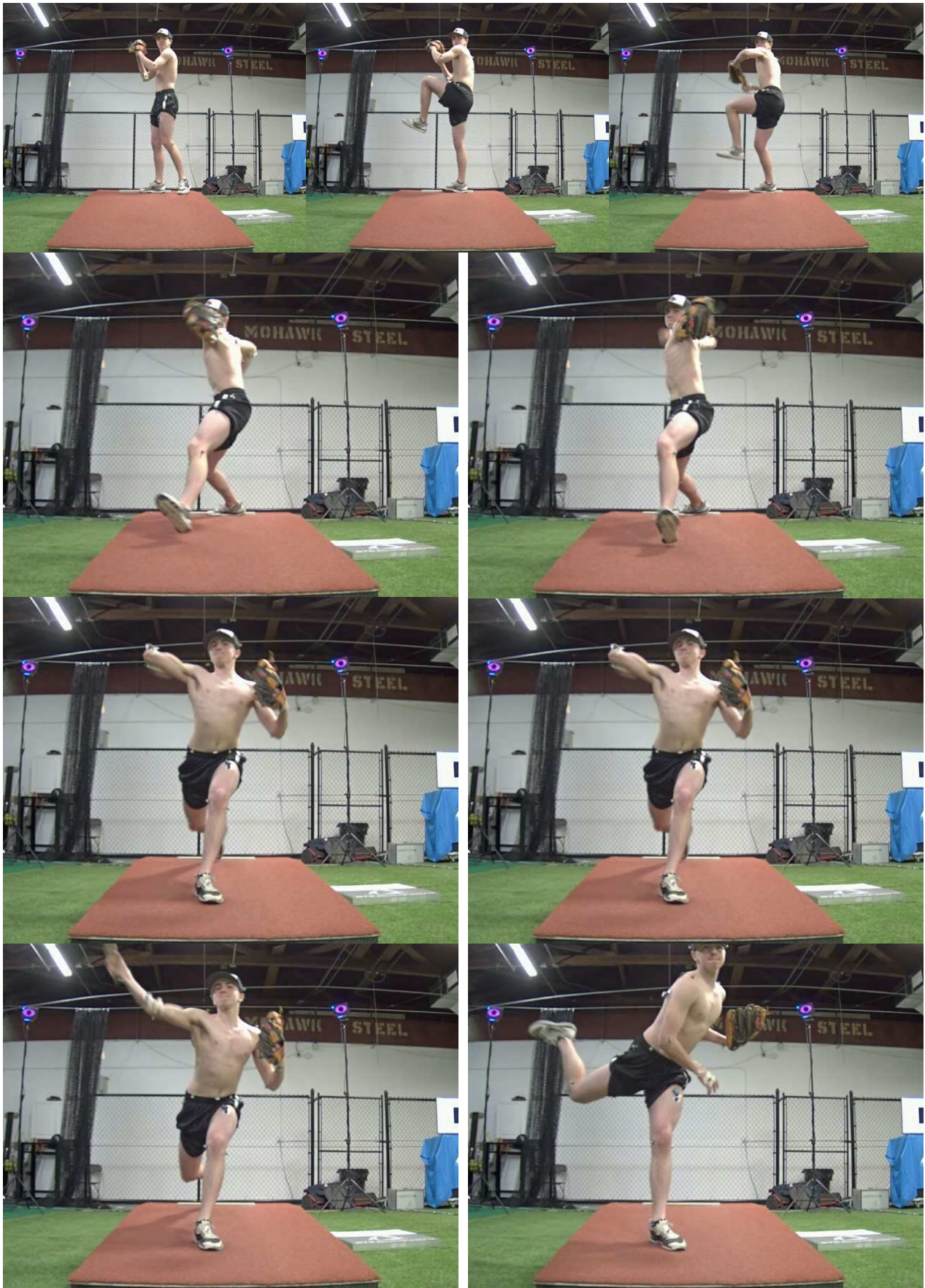


Notes:

Pitching Motion - Side View



Pitching Motion - Frontal View



Pitch Characteristics

	Avg +/- Std Dev	Elite Range
Pitch Velocity (mph)		85 to 89

Throwing Arm Torques and Forces

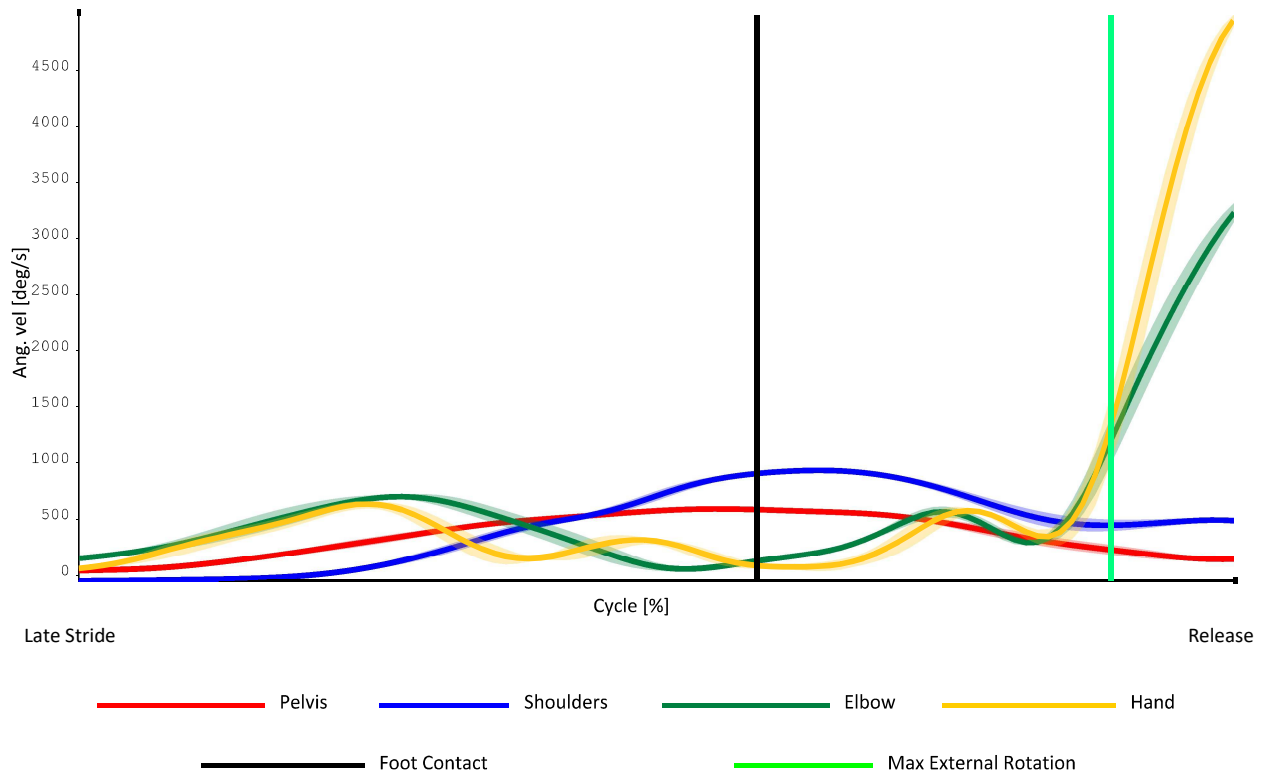
	Avg +/- Std Dev	Elite Range
Max Elbow Varus Torque (N*m)	19.458 ± .969	80 to 113
The UCL can only support about 32 N*m of torque		
Max Elbow Extension Torque (N*m)	43.295 ± .967	38 to 64
Max Shoulder Horizontal Adduction Torque (N*m)	-174.599 ± 6.922	-87 to -135
Max Shoulder Internal Rotation Torque (N*m)	42.332 ± 1.269	80 to 116

Torques represent rotational forces on the body

Injuries most likely occur when high forces and torques are repeatedly applied to vulnerable tissue & when the pitcher transitions through susceptible positions

