

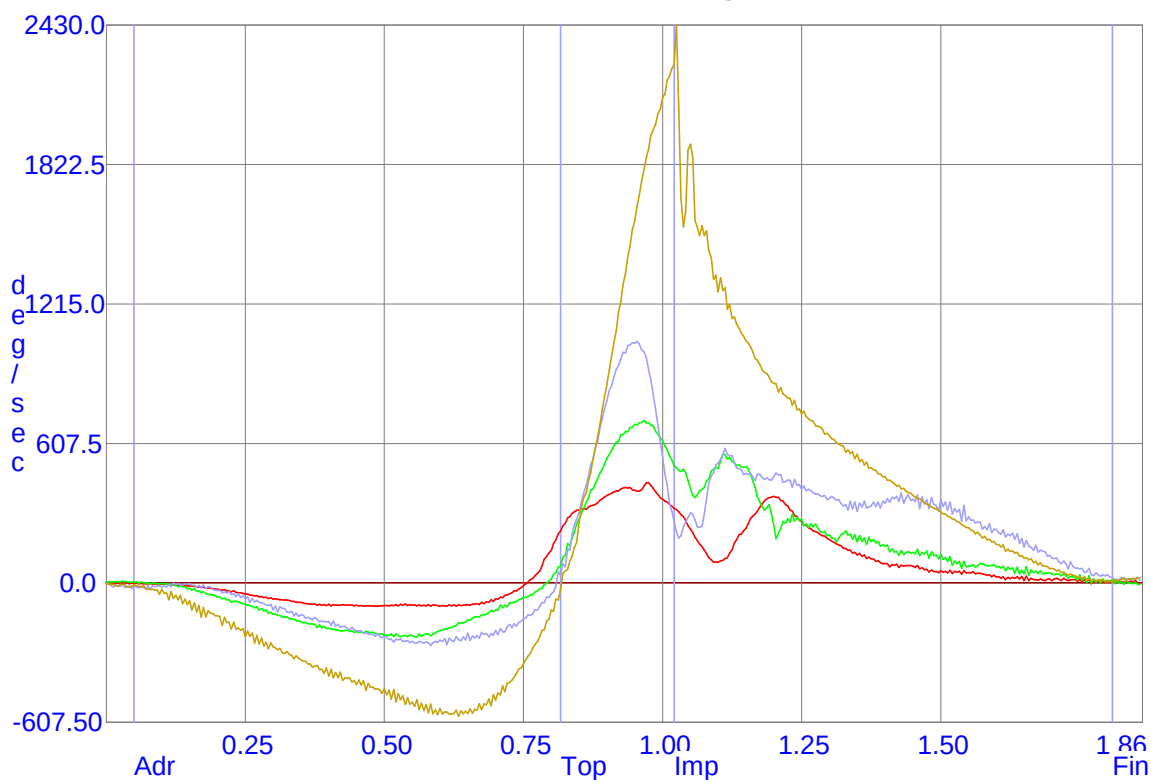
TPI 3D

■ BIOMECHANICAL SPORTS ANALYSIS

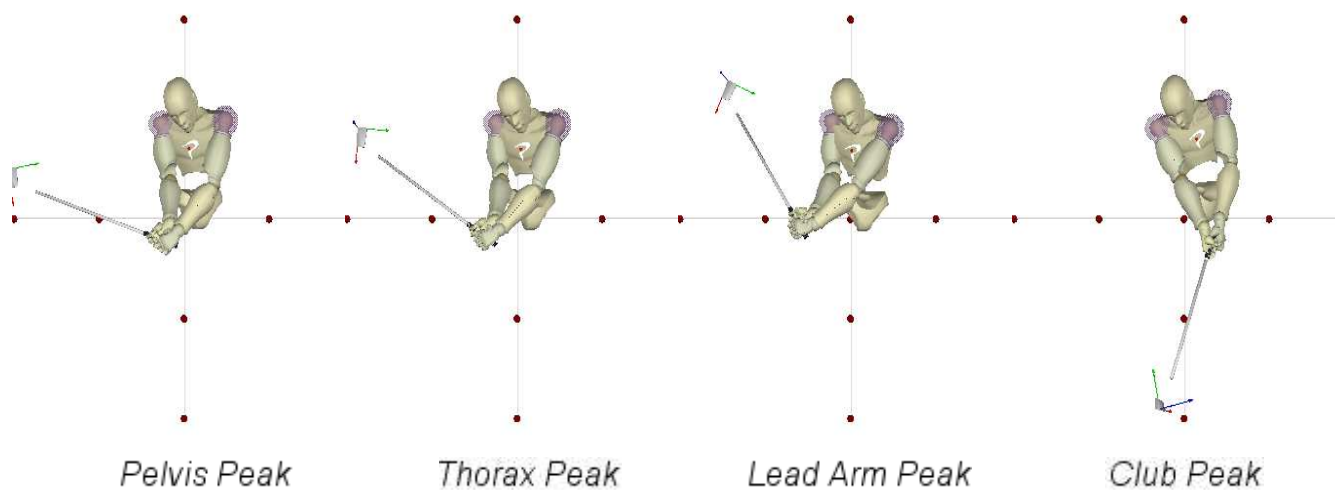


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Kinematic Sequence



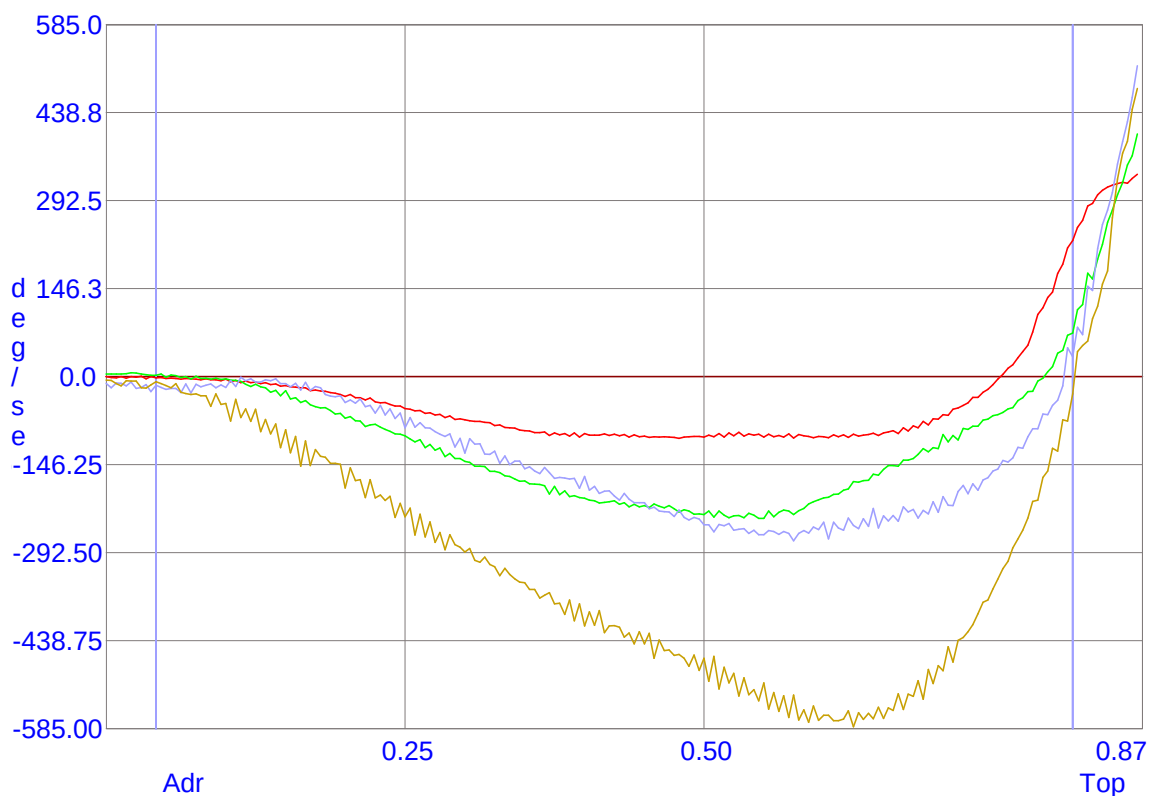
Positions at Peak Segmental Angular Speeds



		Backswing	Downswing	Follow Through
Tempo	ms	767	204	788

