

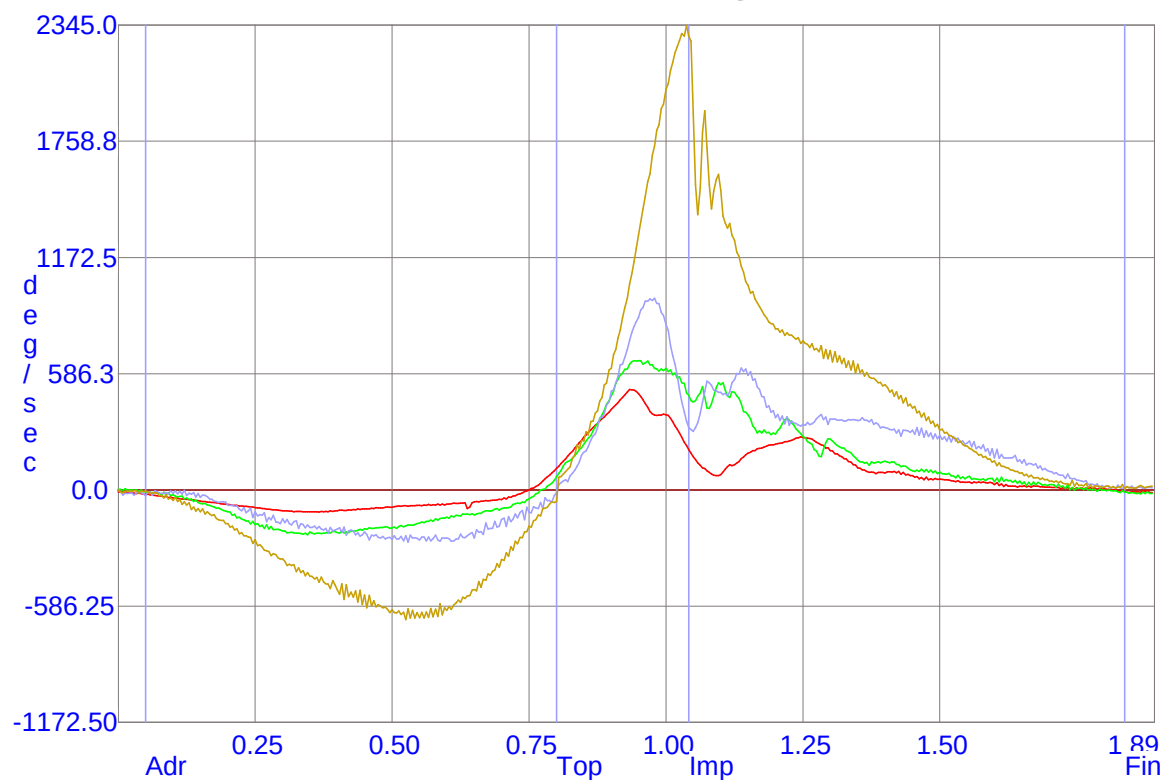
TPI 3D

■ **BIOMECHANICAL SPORTS ANALYSIS**

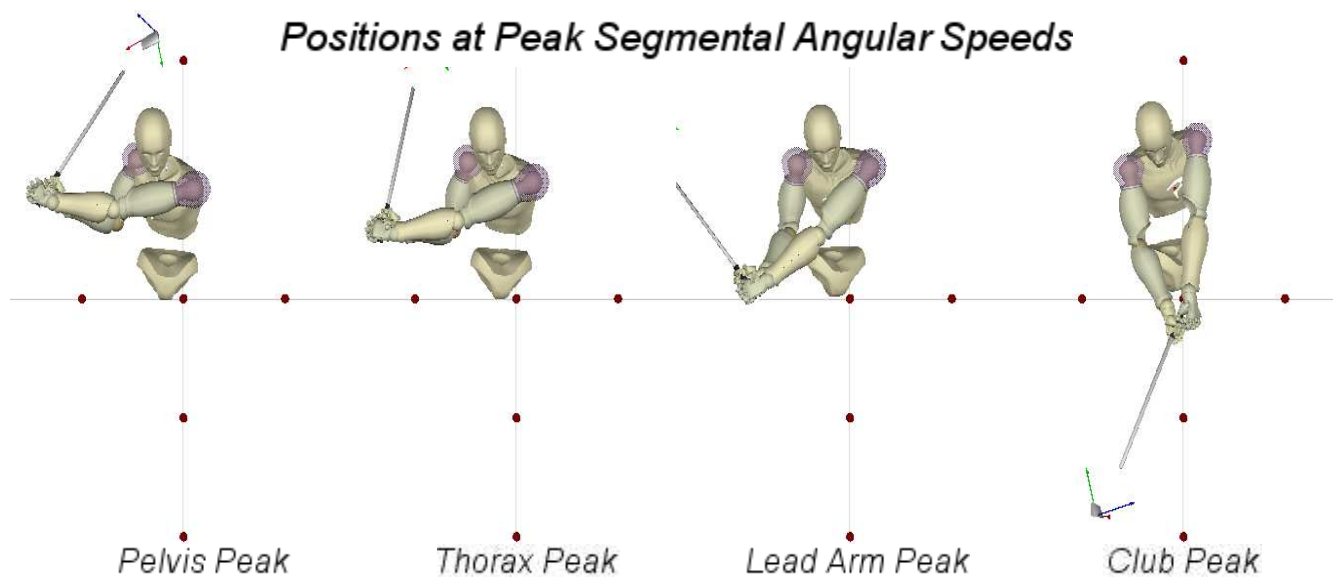


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Kinematic Sequence



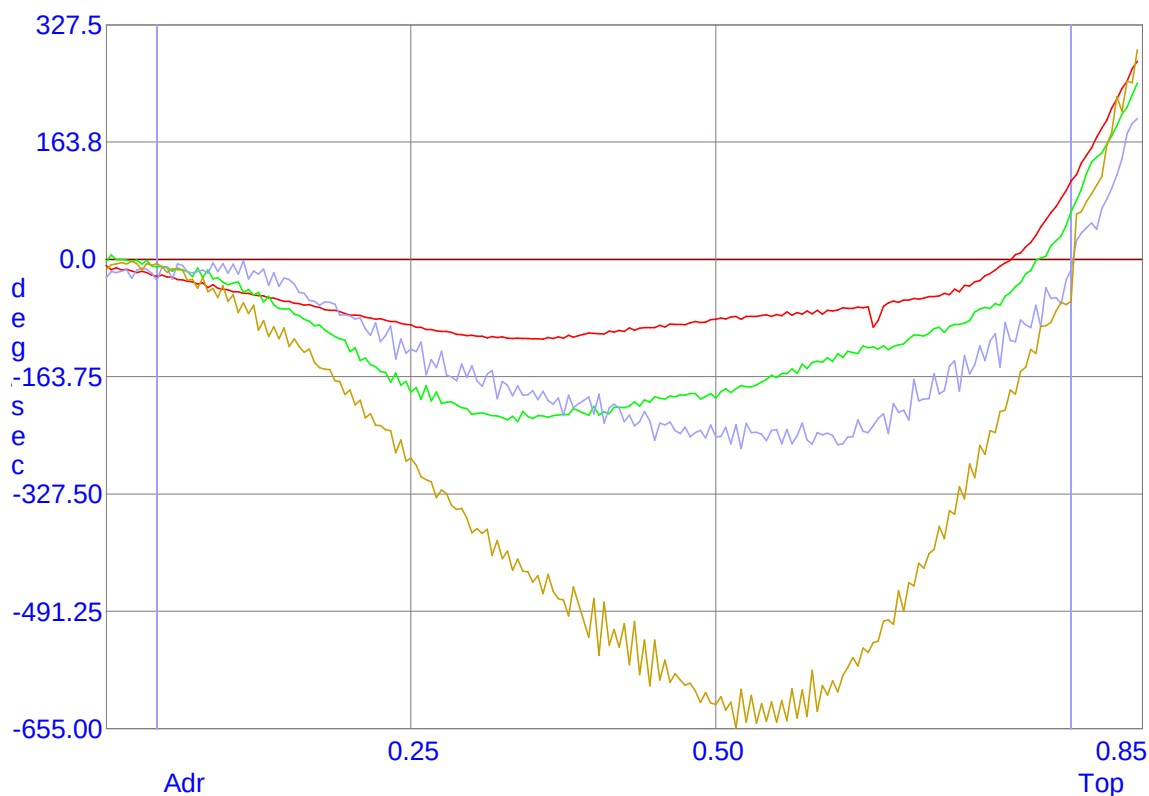
Positions at Peak Segmental Angular Speeds



		Backswing	Downswing	Follow Through
Tempo	ms	750	242	796

