

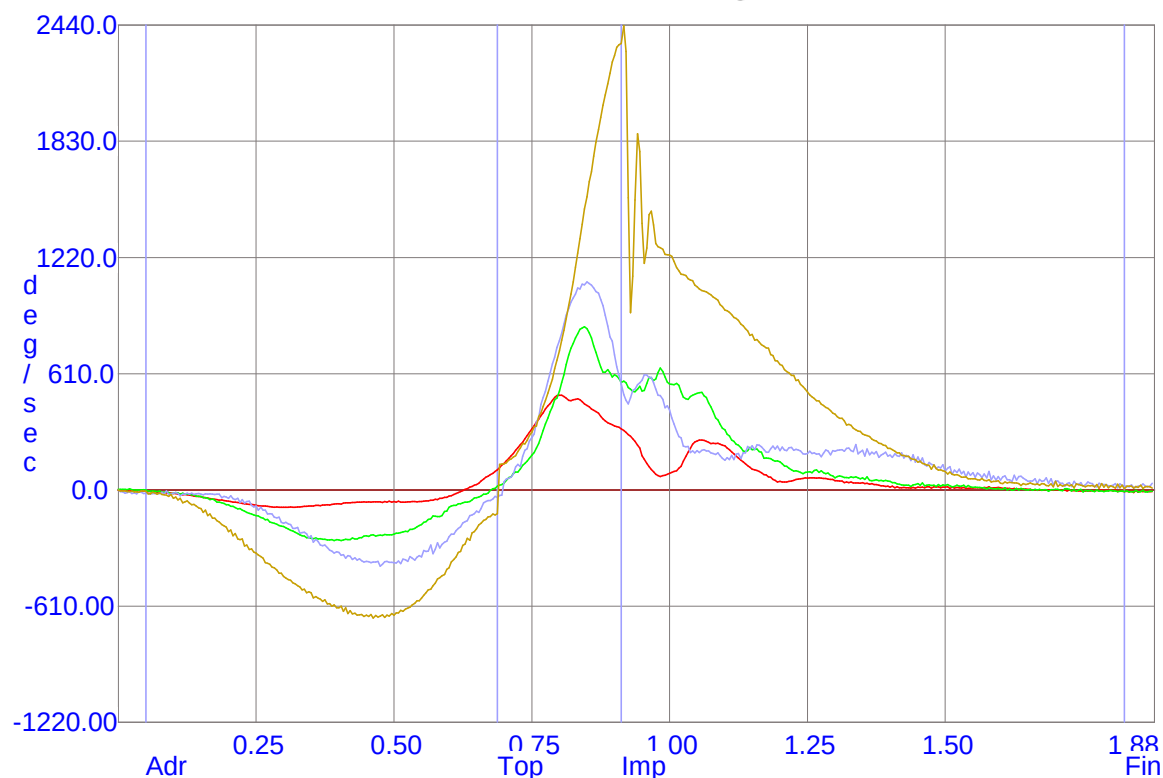
TPI 3D

■ **BIOMECHANICAL SPORTS ANALYSIS**

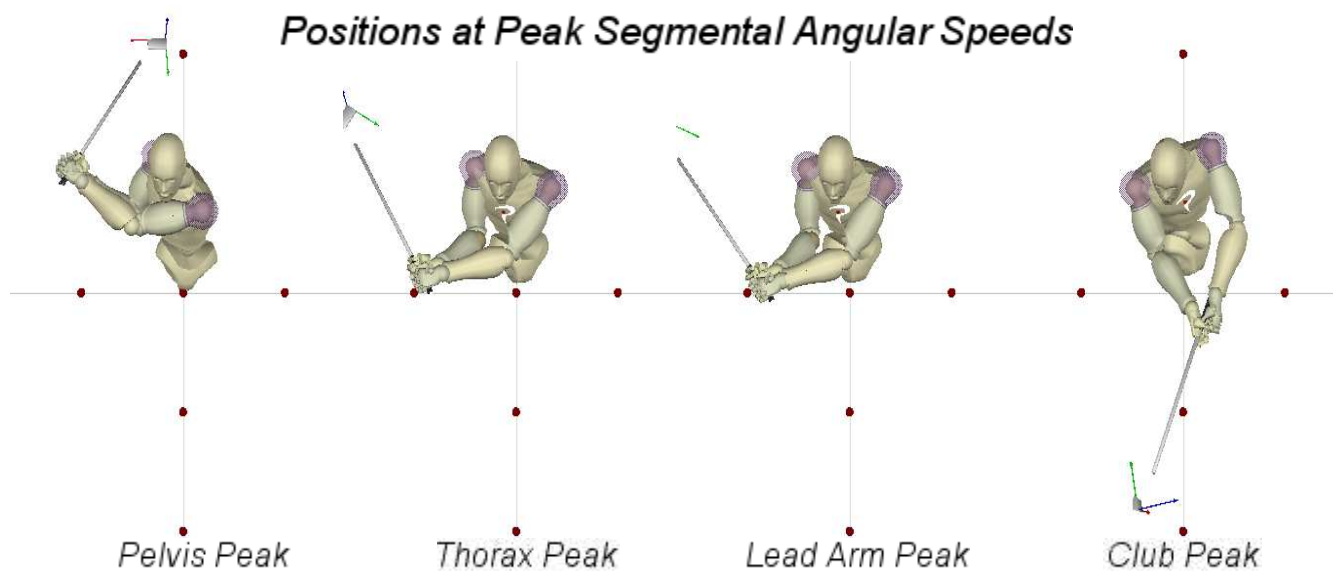


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Kinematic Sequence



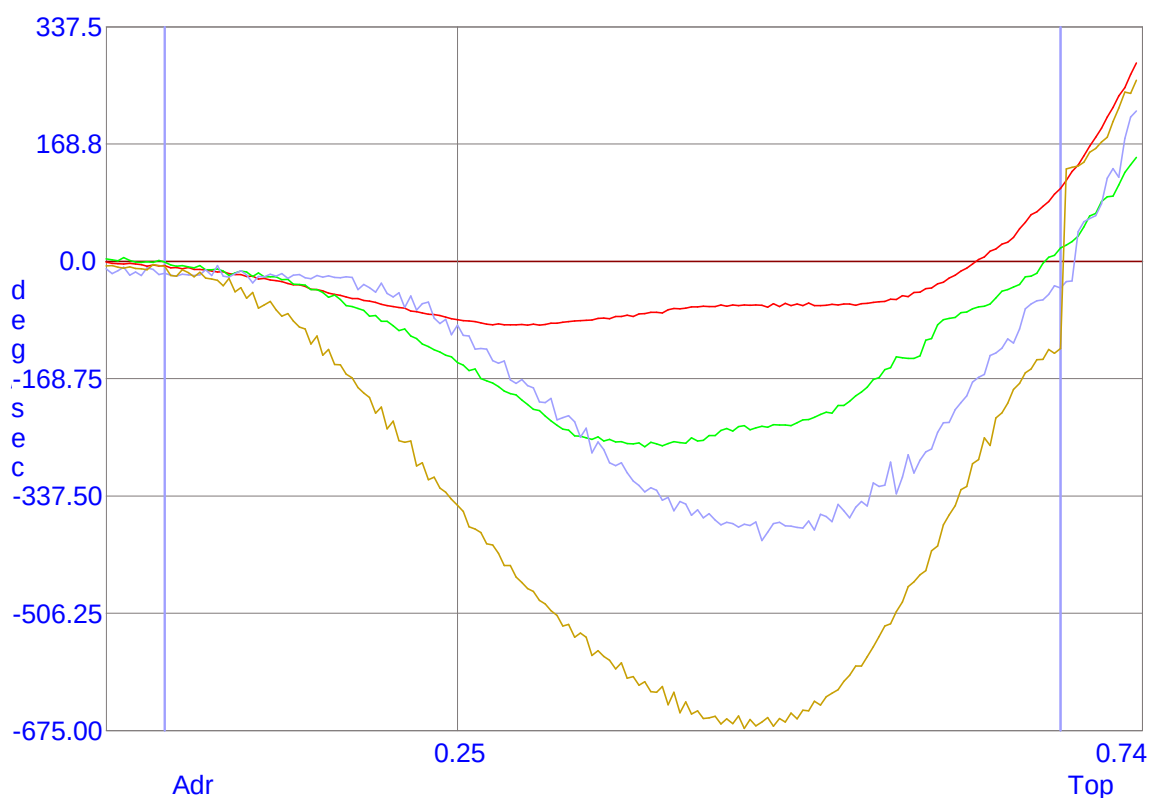
Positions at Peak Segmental Angular Speeds



		Backswing	Downswing	Follow Through
Tempo	ms	638	225	913

