Isokinetics: What Can We Learn From the Test?

Ryan Malm, PT, DPT, ATC

The Bone and Joint Center

Disclosures

Bone and Joint currently uses Humac Norm Isokinetic Extremity System. There are many other brands that are comparable.

What is Isokinetic Testing?

- Isokinetic= “Same Speed”
- Isokinetic Testing: A test to measure a muscle’s performance while moving at a constant speed regardless of the amount of resistance being applied

Advantages

- Objective Measurements for accurate comparisons
- Evaluation of muscle function throughout full ROM
- Muscle isolation to assess weaknesses or imbalances
- Variable speeds to assess muscle performance at various movement velocities
- Biofeedback provides real-time feedback to patient
- Bilateral comparison: contralateral limbs to help identify imbalances

Barriers

- Cost and Accessibility
- Technical Complexity
- Functional Relevance
- Patient Factors
- Joint Specificity

Who Doesn’t Get Tested?

- Acute Injury
- Immediately Post-op
- MMT <4/5
- High pain with MMT
- Not safe to transfer on/off the machine

Who Gets Tested?

- Exerciser/active individual
- MMT 5/5 with tolerable pain
- As part of the rehab process to evaluate strength deficits
- As part of RTS protocol (Specifically ACLr)

Allahabadi, Sachin, et al. “Incidence of anterior cruciate ligament graft tears in high-risk populations: An analysis of professional athlete and pediatric populations” *The Knee (2020)*

- Pediatric Population
  - 19% Re-tear rate (1 in 5)
- NFL
  - 12.3% Re-tear rate (1 in 8)

Grindem H, Snyder-Mackler L, Moksnes H, Engebretsen L, Risberg MA. Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. *Br J Sports Med. 2016*

Reinjury rate reduced by 84% when delaying RTS until 9 months AND achieving quad symmetry

For every month that RTS was delayed until 9 months, the rate of re-injury was reduced by 51%

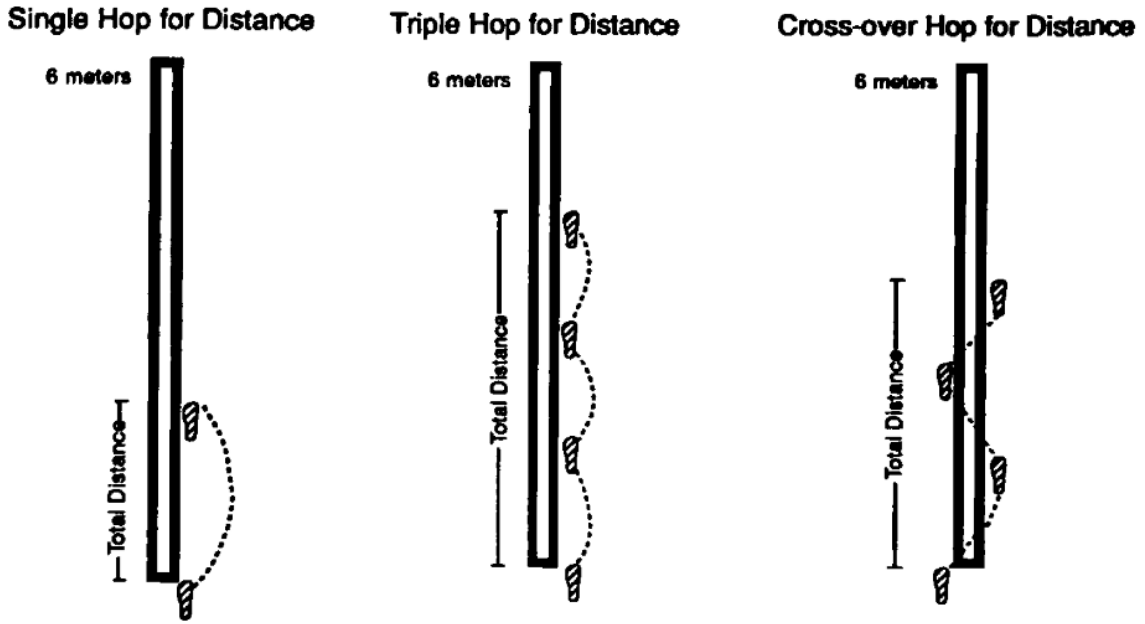
Grindem H, Snyder-Mackler L, Moksnes H, Engebretsen L, Risberg MA. Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. *Br J Sports Med. 2016*