Backswing Sequence

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



Backswing Parameters

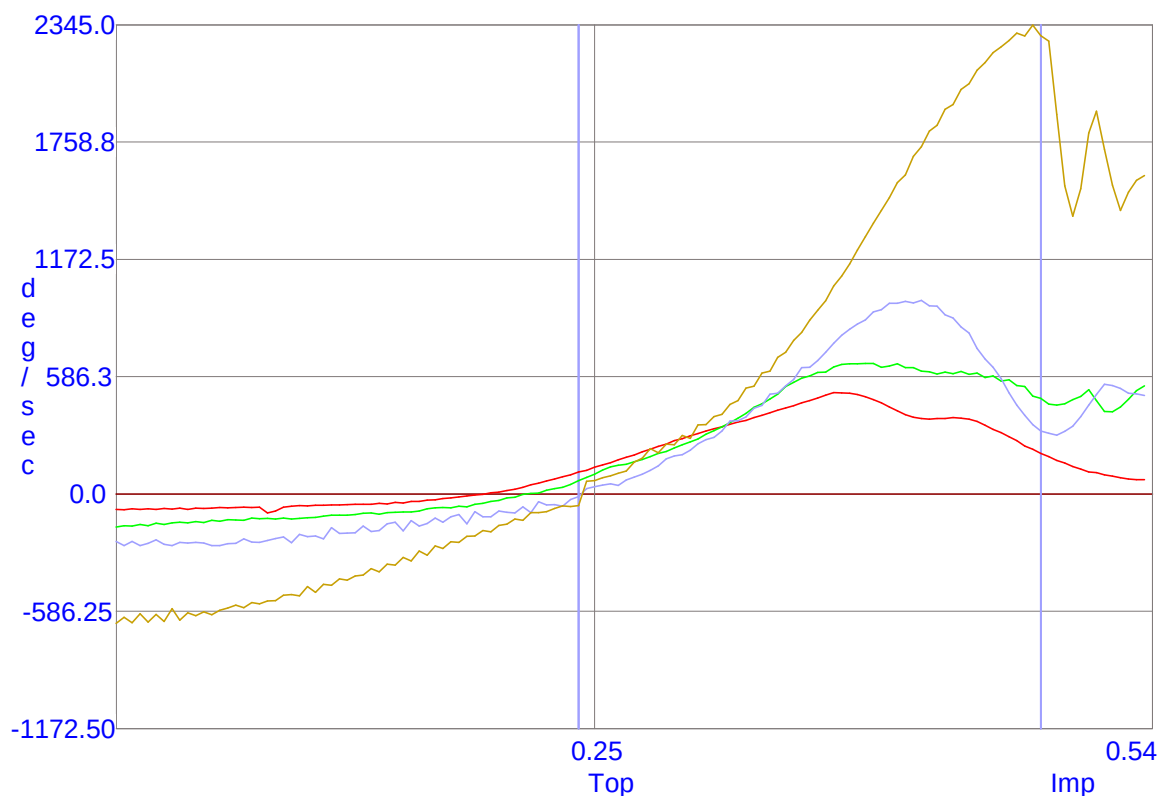
		Pelvis	Thorax	Arm	Club
Peak Order	order	2	1	4	3
Peak to Top	ms	433	454	271	275
Peak to Impact	ms	675	696	513	517
Peak Speed	d/s	112	227	264	655
Acceleration	d/s/s	277	731	489	1365
Deceleration	d/s/s	697	991	521	1254