Kinematic Sequence

Rotational Velocities Calculated Around Longest Axis of Body Segment



Max Rotational Velocity Events

	Avg	Elite Range
Pelvis (%)	0	17 to 41
Shoulders (%)	12.333	39 to 58

Max Rotational Velocities

	Avg +/- Std Dev	Elite Range
Pelvis (deg/s)	596.207 ± 9	522 to 675
Shoulders (deg/s)	940.84 ± 3.794	1075 to 1223

Balance Point Characteristics

	Avg +/- Std Dev	Elite Range
Normalized Knee Height at Balance Point (% Height)	61.977 ± 1.194	60 to 68
Movement of COM Towards Target (cm)	8.2 ± .86	15 to 23

Stride Characteristics

Minimum Throwing Wrist Velocity (m/s)	1.685 ± .025	> 1	Wrist velocity dropping below
Max Back Foot Horizontal Push-off Force (% Body Weight)		> 35	1 m/s can cause arm to lag behind
Max Back Foot Vertical Force (% Body Weight)			
Hip Hike (deg)	11.667 ± 1.239	> 0	

Foot Contact

Throwing Arm Pronation Angle (deg)	98.633 ± 3.842	> 100
Throwing Elbow Flexion Angle (deg)	81.167 ± 3.126	74 to 107
Throwing Shoulder External Rotation Angle (Inverted W) (deg)	73.033 ± 9.459	24 to 79, target 45
Throwing Shoulder Abduction Angle (deg)	101.533 ± 2.424	78 to 103
Normalized Stride Length (% Height)	79.877 ± .378	77 to 87
Stride Angle (positive is closed) (deg)	6.367 ± .618	> 0
Stride Leg Knee Flexion Angle (deg)	17 ± 3.718	36 to 42
Stride Leg Foot Progression Angle (deg)	-8.5 ± 3.293	7 to 26

Arm Cocking

Max Shoulder External Rotation Velocity (deg/s)	-1553.838 ± 31.172	-1291 to -1866
Max X-Factor (deg)	25.133 ± 3.809	38 to 59
Max Front Foot Force (% Body Weight)		

Max External Rotation

Max Shoulder External Rotation Angle (deg)	174.467 ± 1.563	173 to 191
Shoulder Horizontal Abduction Angle (deg)	15.233 ± .741	9 to 22
Throwing Shoulder Abduction Angle (deg)	105.2 ± .909	
Elbow Flexion Angle (deg)	102 ± 1.236	88 to 118

Arm Acceleration

	Avg +/- Std Dev	Elite Range
Max Pelvis Deceleration (deg/s)	-114.447 ± 9.655	-22 to -38
Max Pelvis Deceleration Event (%)	50.68	30 to 72
Max Elbow Extension Angular Velocity (deg/s)	-1875.893 ± 40.861	-2148 to -2880
Max Shoulder Internal Rotation Velocity (deg/s)	4247.732 ± 182.122	8338 to 8556

Release Point

Glove Knee Extension from Foot Contact (deg)	-10.367 ± 4.542	0 to 21
Release Point Distance from Rubber (cm)	150.067 ± 1.674	> 177

The farther the distance from the rubber the ball is released, the less time the batter will have to react to the ball, increasing the "apparent velocity" of the pitch. Every 7 cm gives about 1 mph to the apparent velocity.

COM Alpha Vector (deg)	-9.533 ± 2.05	0
Head Beta Vector (deg)	9.967 ± 1.554	0
Throwing Hand Beta Vector (deg)	8.433 ± 2.49	0