Backswing Sequence

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



Backswing Parameters

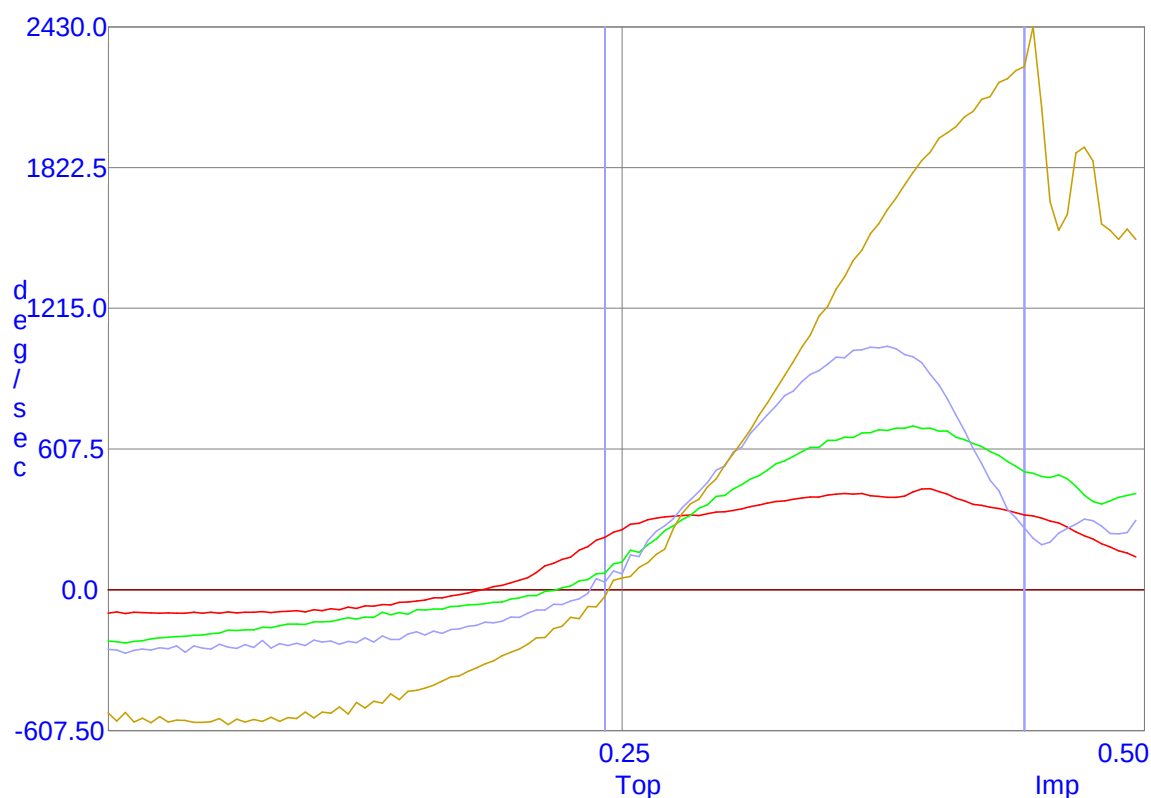
		Pelvis	Thorax	Arm	Club
Peak Order	order	1	2	3	4
Peak to Top	ms	329	258	233	183
Peak to Impact	ms	533	463	438	388
Peak Speed	d/s	103	236	273	582
Acceleration	d/s/s	229	468	485	983
Deceleration	d/s/s	751	606	573	948