Segmental Interactions

		Pelvis-Thorax	Thorax-Arm	Arm-Club
Time Between Peaks	ms	-21	183	-4

Transition Sequence

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



Transition Parameters

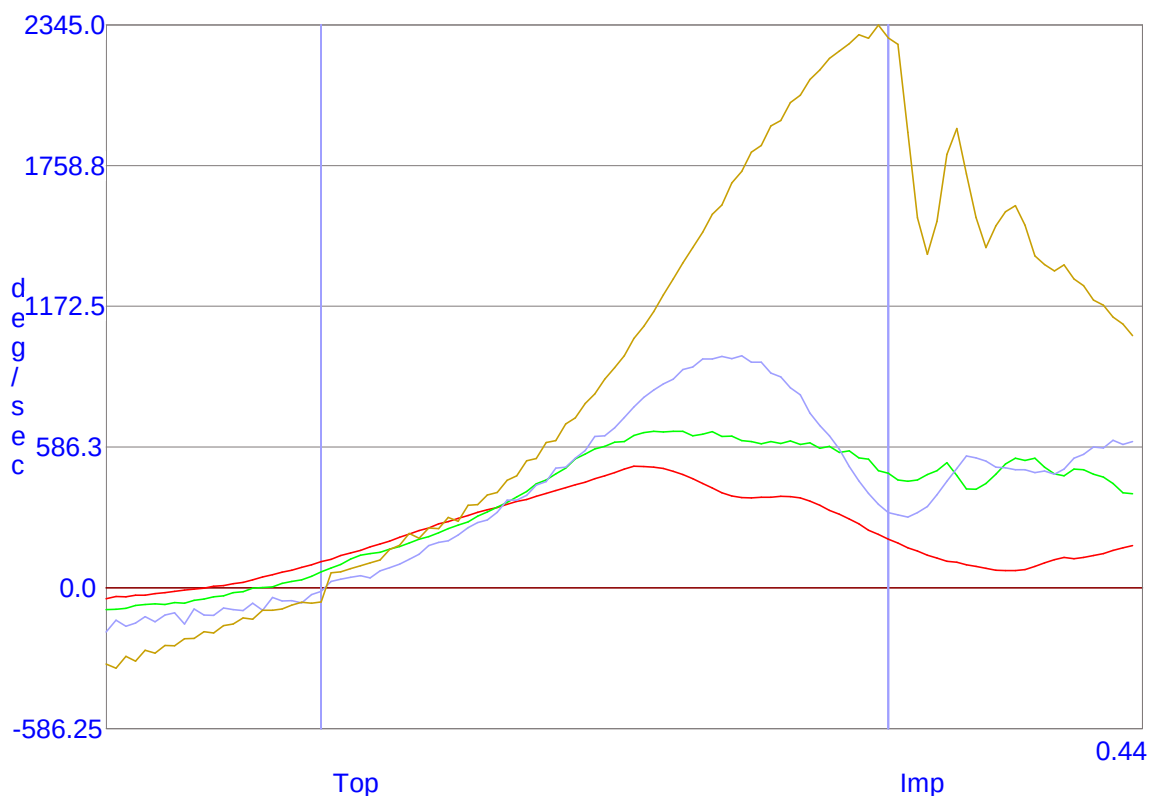
		Pelvis	Thorax	Arm	Club
Transition Order	order	1	2	3	3
Transition to Top	ms	50	29	0	0
Transition to Peak	ms	183	179	179	238
Transition to Impact	ms	292	271	242	242
Transition Acceleration	d/s/s	1528	2229	2694	4937

Segmental Interactions

		Pelvis-Thorax	Thorax-Arm	Arm-Club
Time Between Transitions	ms	21	29	0

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	108	92	63	4
Peak Speed	d/s	506	652	967	2343
% of Max	%	22	28	41	100
Acceleration	d/s/s	2767	3646	5476	10111
Deceleration	d/s/s	2797	1904	10449	9748

Segmental Interactions

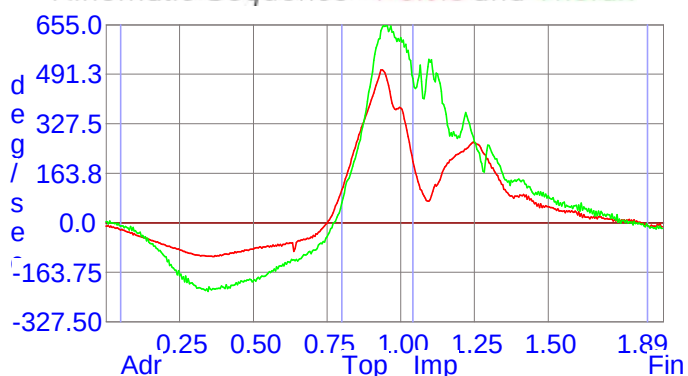
		Plv-Thx	Thx-Arm	Arm-Clb
Time Between Peaks	ms	17	29	58
Angular Speed Gain	d/s	146	315	1376
Gain Factor	ratio	1.3	1.5	2.4

Contribution by Joint

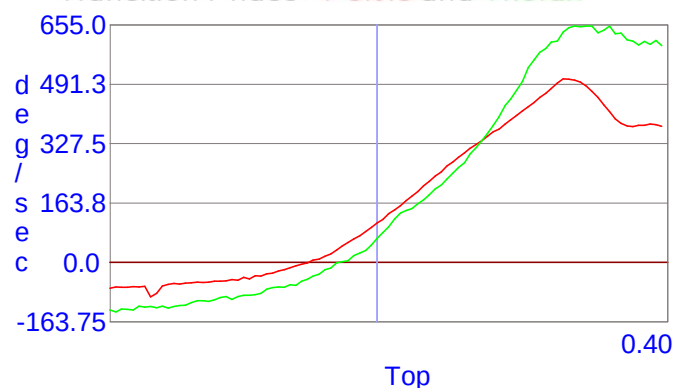
		Legs	Core	Shldr	Wrist
% Contribution	%	22	6	13	59