- More symmetrical quad strength prior to RTS significantly reduced the knee reinjury rate
  - 38.2% of those who failed RTS criteria suffered reinjuries versus 5.6% of those who passed
  - 1% increase in strength symmetry = 3% reduced reinjury rate

Rambaud AJM, et al. Criteria for Return to Sport after Anterior Cruciate Ligament reconstruction with lower reinjury risk (CR'STAL study): protocol for a prospective observational study in France. BMJ Open 2017

- Hop Testing
  - Single Hop
  - Triple Hop
  - Cross-over Hop

- Goal is 90% compared bilaterally
- Limb Symmetry Index (LSI)



Barfod K, et al. 2019 Knee extensor strength and hop test performance following anterior cruciate ligament reconstruction. *Knee. 2019 Jan*

- 69 ACL reconstruction patients
  - At 6 months
    - 66.7% symmetric hop test but only 27.5% had symmetric quad strength
  - At 12 months
    - 89.9% had symmetric hop test but only 46.4% had symmetric quad strength

- Recovery of quad strength was associated with hopping distance
- Recovery of hopping distance was not associated with knee extensor strength.

The Bone and Joint Center Protocol

- Standard Isokinetic Test (Concentric/Concentric)
  - 5 Reps @ 60 deg/sec
  - 10 Reps @ 180 deg/sec
  - 15 Reps @ 300 deg/sec

Test Day

- Rest 2-3 days prior
- Perform adequate warm-up
- Explanation of test
  - Testing both legs, # of reps, amount of resistance, etc.
- Familiarization/Warm-up reps
- Give consistent cues and encouragement
- Explanation of findings!

Criteria

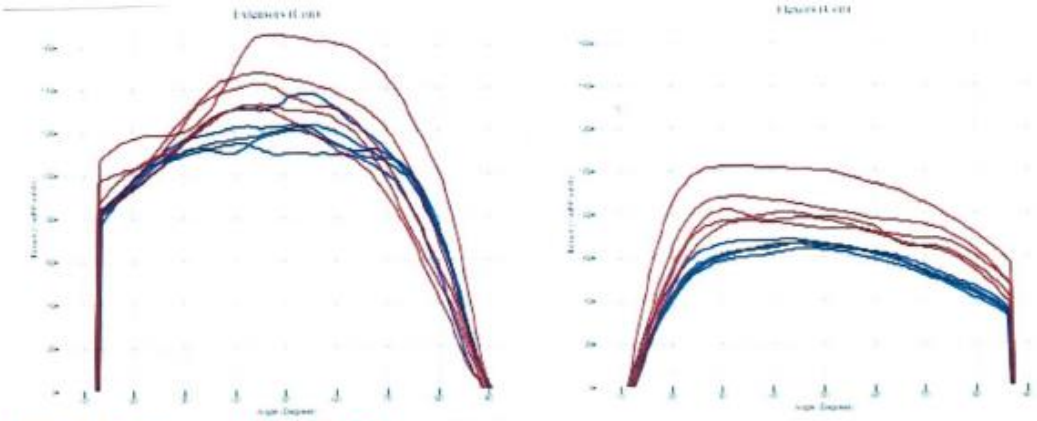
- Quad Peak Torque Comparison
  - Males: 85%>
  - Females: 85%
- Hamstring Peak Torque Comparison
  - Males: 90%>
  - Females: 100%
- Hamstring/Quad Ratio
  - Males 180 deg/sec 66-75%
  - Females 180 deg/sec 75%>
- Quad Peak Torque to Body Weight Ratio
  - Males 180 deg/sec 60-65%
  - Females 180 deg/sec 50-55%