Backswing Sequence

Angular Velocity: **Pelvis** **Thorax** **Arm** **Club**



Backswing Parameters

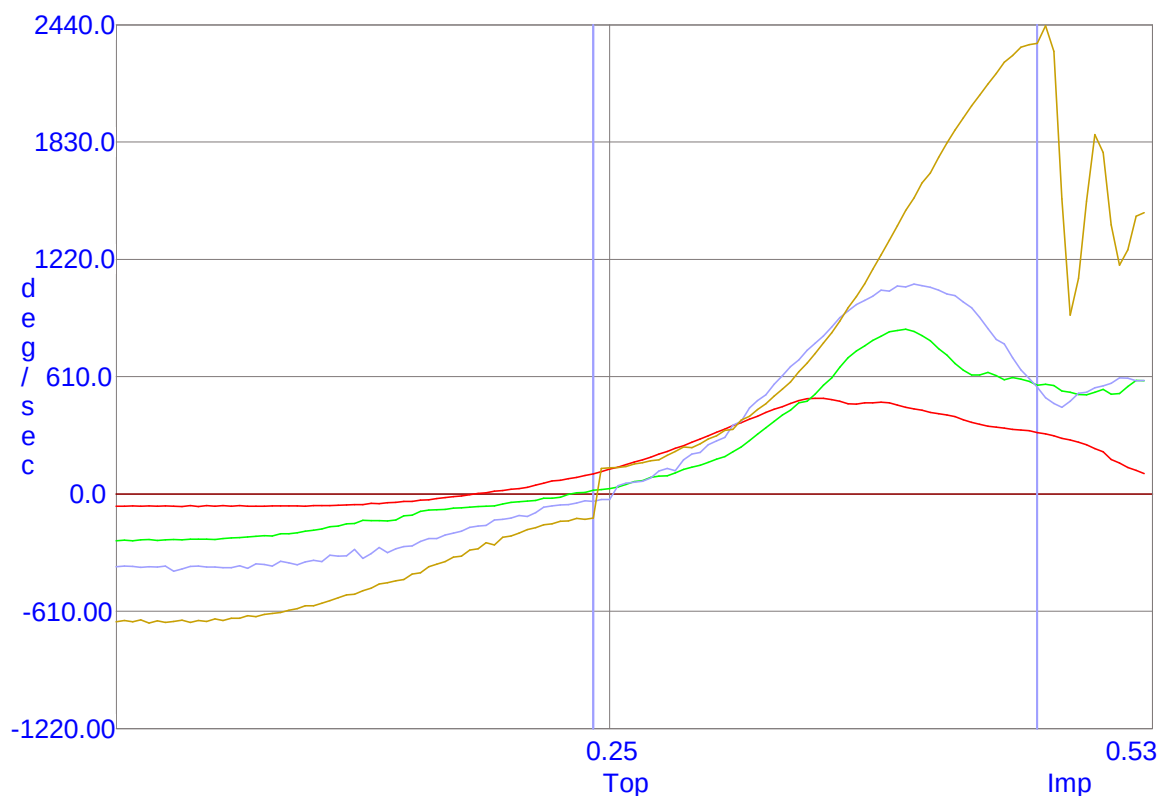
		Pelvis	Thorax	Arm	Club
Peak Order	order	1	2	4	3
Peak to Top	ms	371	296	213	225
Peak to Impact	ms	596	521	438	450
Peak Speed	d/s	92	267	402	672
Acceleration	d/s/s	321	778	904	1613
Deceleration	d/s/s	738	837	854	1325