Spine Link Interactions

Kinematic Sequence - Pelvis and Thorax



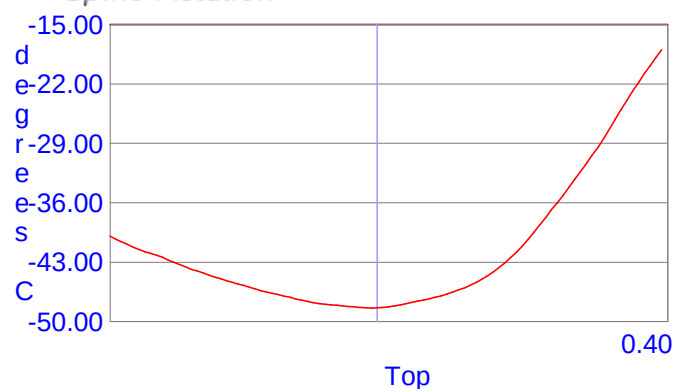
Transition Phase - Pelvis and Thorax



Total Spine Rotation (deg)

	Angle
At Pelvis Transition	48
At Thorax Transition	48
At Maximum	45

Spine Rotation



Transitional Spine Rotation (Stretch)

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	0	21	21
Ipsi-Directional	-3	100	-27
Total Stretch	-2	121	-19

Transitional Timings (ms)

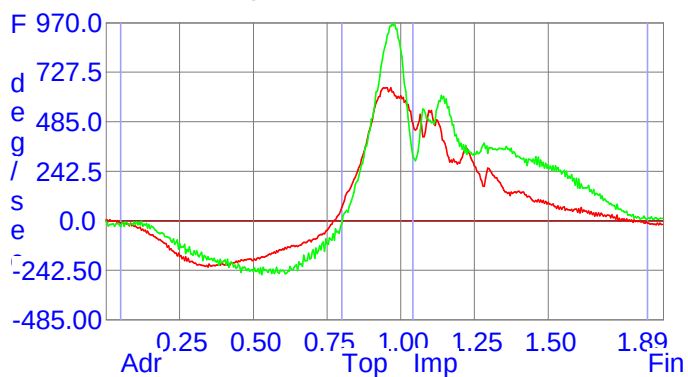
	Pelvis	Thorax
To Club Transition	50	29
To Impact	292	271

Transitional Accelerations (d/s/s)

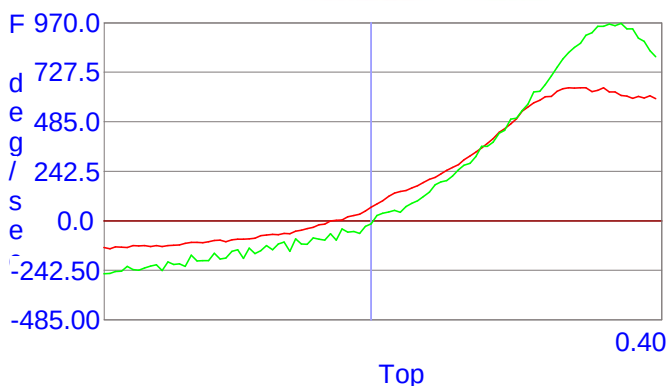
	Pelvis	Thorax
Acceleration	1528	2229

Shoulder Link Interactions

Kinematic Sequence - Thorax and Arm



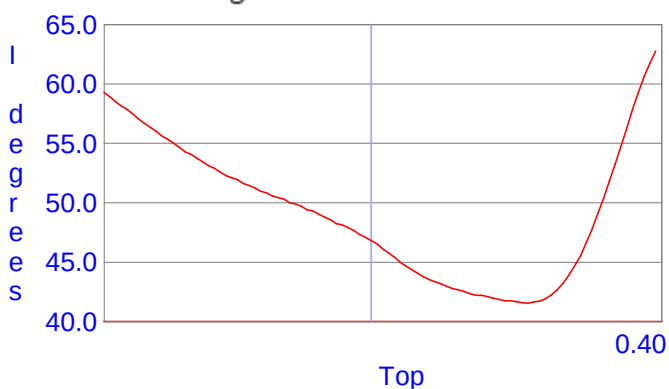
Transition Phase - Thorax and Arm



Total Shoulder Angle (deg)

	Angle
At Thorax Transition	49
At Arm Transition	47
At Min Angle	42

Shoulder Angle



Transitional Shoulder Stretch

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	2	29	60
Ipsi-Directional	5	113	47
Total Stretch	7	142	50

Transitional Timings (ms)

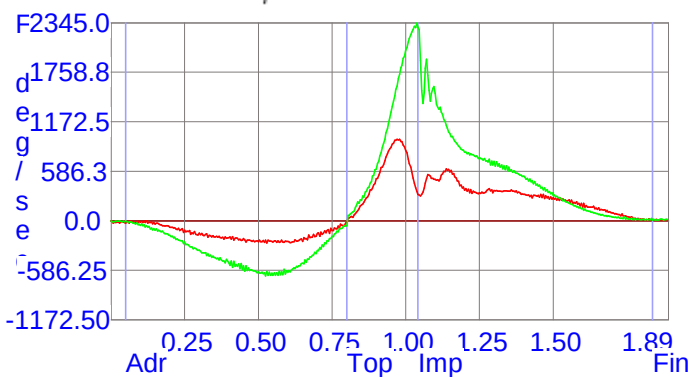
	Thorax	Lead Arm
To Club Transition	29	0
To Impact	271	242

Transitional Accelerations (d/s/s)