Segmental Interactions

		Pelvis-Thorax	Thorax-Arm	Arm-Club
Time Between Peaks	ms	71	25	50

Transition Sequence

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



Transition Parameters

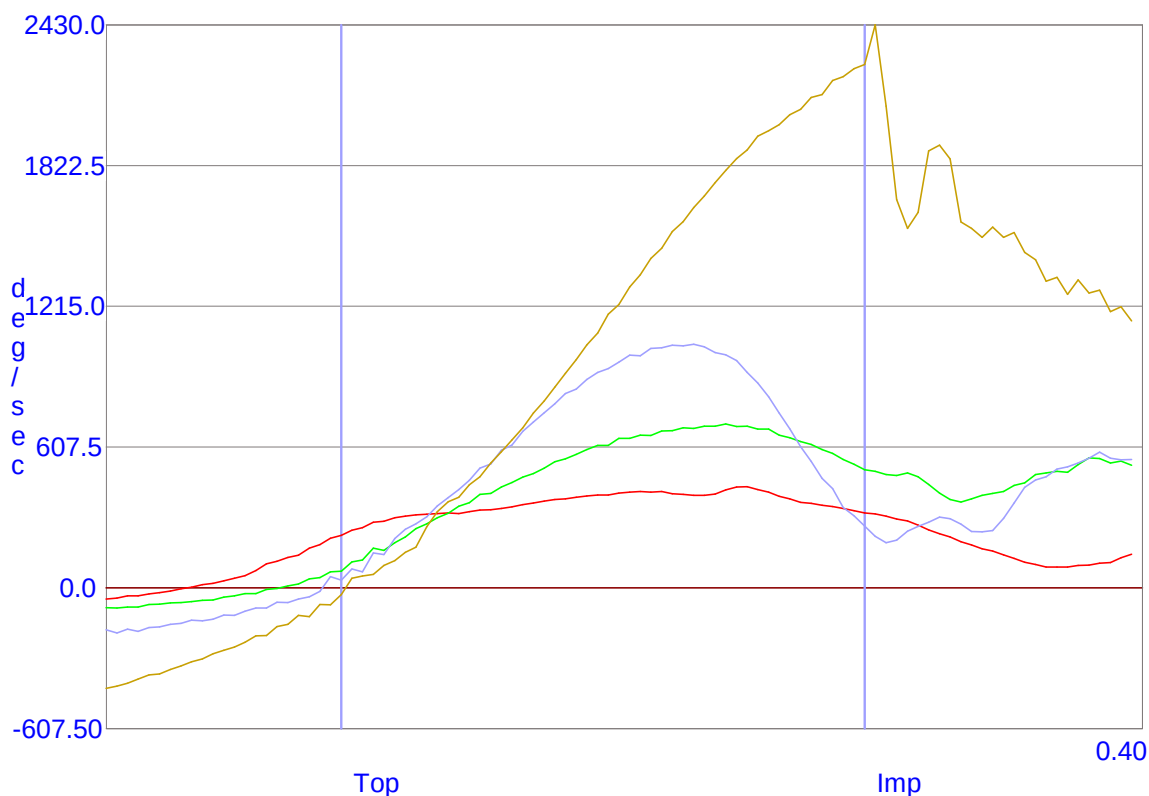
		Pelvis	Thorax	Arm	Club
Transition Order	order	1	2	3	4
Transition to Top	ms	63	25	8	0
Transition to Peak	ms	221	175	146	204
Transition to Impact	ms	267	229	213	204
Transition Acceleration	d/s/s	1999	2517	4865	7181

Segmental Interactions

		Pelvis-Thorax	Thorax-Arm	Arm-Club
Time Between Transitions	ms	38	17	8

Downswing Sequence

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



Sequence Parameters

		Pelvis	Thorax	Arm	Club
Peak Order	order	3	2	1	4
Peak Time Pre-Impact	ms	46	54	67	0
Peak Speed	d/s	436	707	1051	2259
% of Max	%	19	31	47	100
Acceleration	d/s/s	1995	4055	7316	11206
Deceleration	d/s/s	2456	3643	11771	8600

Segmental Interactions

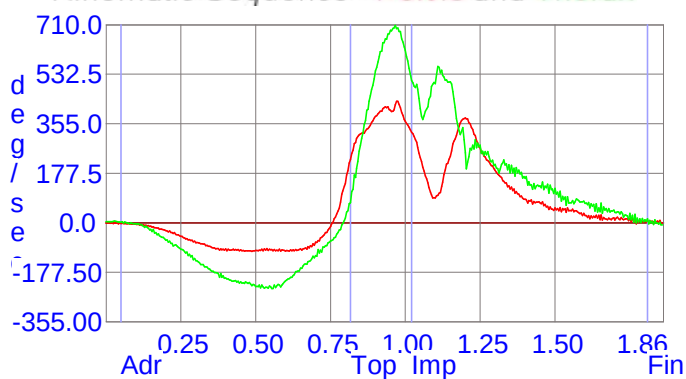
		Plv-Thx	Thx-Arm	Arm-Clb
Time Between Peaks	ms	-8	-13	67
Angular Speed Gain	d/s	271	344	1208
Gain Factor	ratio	1.6	1.5	2.1

Contribution by Joint

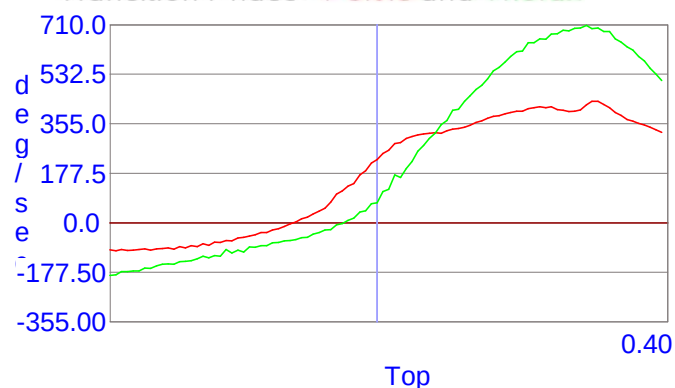
		Legs	Core	Shldr	Wrist
% Contribution	%	19	12	15	53