Segmental Interactions

		Pelvis-Thorax	Thorax-Arm	Arm-Club
Time Between Peaks	ms	75	83	-13

Transition Sequence

Angular Velocity: **Pelvis** **Thorax** **Arm** **Club**



Transition Parameters

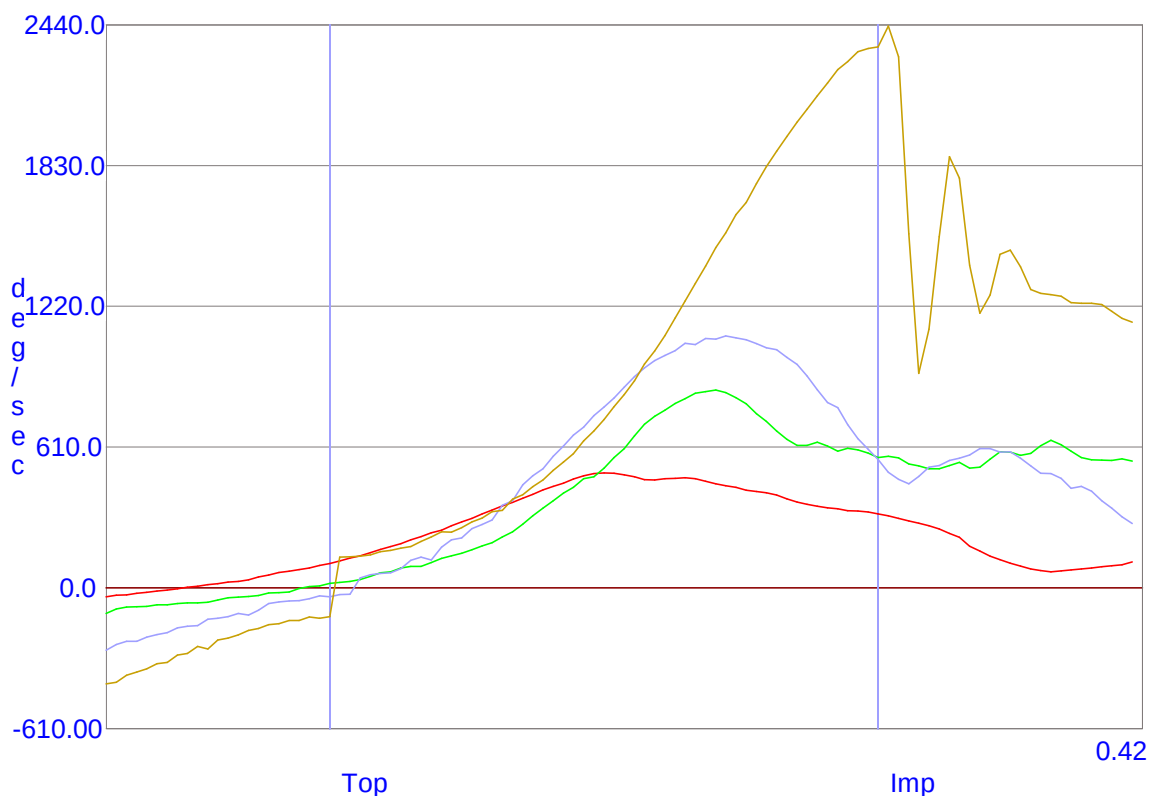
		Pelvis	Thorax	Arm	Club
Transition Order	order	1	2	4	3
Transition to Top	ms	63	13	-8	0
Transition to Peak	ms	175	171	154	225
Transition to Impact	ms	288	238	217	225
Transition Acceleration	d/s/s	1314	1587	3619	6761

Segmental Interactions

		Pelvis-Thorax	Thorax-Arm	Arm-Club
Time Between Transitions	ms	50	21	-8

Downswing Sequence

Angular Velocity: **Pelvis** **Thorax** **Arm** **Club**



Sequence Parameters

		Pelvis	Thorax	Arm	Club
Peak Order	order	1	2	3	4
Peak Time Pre-Impact	ms	113	67	63	0
Peak Speed	d/s	497	856	1091	2343
% of Max	%	21	37	47	100
Acceleration	d/s/s	2864	5029	7678	10972
Deceleration	d/s/s	1576	4379	8568	8672

Segmental Interactions

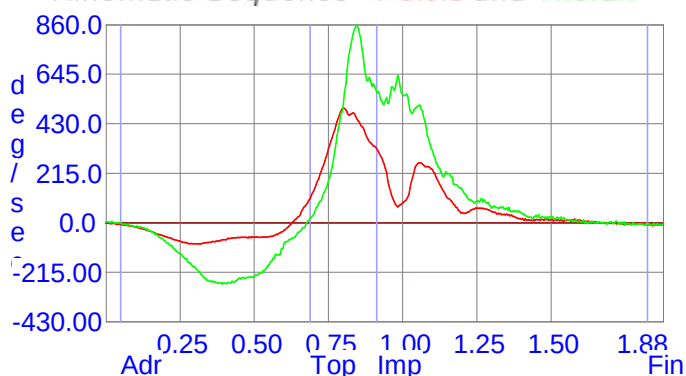
		Plv-Thx	Thx-Arm	Arm-Clb
Time Between Peaks	ms	46	4	63
Angular Speed Gain	d/s	359	235	1252
Gain Factor	ratio	1.7	1.3	2.1