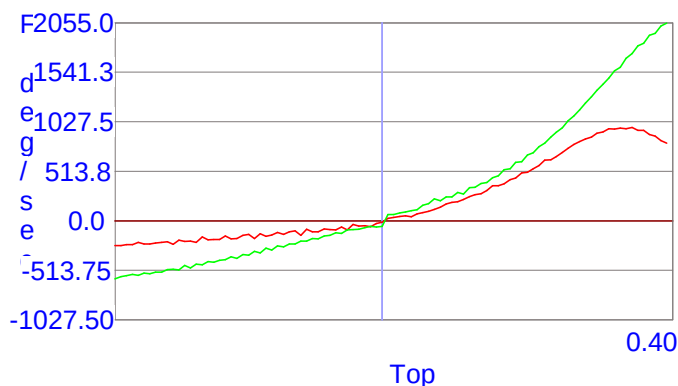
	Thorax	Lead Arm
Acceleration	2229	2694

Wrist Link Interactions

Kinematic Sequence - Arm and Club



Transition Phase - Arm and Club



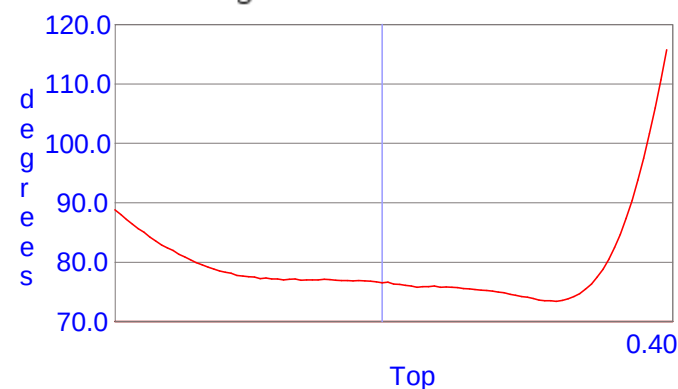
Wrist Set Angles (deg)

	Angle
At Arm Transition	77
At Club Transition	77
At Max Set	73
At Arm 30deg Pre-Impact	102

Shaft Lean (deg)

	Angle
At Impact	13 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)

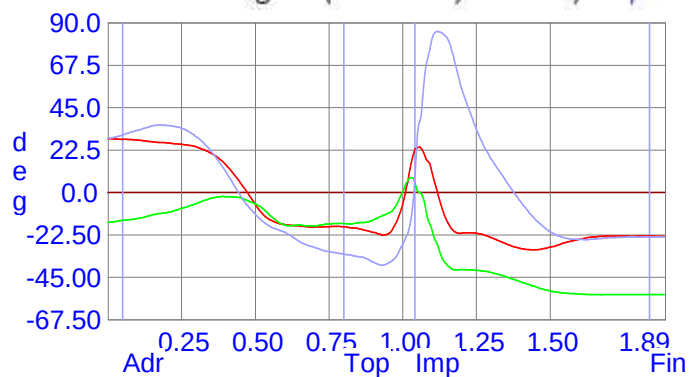
	Lead Arm	Club
To Club Transition	0	0
To Impact	242	242

Transitional Accelerations (d/s/s)

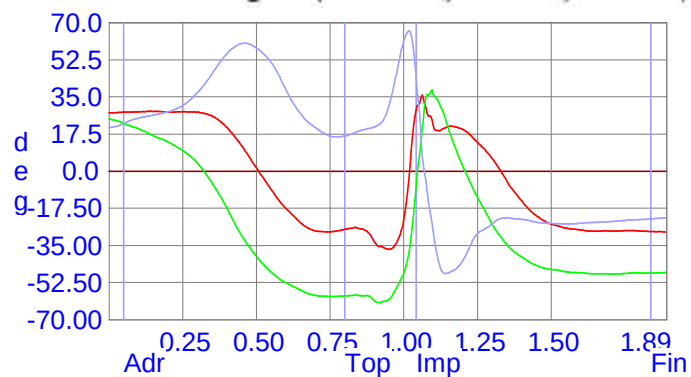
	Lead Arm	Club
Acceleration	2694	4937

Wrist Link Interactions

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



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



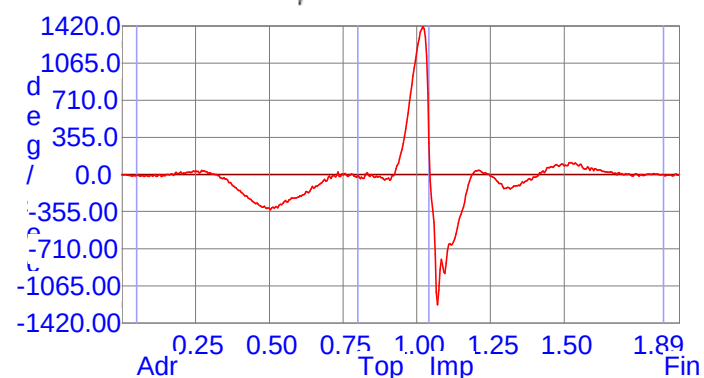
Lead Wrist Angles (Degrees)

	Adr	Top	Imp	Fin
Deviation	28 U	18 R	23 U	23 R
Flexion Extension	15 E	17 E	5 F	54 E
Forearm Sup-Pro	31 S	33 P	8 S	24 P

Trail Wrist Angles (Degrees)

	Adr	Top	Imp	Fin
Deviation	28 U	27 R	29 U	28 R
Flexion Extension	22 F	59 E	7 E	48 E
Forearm Pro-Sup	22 P	16 P	44 P	22 S

Wrist Release Speed



Angular Velocities (Deg/Sec)

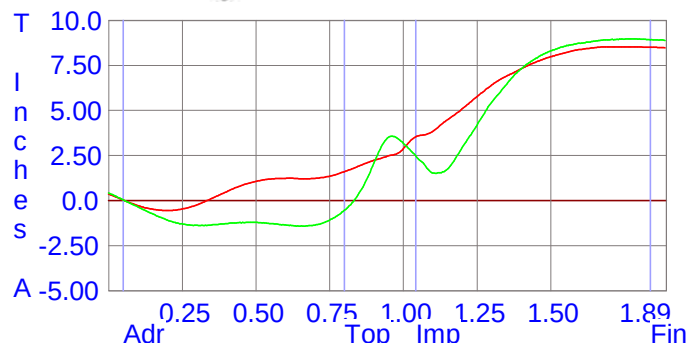
	Imp
Lead Wrist Sup-Pro Vel	2053 S
Lead Wrist Ext-Flex Vel	508 E
Trail Elbow Extn Vel	813 E
Club Handle Axial Vel	1631 C