Spine Link Interactions

Kinematic Sequence - Pelvis and Thorax



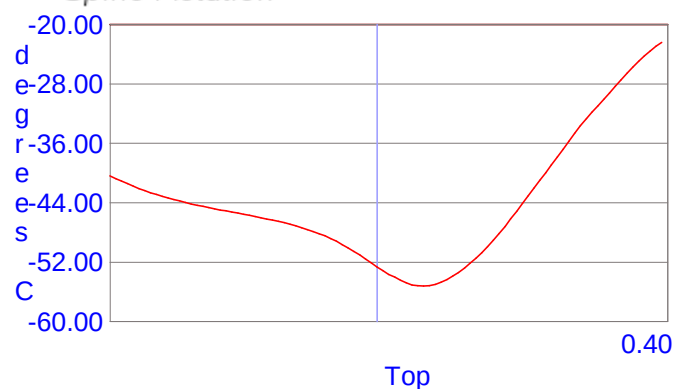
Transition Phase - Pelvis and Thorax



Total Spine Rotation (deg)

	Angle
At Pelvis Transition	47
At Thorax Transition	50
At Maximum	55

Spine Rotation



Transitional Spine Rotation (Stretch)

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	3	38	73
Ipsi-Directional	5	67	81
Total Stretch	8	104	78

Transitional Timings (ms)

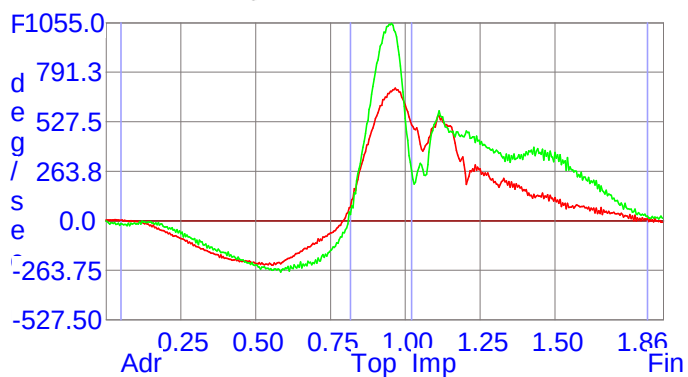
	Pelvis	Thorax
To Club Transition	63	25
To Impact	267	229

Transitional Accelerations (d/s/s)

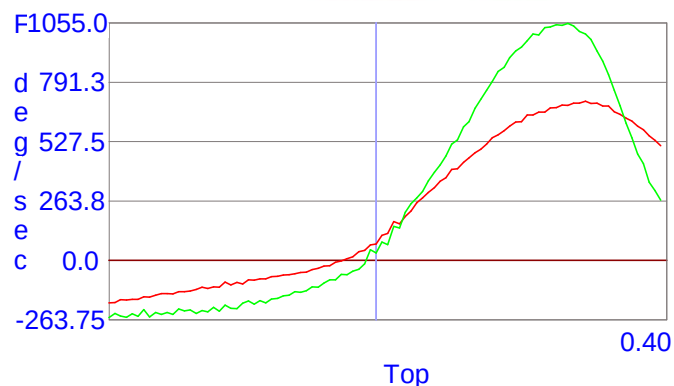
	Pelvis	Thorax
Acceleration	1999	2517

Shoulder Link Interactions

Kinematic Sequence - Thorax and Arm



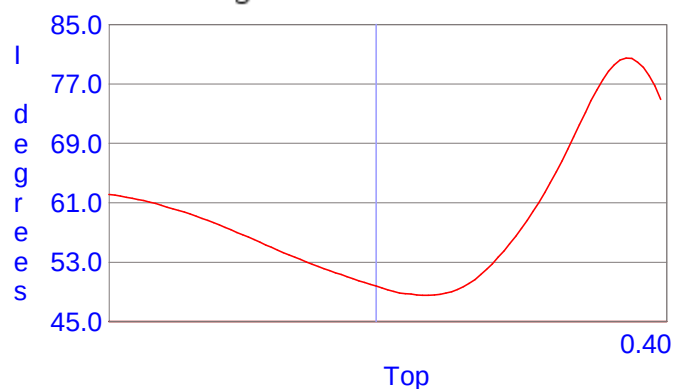
Transition Phase - Thorax and Arm



Total Shoulder Angle (deg)

	Angle
At Thorax Transition	51
At Arm Transition	50
At Min Angle	49

Shoulder Angle



Transitional Shoulder Stretch

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	1	17	65
Ipsi-Directional	2	46	37
Total Stretch	3	63	45

Transitional Timings (ms)

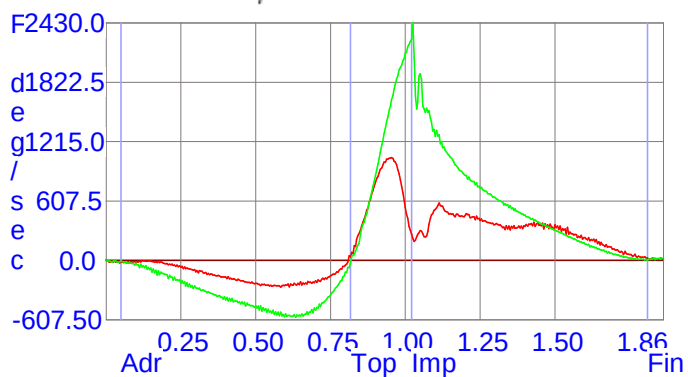
	Thorax	Lead Arm
To Club Transition	25	8
To Impact	229	213

Transitional Accelerations (d/s/s)

	Thorax	Lead Arm
Acceleration	2517	4865

Wrist Link Interactions

Kinematic Sequence - Arm and Club



Wrist Set Angles (deg)

	Angle
At Arm Transition	69
At Club Transition	68
At Max Set	63
At Arm 30deg Pre-Impact	89

Shaft Lean (deg)

	Angle
At Impact	20 F

Transitional Wrist Set Stretch

	Angle (deg)	Time (ms)	Rate (d/s)
Contra-Directional	1	8	66
Ipsi-Directional	6	71	79
Total Stretch	6	79	78

Transitional Timings (ms)