Contribution by Joint

		Legs	Core	Shldr	Wrist
% Contribution	%	21	15	10	53

Spine Link Interactions

Kinematic Sequence - Pelvis and Thorax



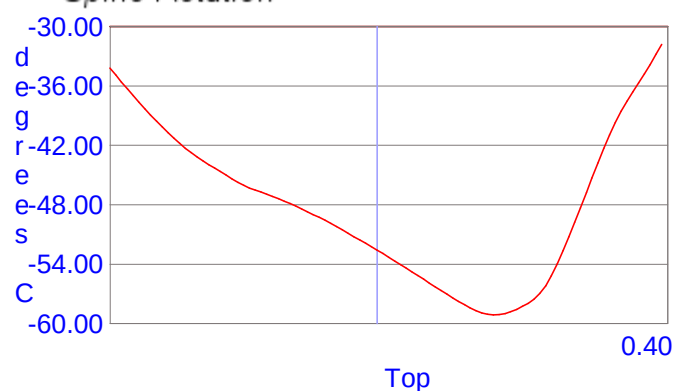
Transition Phase - Pelvis and Thorax



Total Spine Rotation (deg)

	Angle
At Pelvis Transition	48
At Thorax Transition	52
At Maximum	58

Spine Rotation



Transitional Spine Rotation (Stretch)

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	4	50	74
Ipsi-Directional	6	121	53
Total Stretch	10	171	59

Transitional Timings (ms)

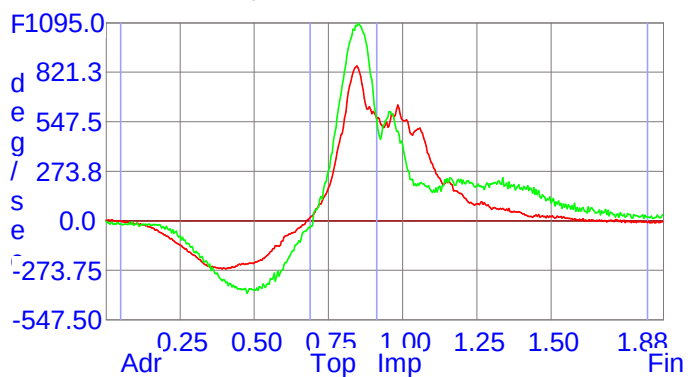
	Pelvis	Thorax
To Club Transition	63	13
To Impact	288	238

Transitional Accelerations (d/s/s)

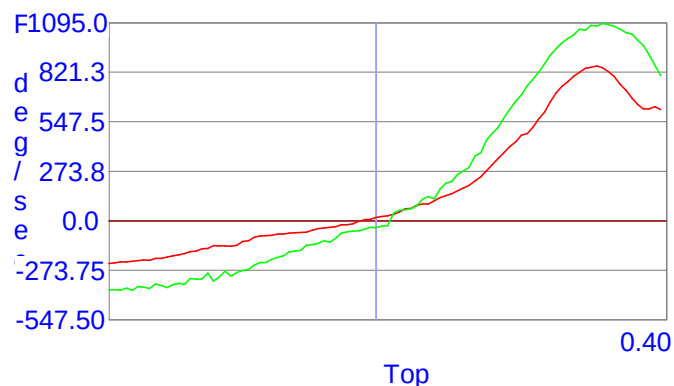
	Pelvis	Thorax
Acceleration	1314	1587

Shoulder Link Interactions

Kinematic Sequence - Thorax and Arm



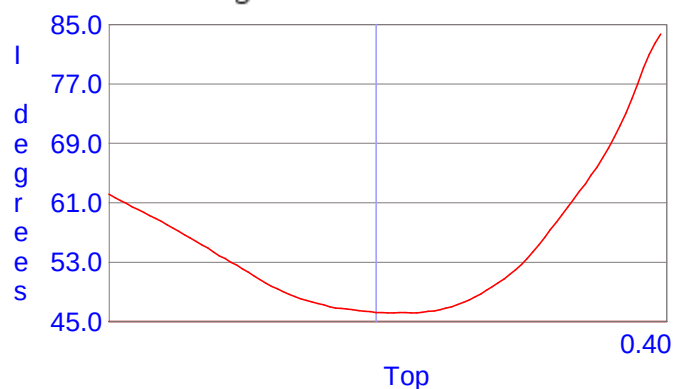
Transition Phase - Thorax and Arm



Total Shoulder Angle (deg)

	Angle
At Thorax Transition	46
At Arm Transition	46
At Min Angle	46

Shoulder Angle



Transitional Shoulder Stretch

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	0	21	15
Ipsi-Directional	0	0	0
Total Stretch	0	21	15

Transitional Timings (ms)

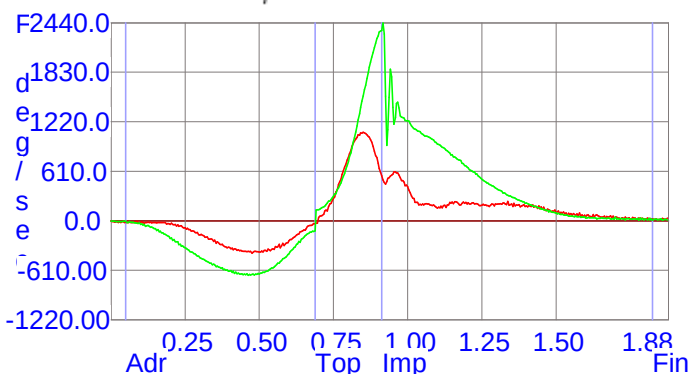
	Thorax	Lead Arm
To Club Transition	13	-8
To Impact	238	217

Transitional Accelerations (d/s/s)