Max Release Speed	deg/sec	1415
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Projected Impact Speed	mph	99
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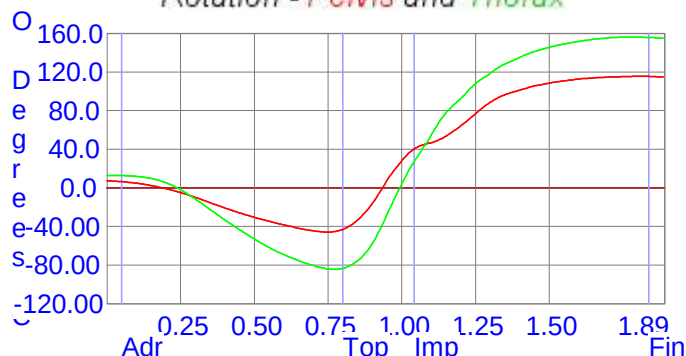
Trunk Dynamic Stability

Sway - Pelvis and Thorax



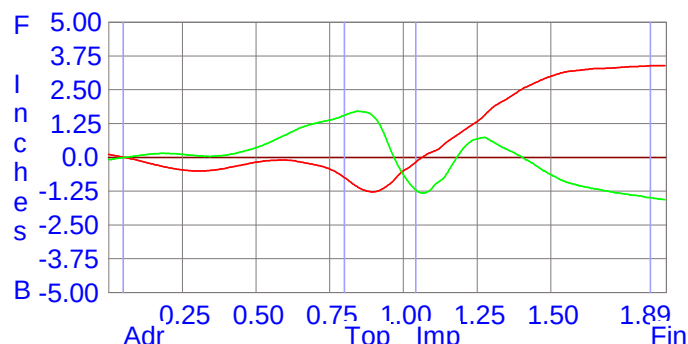
(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 T	1.6 T	3.5 T	8.5 T
Thorax	0.0 T	0.5 A	2.5 T	8.9 T

Rotation - Pelvis and Thorax



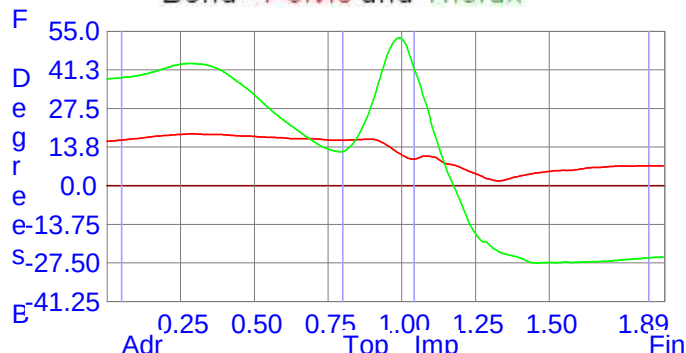
(Degrees)	Adr	Top	Imp	Fin
Pelvis	6 O	43 C	40 O	9 O
Thorax	13 O	83 C	27 O	156 O

Thrust - Pelvis and Thorax



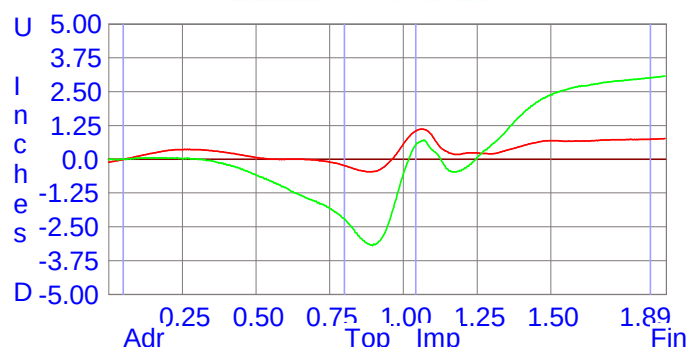
(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 F	0.7 B	0.2 B	3.4 F
Thorax	0.0 B	1.6 F	1.2 B	1.5 B

Bend - Pelvis and Thorax



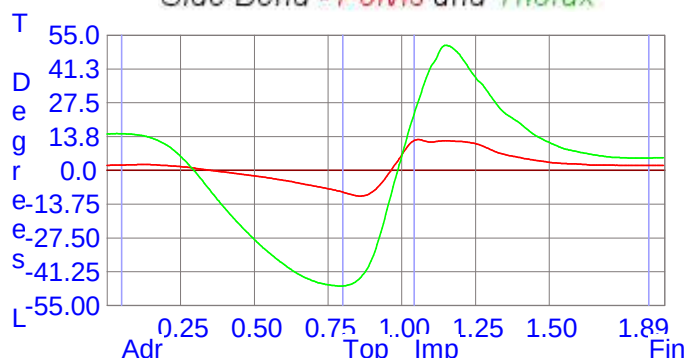
(Degrees)	Adr	Top	Imp	Fin
Pelvis	16 F	16 F	9 F	7 F
Thorax	38 F	12 F	42 F	26 B

Lift - Pelvis and Thorax



(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 D	0.2 D	1.0 U	0.7 U
Thorax	0.0 D	2.2 D	0.5 U	3.0 U

Side Bend - Pelvis and Thorax



(Degrees)	Adr	Top	Imp	Fin
Pelvis	2 T	9 L	12 T	2 T
Thorax	15 T	47 L	23 T	5 T

Dynamic Range of Motion

Head Angles (deg)

Rotation	16 C	101 O	117
Bend	67 F	11 B	78
Side Bend	16 L	48 T	64

Neck Angles (deg)

Rotation	57 C	69 O	126
Flexion-Extension	3 E	47 E	44
Side Bend	34 L	30 T	64

Thorax Angles (deg)

Rotation	84 C	156 O	240
Bend	53 F	28 B	80
Side Bend	47 L	51 T	98

Lead Shoulder Angles (deg)

Elevation	12 A	164 B	176
Horizontal Adduction	42 I	182 I	140

Pelvis Angles (deg)

Rotation	46 C	116 O	161
Bend	18 F	2 F	17
Side Bend	10 L	13 T	23

Spine Angles (deg)