	Lead Arm	Club
To Club Transition	8	0
To Impact	213	204

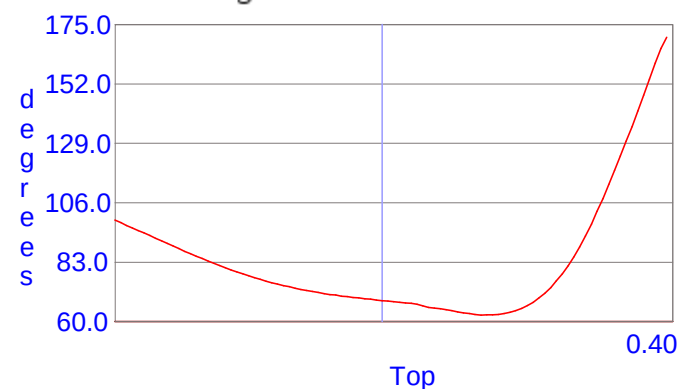
Transitional Accelerations (d/s/s)

	Lead Arm	Club
Acceleration	4865	7181

Transition Phase - Arm and Club

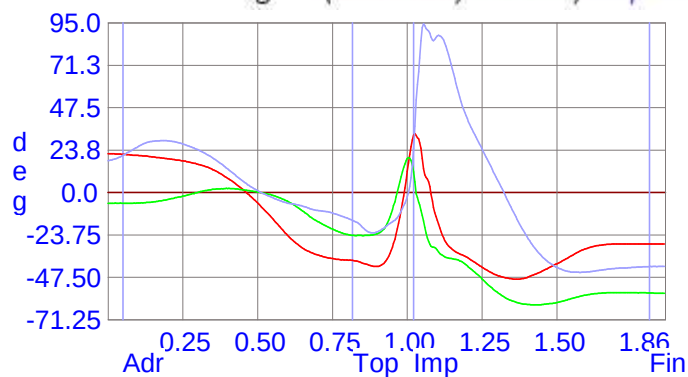


Wrist Set Angle

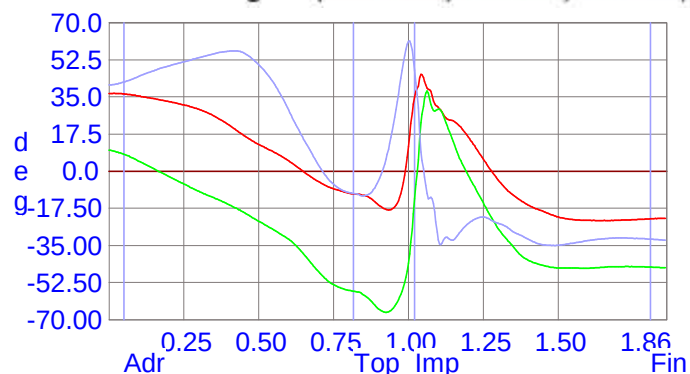


Wrist Link Interactions

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



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



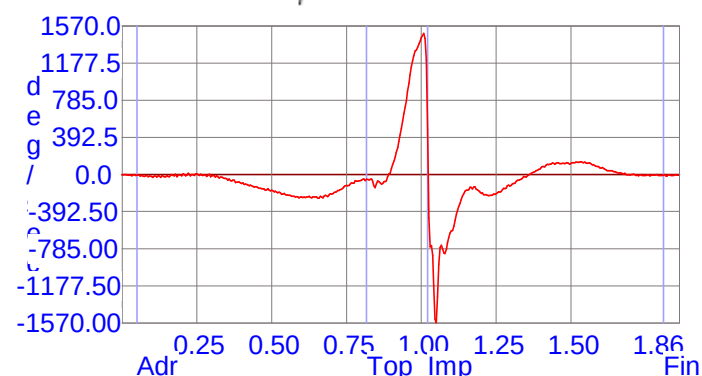
Lead Wrist Angles (Degrees)

	Adr	Top	Imp	Fin
Deviation	21 U	38 R	32 U	29 R
Flexion Extension	6 E	24 E	11 F	56 E
Forearm Sup-Pro	21 S	16 P	25 S	41 P

Trail Wrist Angles (Degrees)

	Adr	Top	Imp	Fin
Deviation	36 U	11 R	35 U	22 R
Flexion Extension	8 F	57 E	13 E	45 E
Forearm Pro-Sup	42 P	10 S	48 P	32 S

Wrist Release Speed



Angular Velocities (Deg/Sec)

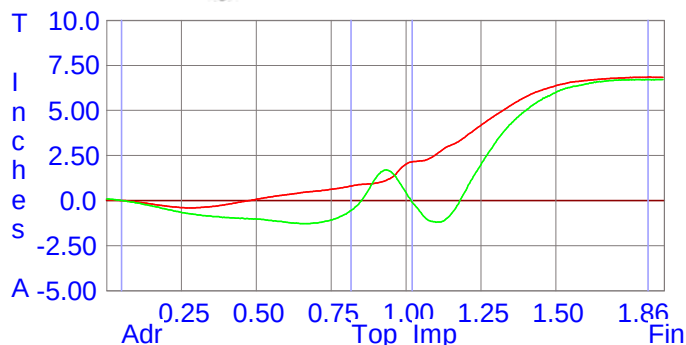
	Imp
Lead Wrist Sup-Pro Vel	2264 S
Lead Wrist Ext-Flex Vel	1111 E
Trail Elbow Extn Vel	724 E
Club Handle Axial Vel	1858 C

Max Release Speed	deg/sec	1491
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Projected Impact Speed	mph	94
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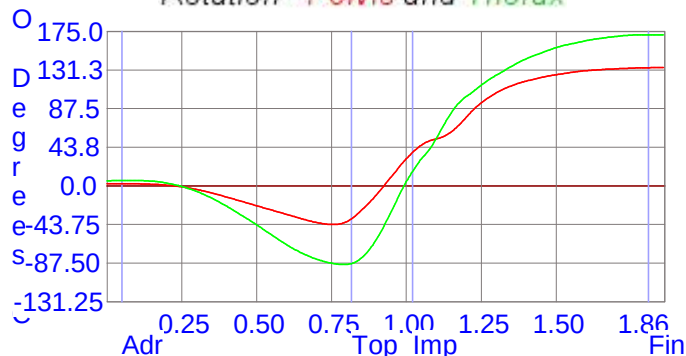
Trunk Dynamic Stability