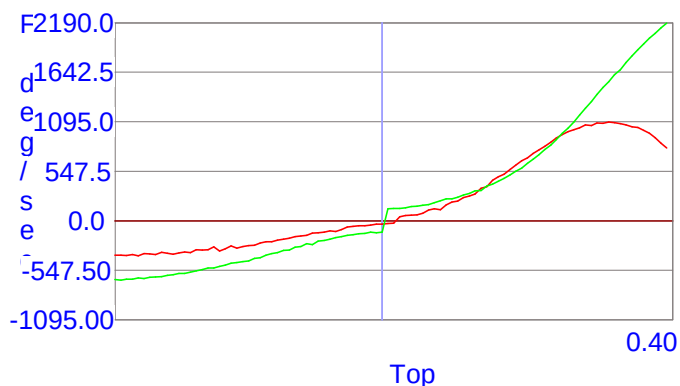
	Thorax	Lead Arm
Acceleration	1587	3619

Wrist Link Interactions

Kinematic Sequence - Arm and Club



Transition Phase - Arm and Club



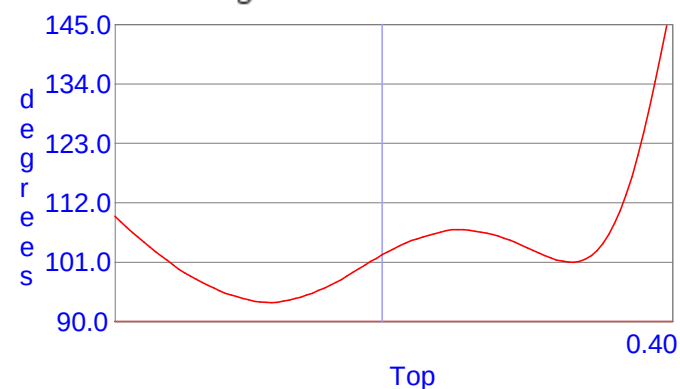
Wrist Set Angles (deg)

	Angle
At Arm Transition	103
At Club Transition	102
At Max Set	94
At Arm 30deg Pre-Impact	108

Shaft Lean (deg)

	Angle
At Impact	21 F

Wrist Set Angle



Transitional Wrist Set Stretch

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	0	0	0
Ipsi-Directional	0	0	0
Total Stretch	0	0	0

Transitional Timings (ms)

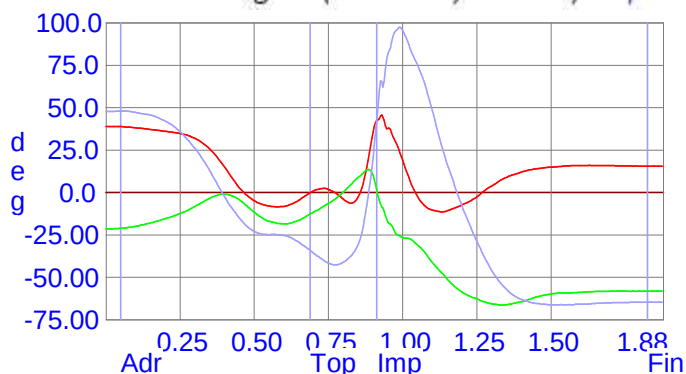
	Lead Arm	Club
To Club Transition	-8	0
To Impact	217	225

Transitional Accelerations (d/s/s)

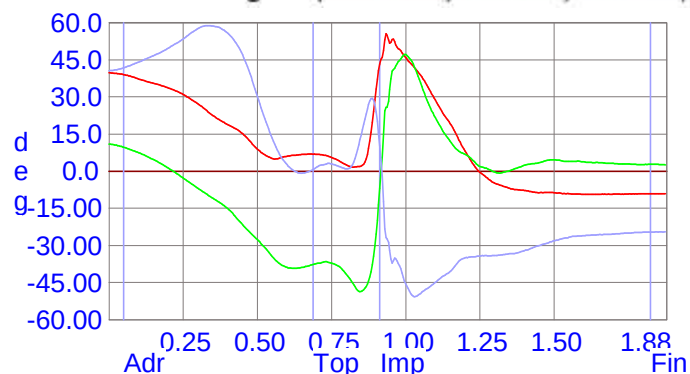
	Lead Arm	Club
Acceleration	3619	6761

Wrist Link Interactions

Lead Wrist Angles (Uln-Rad, Flx-Ext, Sup-Pro)



Trail Wrist Angles (Uln-Rad, Flx-Ext, Pro-Sup)



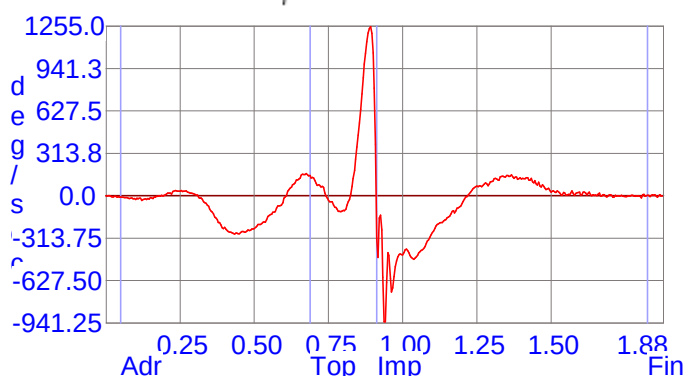
Lead Wrist Angles (Degrees)

	Adr	Top	Imp	Fin
Deviation	39 U	0 R	42 U	16 U
Flexion Extension	21 E	13 E	2 F	58 E
Forearm Sup-Pro	48 S	34 P	43 S	65 P

Trail Wrist Angles (Degrees)

	Adr	Top	Imp	Fin
Deviation	39 U	7 U	43 U	9 R
Flexion Extension	10 F	38 E	7 E	3 F
Forearm Pro-Sup	42 P	1 P	10 P	25 S

Wrist Release Speed



Angular Velocities (Deg/Sec)

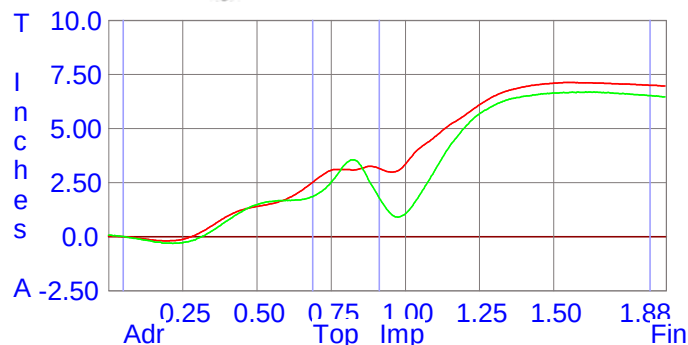
	Imp
Lead Wrist Sup-Pro Vel	1827 S
Lead Wrist Ext-Flex Vel	846 E
Trail Elbow Extn Vel	482 E
Club Handle Axial Vel	1406 C