Rotation	48 C	37 O	85
Flexion-Extension	41 F	34 E	75
Side Bend	39 L	39 T	78
Forward Tilt	41 F	16 F	24
Side Tilt	1 L	11 T	12

Trail Elbow Angles (deg)

Flexion-Extension	171 F	66 F	105
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Lead Elbow Angles (deg)

Flexion-Extension	180 F	53 F	127
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Trail Wrist Angles (deg)

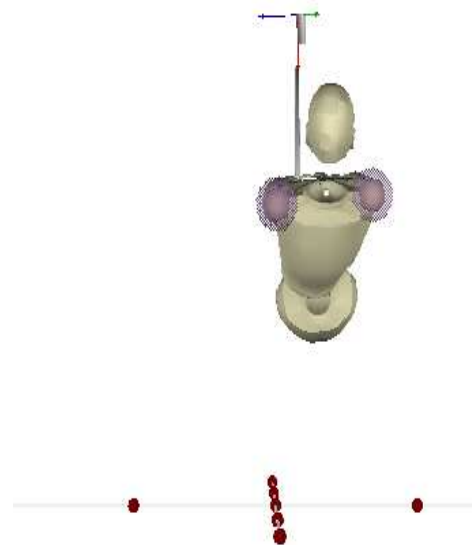
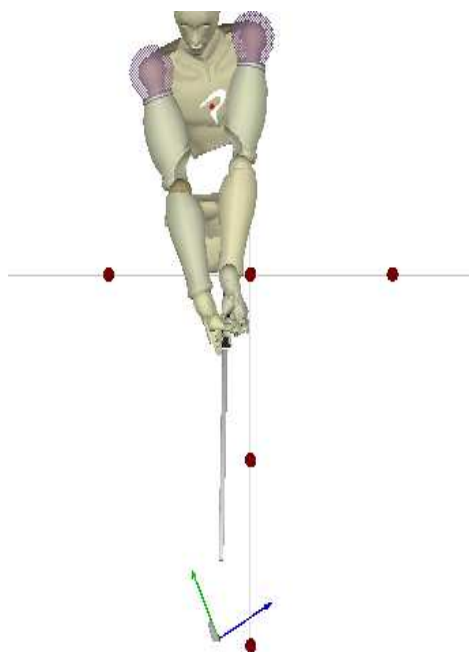
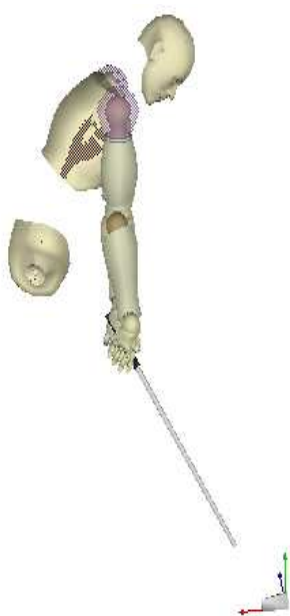
Rotation	66 S	48 P	114
Flexion-Extension	38 E	62 F	100
Deviation	36 U	37 R	73

Lead Wrist Angles (deg)

Rotation	85 S	39 P	124
Flexion-Extension	8 F	54 E	62
Deviation	29 U	30 R	59

Columns are max range to each side and total range traveled

Position At Address



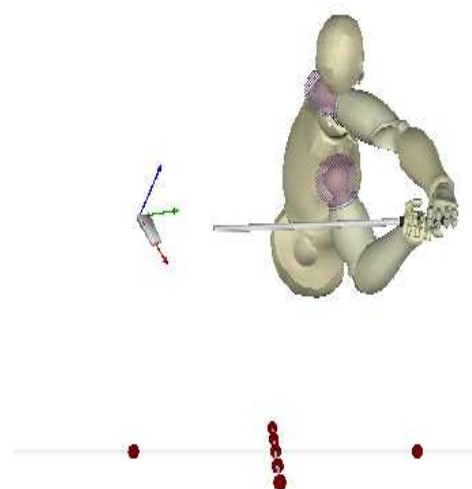
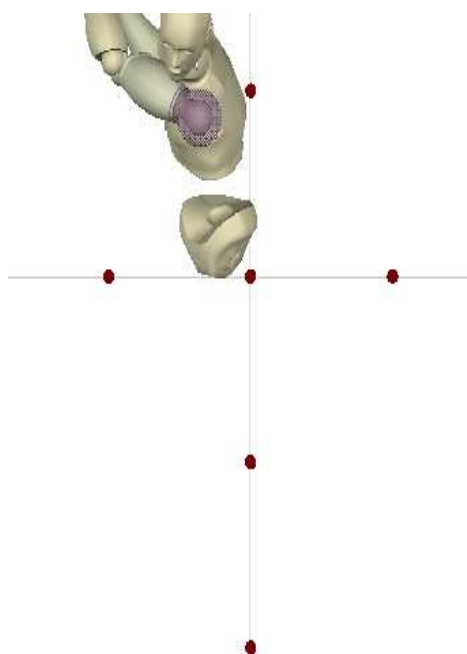
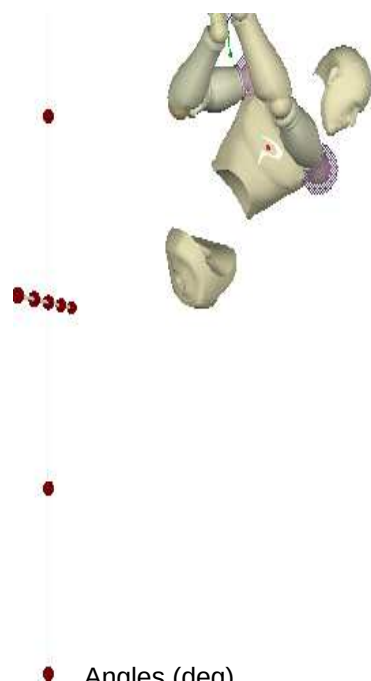
Angles (deg)

	Pelvis	Thorax
Rotation	6 O	13 O
Bend	16 F	38 F
Side Bend	2 T	15 T

Angles (deg)