Sway - Pelvis and Thorax



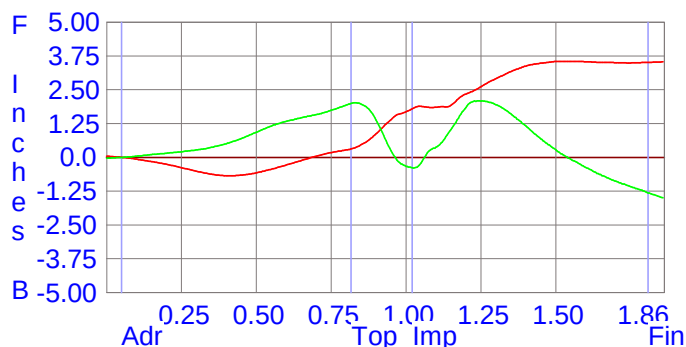
(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 T	0.8 T	2.2 T	6.9 T
Thorax	0.0 T	0.6 A	0.1 A	6.7 T

Rotation - Pelvis and Thorax



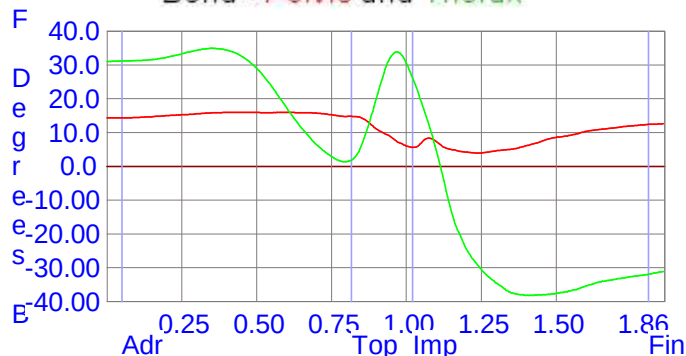
(Degrees)	Adr	Top	Imp	Fin
Pelvis	2 O	37 C	38 O	7 O
Thorax	6 O	88 C	16 O	171 O

Thrust - Pelvis and Thorax



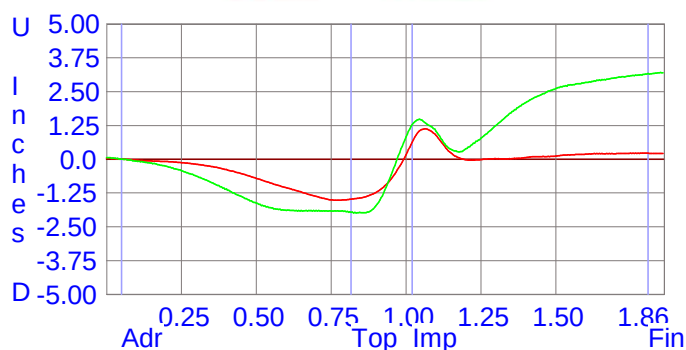
(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 F	0.3 F	1.8 F	3.5 F
Thorax	0.0 B	2.0 F	0.4 B	1.3 B

Bend - Pelvis and Thorax



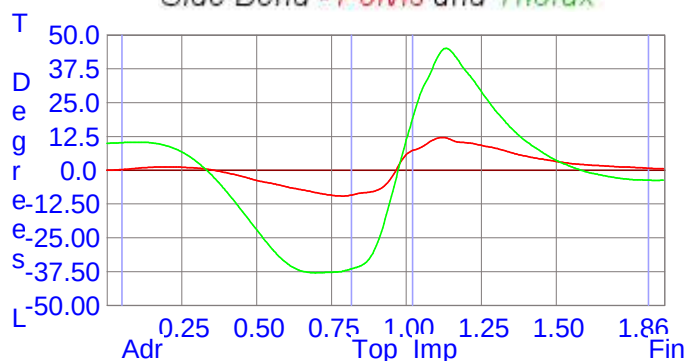
(Degrees)	Adr	Top	Imp	Fin
Pelvis	14 F	15 F	6 F	12 F
Thorax	31 F	2 F	26 F	32 B

Lift - Pelvis and Thorax



(Inches)	Adr	Top	Imp	Fin
Pelvis	0.0 U	1.5 D	0.6 U	0.2 U
Thorax	0.0 U	2.0 D	1.3 U	3.2 U

Side Bend - Pelvis and Thorax



(Degrees)	Adr	Top	Imp	Fin
Pelvis	0 L	9 L	7 T	1 T
Thorax	10 T	36 L	19 T	4 L

Dynamic Range of Motion

Head Angles (deg)

Rotation	20 C	109 O	129
Bend	61 F	22 B	83
Side Bend	6 L	48 T	54

Thorax Angles (deg)

Rotation	89 C	171 O	260
Bend	35 F	38 B	73
Side Bend	38 L	45 T	83

Pelvis Angles (deg)

Rotation	44 C	134 O	178
Bend	16 F	4 F	12
Side Bend	10 L	12 T	22

Trail Elbow Angles (deg)

Flexion-Extension	175 F	89 F	86
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Trail Wrist Angles (deg)

Rotation	61 S	35 P	96
Flexion-Extension	38 E	67 F	104
Deviation	46 U	23 R	69

Neck Angles (deg)

Rotation	61 C	70 O	131
Flexion-Extension	9 E	46 E	37
Side Bend	36 L	20 T	56

Lead Shoulder Angles (deg)

Elevation	4 A	154 B	158
Horizontal Adduction	49 I	200 I	151

Spine Angles (deg)

Rotation	55 C	32 O	87
Flexion-Extension	27 F	46 E	73
Side Bend	30 L	33 T	63
Forward Tilt	34 F	12 F	22
Side Tilt	0 L	15 T	15

Lead Elbow Angles (deg)