Max Release Speed	deg/sec	1250
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Projected Impact Speed	mph	104
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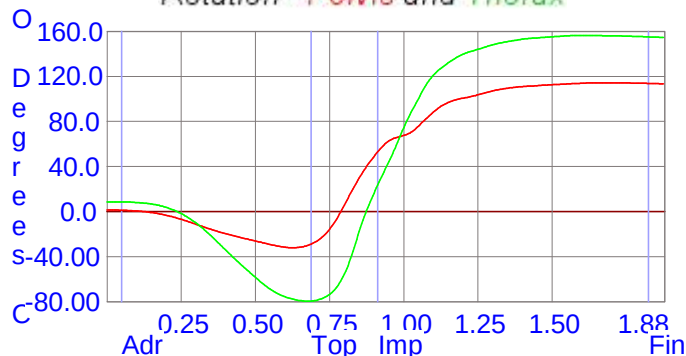
Trunk Dynamic Stability

Sway - Pelvis and Thorax



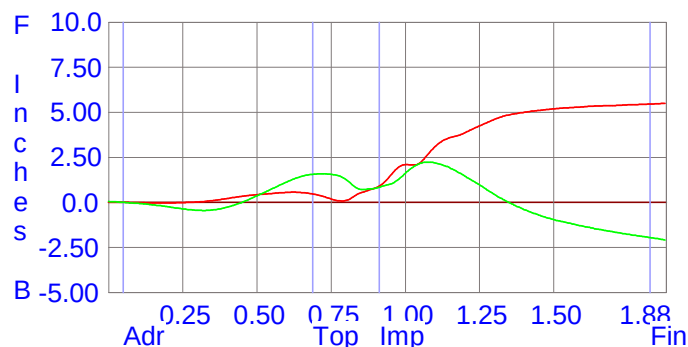
(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 T	2.5 T	3.2 T	7.0 T
Thorax	0.0 T	1.9 T	1.8 T	6.5 T

Rotation - Pelvis and Thorax



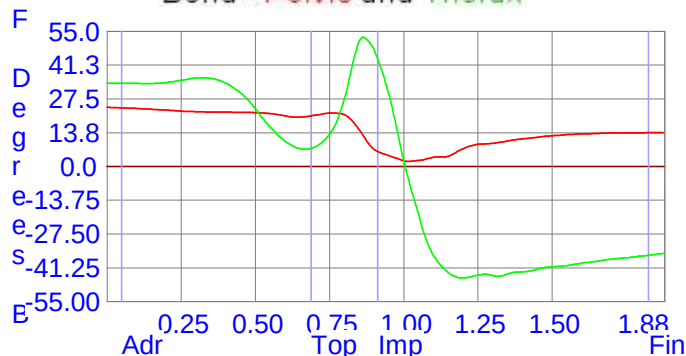
(Degrees)	Adr	Top	Imp	Fin
Pelvis	1 O	29 C	53 O	7 O
Thorax	9 O	79 C	24 O	155 O

Thrust - Pelvis and Thorax



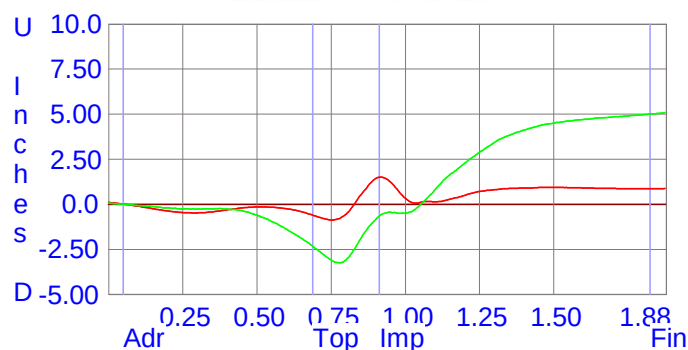
(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 F	0.5 F	0.9 F	5.5 F
Thorax	-0.0 B	1.6 F	0.8 F	2.0 B

Bend - Pelvis and Thorax



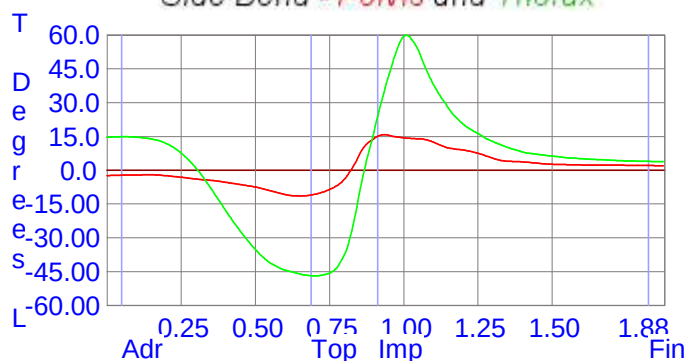
(Degrees)	Adr	Top	Imp	Fin
Pelvis	24 F	21 F	6 F	14 F
Thorax	34 F	7 F	44 F	36 B

Lift - Pelvis and Thorax



(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 U	0.6 D	1.5 U	0.9 U
Thorax	0.0 U	2.3 D	0.7 D	5.0 U

Side Bend - Pelvis and Thorax



(Degrees)	Adr	Top	Imp	Fin
Pelvis	2 L	11 L	15 T	2 T
Thorax	15 T	47 L	24 T	4 T

Dynamic Range of Motion

Head Angles (deg)

Rotation	15 C	93 O	108
Bend	65 F	19 B	84
Side Bend	12 L	46 T	58

Thorax Angles (deg)

Rotation	80 C	156 O	236
Bend	53 F	45 B	98
Side Bend	47 L	60 T	107

Pelvis Angles (deg)

Rotation	32 C	114 O	146
Bend	24 F	2 F	22
Side Bend	11 L	16 T	27

Trail Elbow Angles (deg)

Flexion-Extension	157 F	66 F	91
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Trail Wrist Angles (deg)