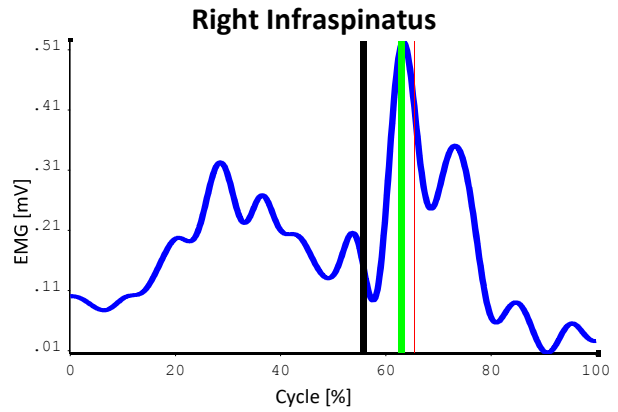
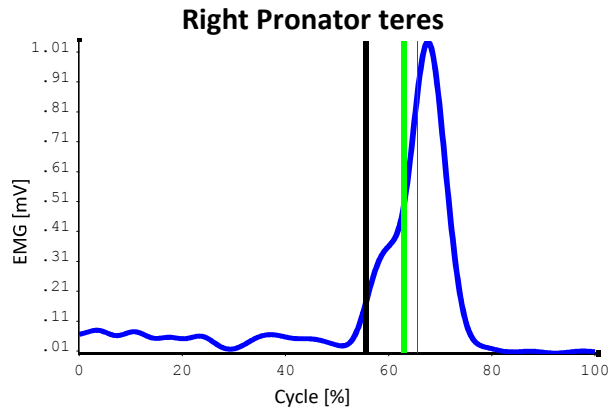
Vector indicates direction of movement at Release. Positive Vector angle is towards glove side

Release Point Distance from Glove Foot (cm)	-3.233 ± 1.621	> 0
Back Foot Force at Release (% Body Weight)		None
Release Point Vertical Hand Position (cm)	124.367 ± .419	Minimize Std Dev
Release Point Medial-Lateral Hand Position (cm)	86.733 ± 3.535	Minimize Std Dev
Wrist Snap Velocity (deg/s)	1507.846 ± 34.968	Maximize
Arm Slot Angle (deg)	14.367 ± .881	0-10 = Side-Arm 10-40 = 3/4 40-90 = Over the Top
Throwing Shoulder Abduction Angle (deg)	91 ± 2.872	87 to 103, target 90
Throwing Elbow Flexion Angle (deg)	57.633 ± 2.858	19 to 28
Throwing Arm Pronation Angle (deg)	104.033 ± 1.103	4-seam FB = 90 2-seam FB > 90 Cut FB < 90 Curveball < 45
Forward Trunk Tilt (deg)	32.867 ± 1.322	29 to 42
Side Trunk Tilt Angle (deg)	19.8 ± 1.556	14 to 31
Pitch Time (Balance Point to Release) (s)	0.767 ± .014	0.95 - 1.05

Follow Through

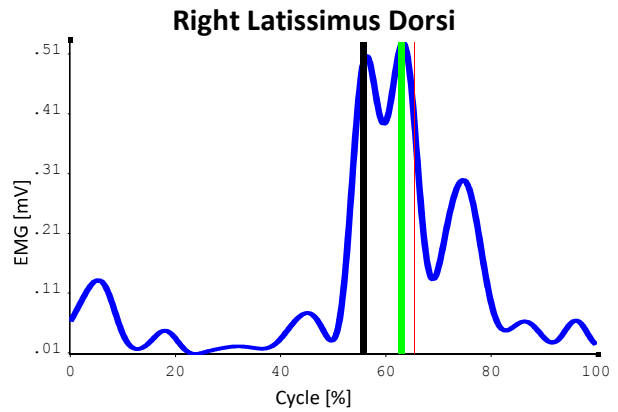
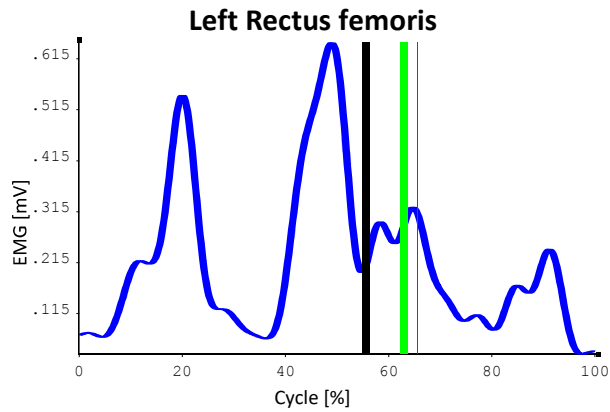
Stride Knee Extension After Release (deg)	0.233 ± 1.634	11 to 36
Max Trunk Flexion Angle (deg)	46.433 ± 4.374	40 to 57