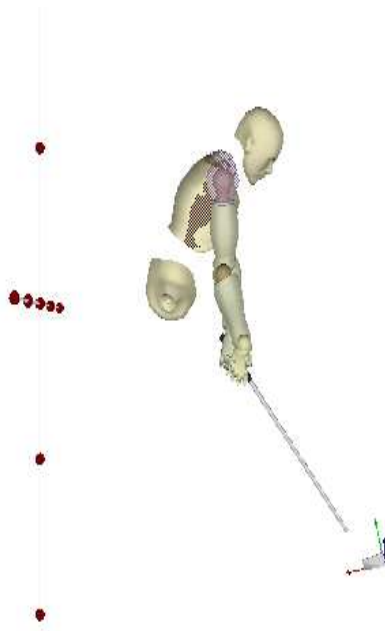
Flexion-Extension	179 F	52 F	126
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Lead Wrist Angles (deg)

Rotation	94 S	45 P	139
Flexion-Extension	20 F	63 E	83
Deviation	33 U	49 R	82

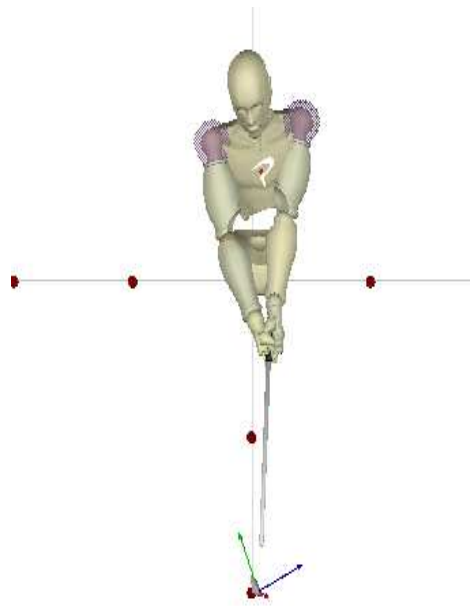
Columns are max range to each side and total range traveled

Position At Address



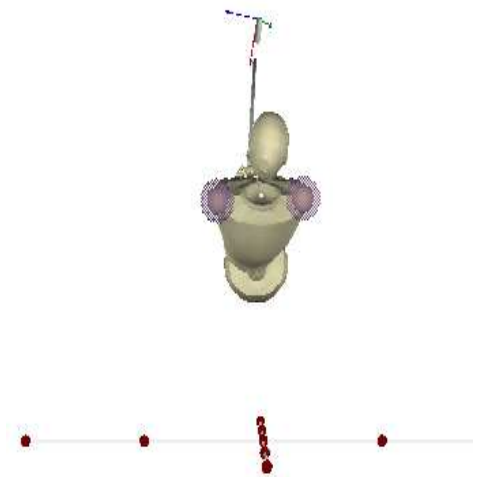
Angles (deg)

	Pelvis	Thorax
Rotation	2 O	6 O
Bend	14 F	31 F
Side Bend	0 L	10 T

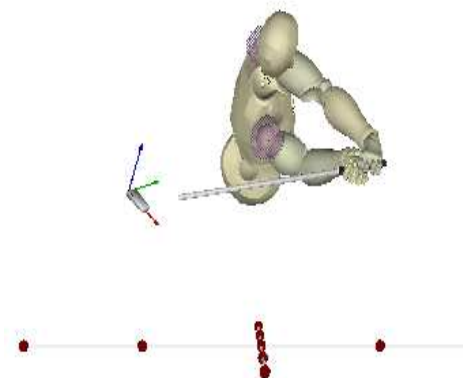
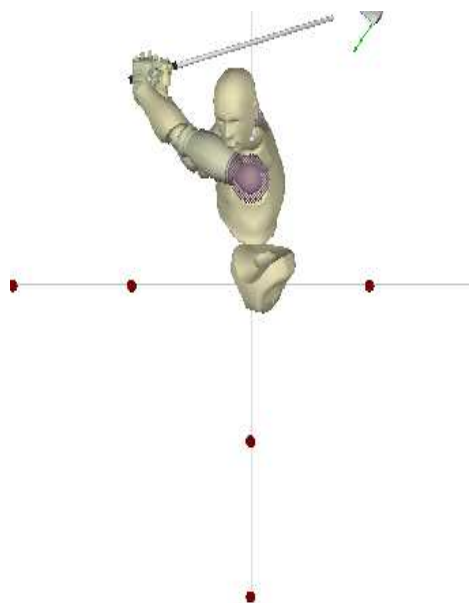
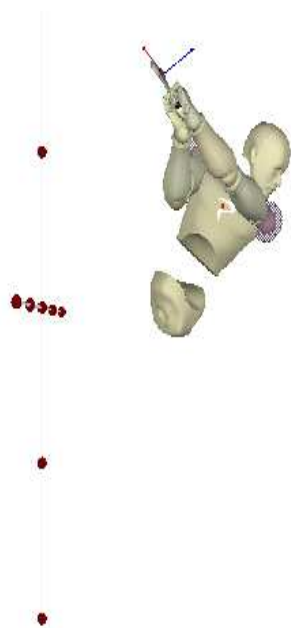


Angles (deg)

	Spine
Rotation	4 O
Flexion-Extension	17 F
Side Bend	10 T



Position At Top



Angles (deg)