Rotation	59 S	51 P	110
Flexion-Extension	47 E	49 F	96
Deviation	56 U	9 R	65

Neck Angles (deg)

Rotation	60 C	65 O	125
Flexion-Extension	6 E	54 E	48
Side Bend	36 L	45 T	82

Lead Shoulder Angles (deg)

Elevation	1 A	144 B	144
Horizontal Adduction	46 I	157 I	111

Spine Angles (deg)

Rotation	59 C	33 O	92
Flexion-Extension	42 F	54 E	96
Side Bend	37 L	46 T	83
Forward Tilt	47 F	15 F	31
Side Tilt	2 T	12 T	10

Lead Elbow Angles (deg)

Flexion-Extension	161 F	56 F	104
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Lead Wrist Angles (deg)

Rotation	97 S	66 P	164
Flexion-Extension	14 F	66 E	80
Deviation	46 U	11 R	57

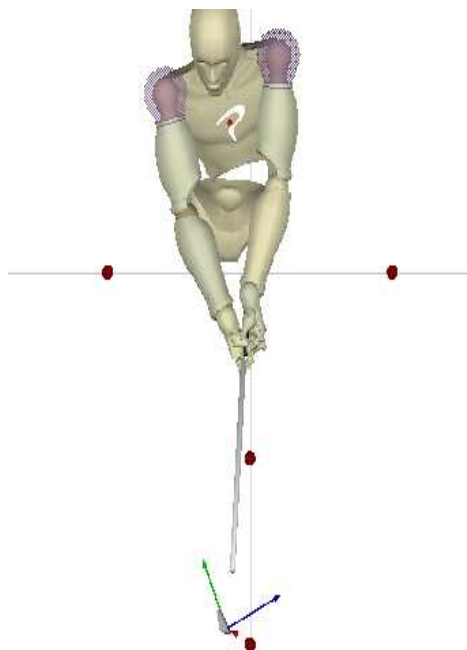
Columns are max range to each side and total range traveled

Position At Address



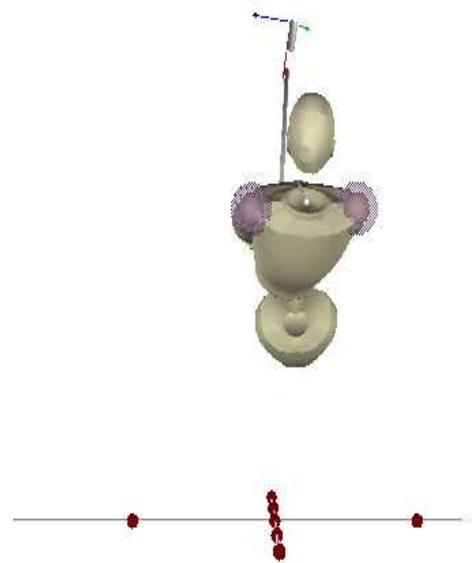
Angles (deg)

	Pelvis	Thorax
Rotation	1 O	9 O
Bend	24 F	34 F
Side Bend	2 L	15 T

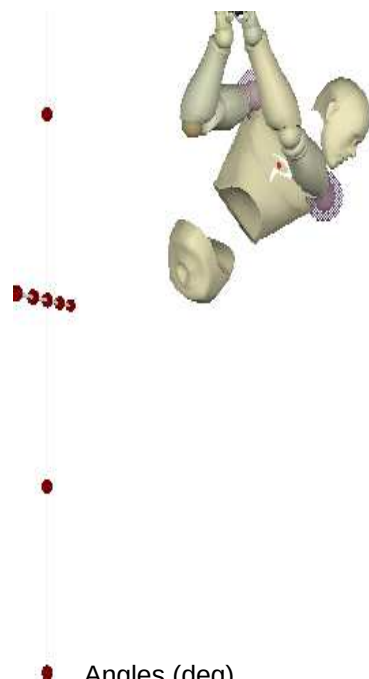


Angles (deg)

	Spine
Rotation	8 O
Flexion-Extension	10 F
Side Bend	17 T



Position At Top

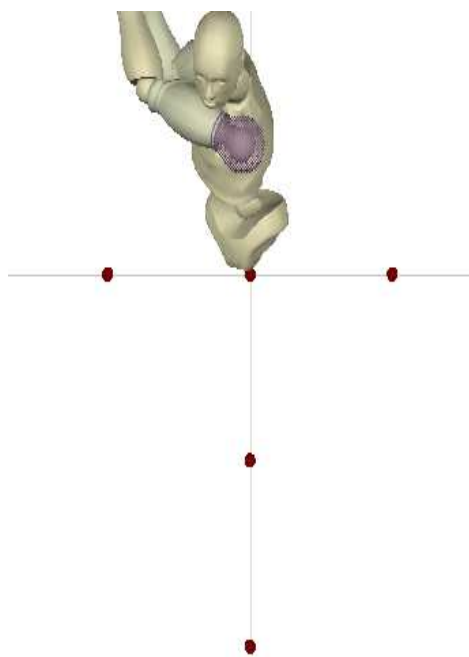


Angles (deg)

	Pelvis	Thorax
Rotation	29 C	79 C
Bend	21 F	7 F
Side Bend	11 L	47 L

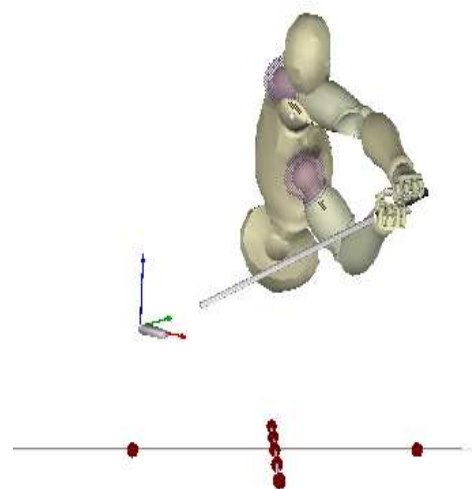
Displacements (inches)