	Spine
Rotation	7 O
Flexion-Extension	22 F
Side Bend	13 T

Position At Top



Angles (deg)

	Pelvis	Thorax
Rotation	43 C	83 C
Bend	16 F	12 F
Side Bend	9 L	47 L

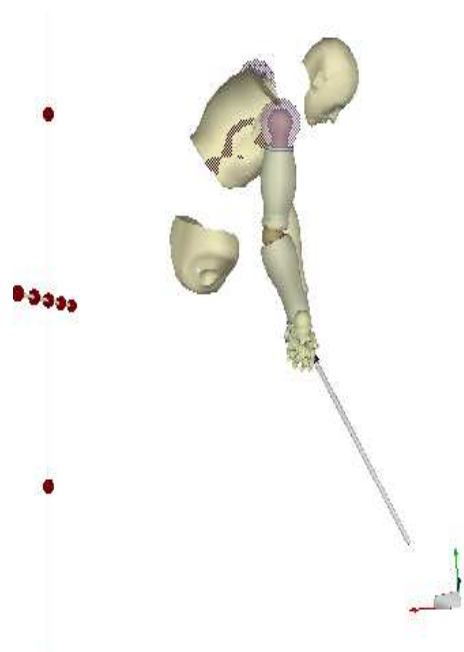
Angles (deg)

	Spine
Rotation	48 C
Flexion-Extension	4 B
Side Bend	38 L

Displacements (inches)

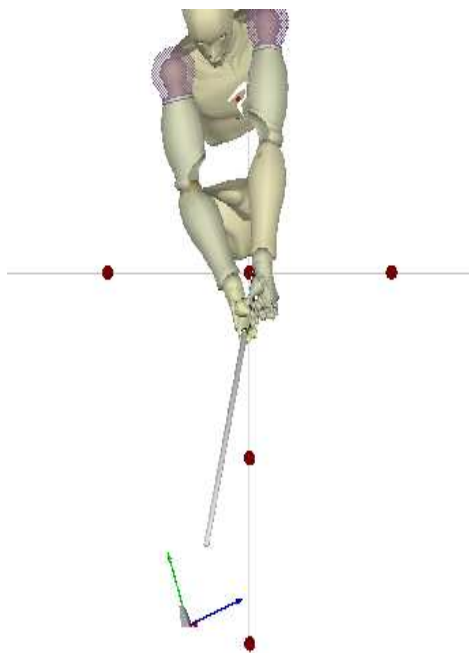
	Pelvis	Thorax
Sway	1.6 T	0.5 A
Thrust	0.7 B	1.6 F
Lift	0.2 D	2.2 D

Position At Impact



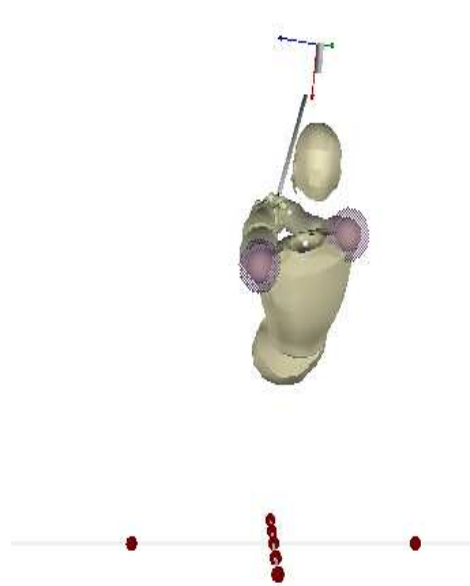
Angles (deg)

	Pelvis	Thorax
Rotation	40 O	27 O
Bend	9 F	42 F
Side Bend	12 T	23 T



Angles (deg)

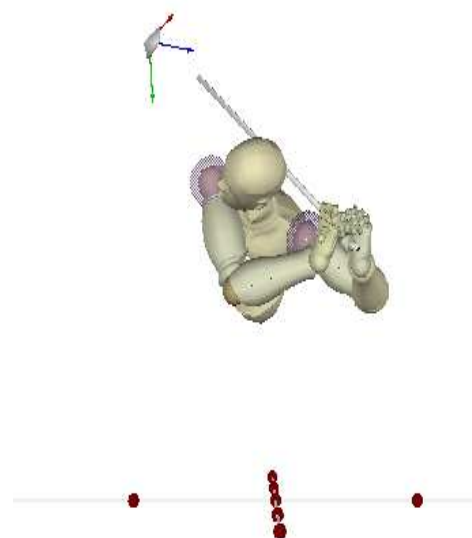
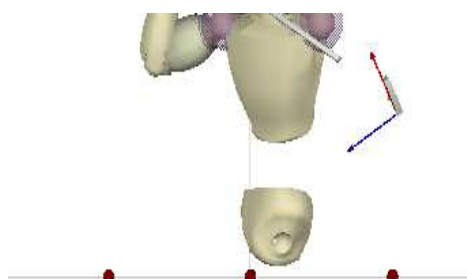
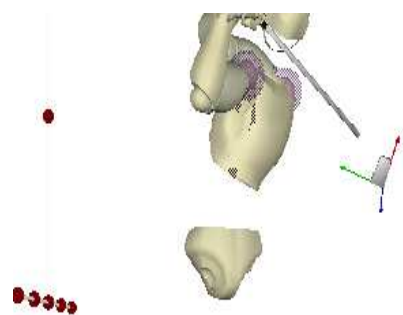
	Spine
Rotation	10 C
Flexion-Extension	32 F
Side Bend	11 T



Displacements (inches)

	Pelvis	Thorax
Sway	3.5 T	2.5 T
Thrust	0.2 B	1.2 B
Lift	1.0 U	0.5 U

Position At Finish



Angles (deg)

	Pelvis	Thorax
Rotation	115 O	156 O
Bend	7 F	26 B
Side Bend	2 T	5 T

Displacements (inches)

	Pelvis	Thorax
Sway	8.5 T	8.9 T
Thrust	3.4 F	1.5 B
Lift	0.7 U	3.0 U

Angles (deg)

	Spine
Rotation	37 O
Flexion-Extension	33 B
Side Bend	3 T