	Pelvis	Thorax
Rotation	37 C	88 C
Bend	15 F	2 F
Side Bend	9 L	36 L

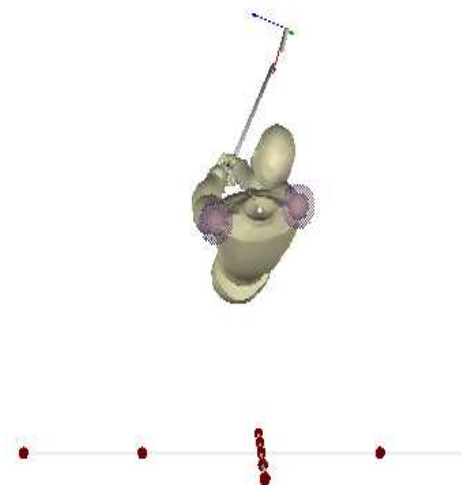
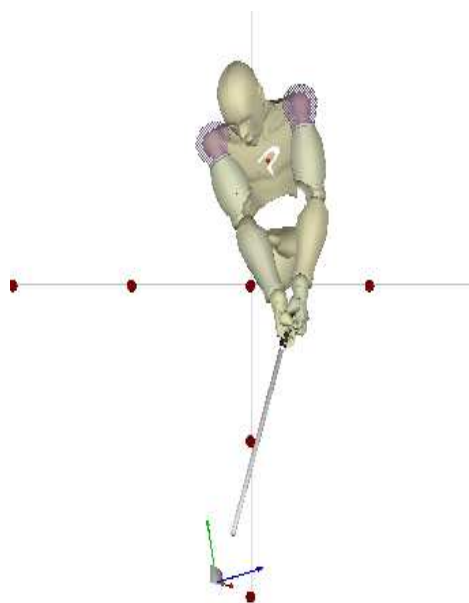
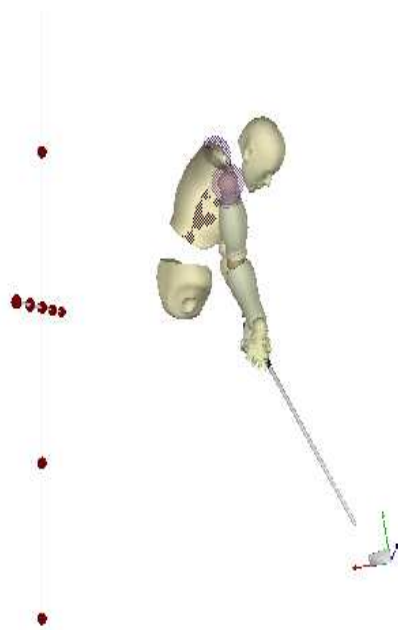
Angles (deg)

	Spine
Rotation	53 C
Flexion-Extension	13 B
Side Bend	27 L

Displacements (inches)

	Pelvis	Thorax
Sway	0.8 T	0.6 A
Thrust	0.3 F	2.0 F
Lift	1.5 D	2.0 D

Position At Impact



Angles (deg)

	Pelvis	Thorax
Rotation	38 O	16 O
Bend	6 F	26 F
Side Bend	7 T	19 T

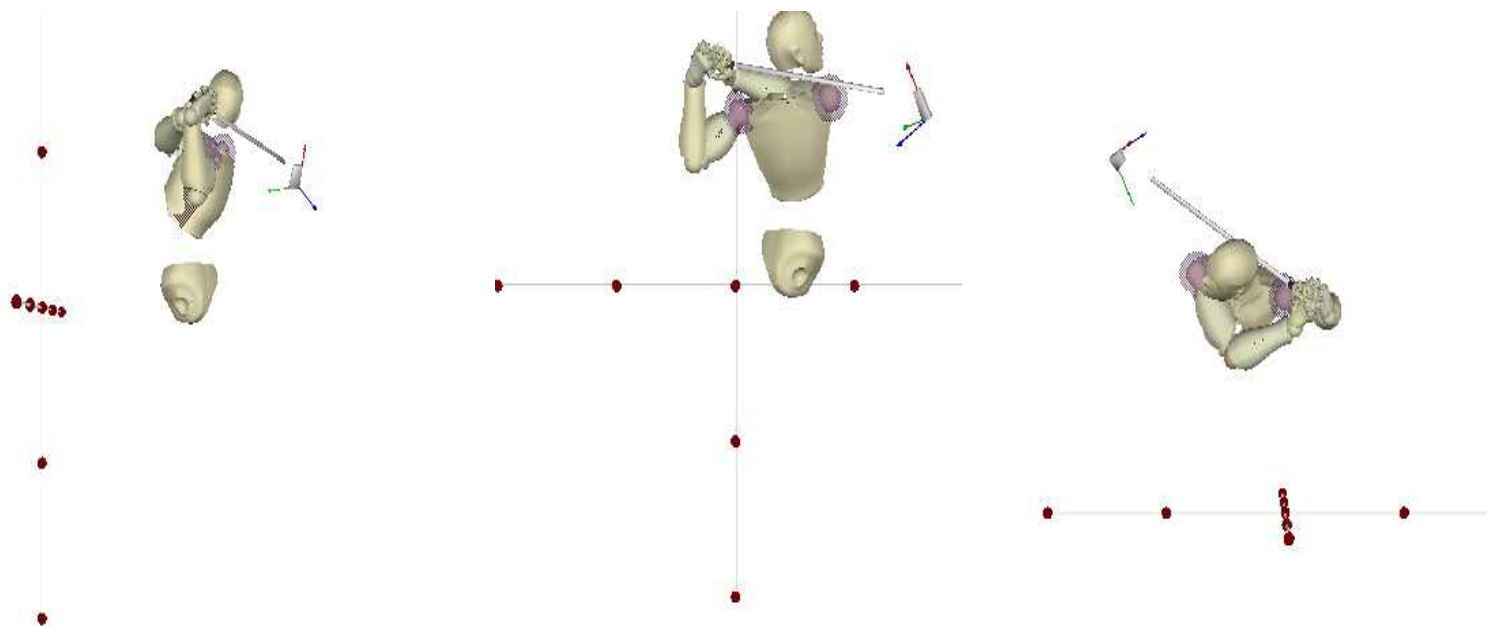
Angles (deg)

	Spine
Rotation	22 C
Flexion-Extension	21 F
Side Bend	12 T

Displacements (inches)

	Pelvis	Thorax
Sway	2.2 T	0.1 A
Thrust	1.8 F	0.4 B
Lift	0.6 U	1.3 U

Position At Finish



Angles (deg)

	Pelvis	Thorax
Rotation	134 O	171 O
Bend	12 F	32 B
Side Bend	1 T	4 L

Angles (deg)

	Spine
Rotation	32 O
Flexion-Extension	44 B
Side Bend	4 L

Displacements (inches)

	Pelvis	Thorax
Sway	6.9 T	6.7 T
Thrust	3.5 F	1.3 B
Lift	0.2 U	3.2 U