	Pelvis	Thorax
Sway	2.5 T	1.9 T
Thrust	0.5 F	1.6 F
Lift	0.6 D	2.3 D

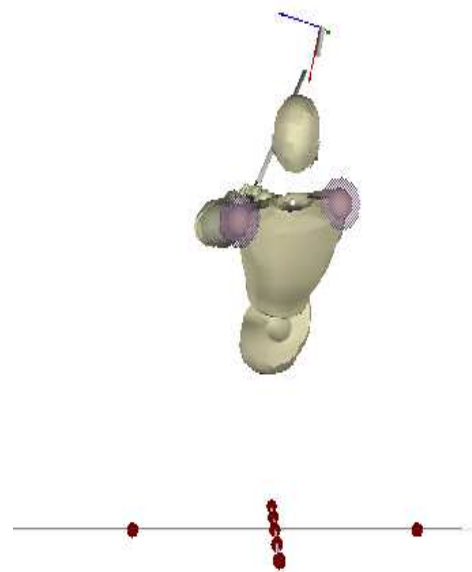
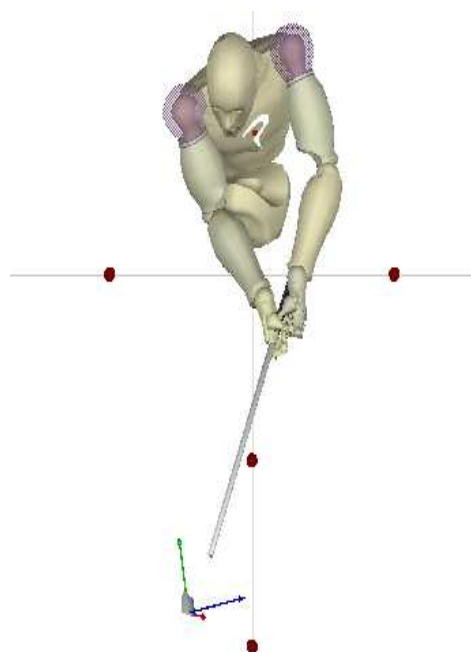
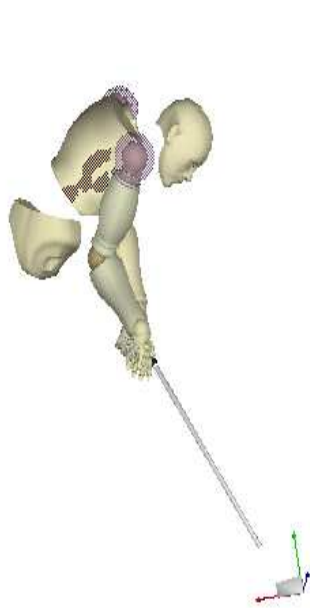


Angles (deg)

	Spine
Rotation	53 C
Flexion-Extension	13 B
Side Bend	36 L



Position At Impact



Angles (deg)

	Pelvis	Thorax
Rotation	53 O	24 O
Bend	6 F	44 F
Side Bend	15 T	24 T

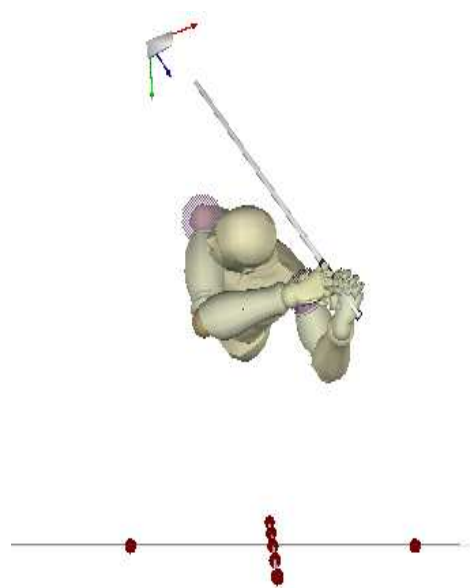
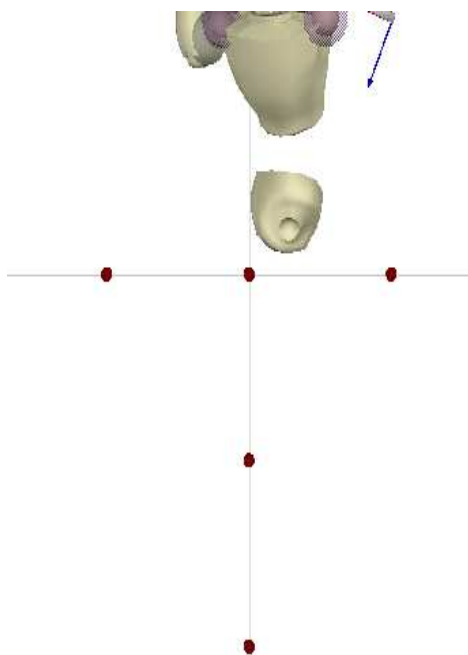
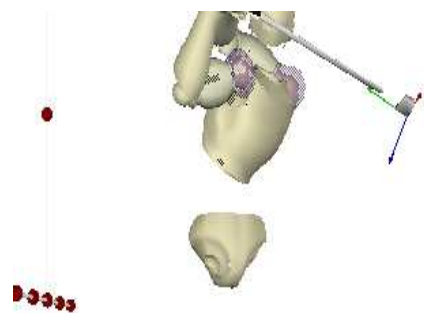
Angles (deg)

	Spine
Rotation	28 C
Flexion-Extension	38 F
Side Bend	9 T

Displacements (inches)

	Pelvis	Thorax
Sway	3.2 T	1.8 T
Thrust	0.9 F	0.8 F
Lift	1.5 U	0.7 D

Position At Finish



Angles (deg)

	Pelvis	Thorax
Rotation	114 O	155 O
Bend	14 F	36 B
Side Bend	2 T	4 T

Angles (deg)

	Spine
Rotation	33 O
Flexion-Extension	50 B
Side Bend	2 T

Displacements (inches)

	Pelvis	Thorax
Sway	7.0 T	6.5 T
Thrust	5.5 F	2.0 B
Lift	0.9 U	5.0 U