Muscle Activation



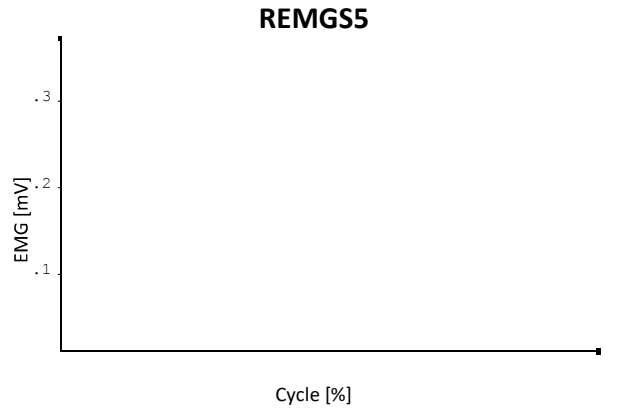
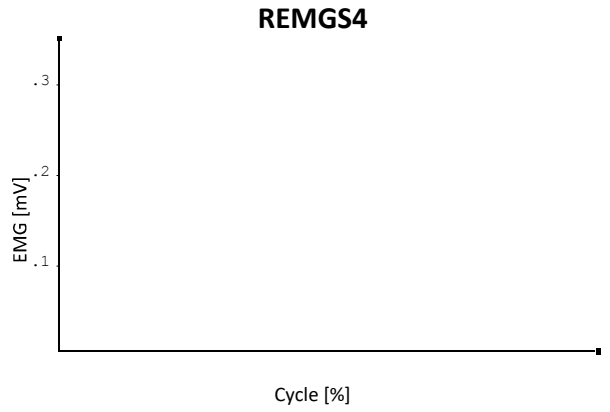
Balance Point Follow Through

Balance Point Follow Through



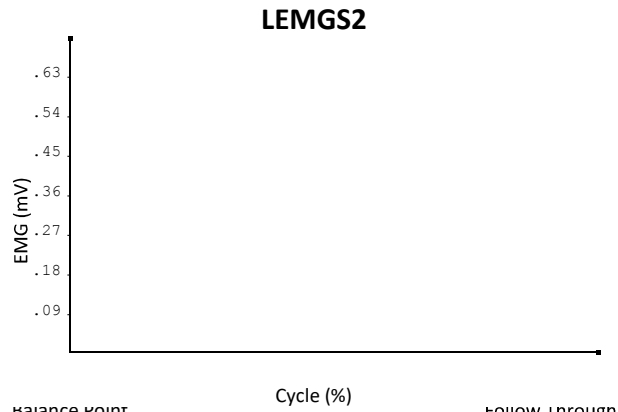
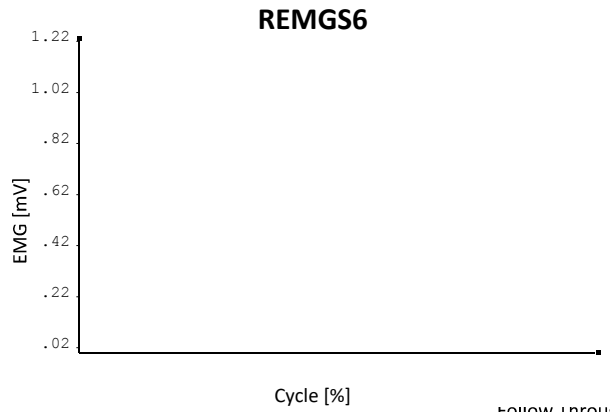
Balance Point Follow Through

Balance Point Follow Through



Balance Point Follow Through

Balance Point Follow Through



Balance Point Follow Through

Balance Point Follow Through

Foot Contact
 MER
 Release