5 Repetitions
@ 60 deg/sec

10 Repetitions
@ 180 deg/sec

15 Repetitions
@ 300 deg/sec

Interpreting Results



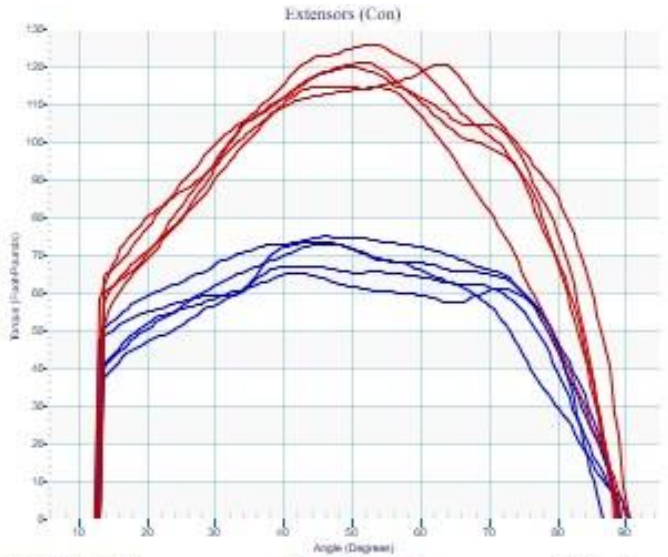
Right Side Curves Left Side Curves Set: 1

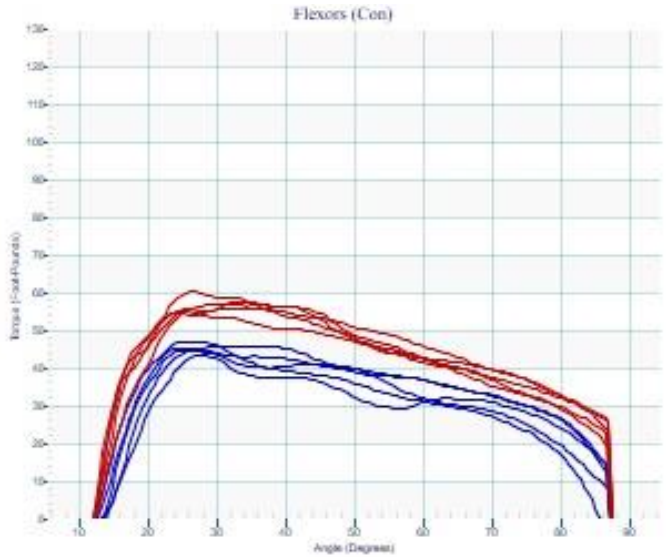
Isokinetic Con/Con Speed 60/60 d/s 5 Reps	Extensors (Con) Value	Cof Var	%BW	Flexors (Con) Value	Cof Var	%BW	Ratio
Peak Torque (Foot-Pounds - Best Repetition)							
Right	138	0.07	51	68	0.03	25	49
Left	165	0.10	61	102	0.12	38	62
Deficit	16			33			
Work per Repetition (Foot-Pounds - Best Repetition)							
Right	141	0.05	52	72	0.03	27	51
Left	172	0.12	64	113	0.14	42	66
Deficit	18			36			
Range of Motion (Degrees)							
Right	10	0.01		90	0.00		
Left	10	0.02		90	0.00		

Isokinetic Con/Con Speed 180/180 d/s 10 Reps	Extensors (Con) Value	Cof Var	%BW	Flexors (Con) Value	Cof Var	%BW	Ratio
Peak Torque (Foot-Pounds - Best Repetition)							
Right	102	0.07	38	56	0.10	21	55
Left	112	0.05	41	75	0.10	28	67
Deficit	9			25			
Work per Repetition (Foot-Pounds - Best Repetition)							
Right	92	0.08	34	48	0.12	18	52
Left	103	0.08	38	65	0.12	24	63
Deficit	11			26			
Range of Motion (Degrees)							
Right	11	0.02		89	0.00		
Left	10	0.02		90	0.00		

Isokinetic Con/Con Speed 300/300 d/s 15 Reps	Extensors (Con) Value	Cof Var	%BW	Flexors (Con) Value	Cof Var	%BW	Ratio
Peak Torque (Foot-Pounds - Best Repetition)							
Right	74	0.08	27	43	0.13	16	58
Left	83	0.07	31	55	0.10	20	66
Deficit	11			22			
Fatigue Index							
Right	17	0.00		26	0.00		
Left	14	0.00		24	0.00		
Total Work Done (Foot-Pounds)							
Right	642	0.00	238	309	0.00	114	48
Left	775	0.00	287	413	0.00	153	53
Deficit	17			25			
MaxGET	Right 12/31/2024 13			Left 12/31/2024 13			

Interpreting Results





Right Side Curves Left Side Curves Set: 1

Isokinetic Con/Con		Extensors (Con)			Flexors (Con)			
Speed 60/60 d/s 5 Reps	Value	Cof Var	%BW	Value	Cof Var	%BW	Ratio
Peak Torque (Foot-Pounds - Best Repetition)							
Right	75	0.06	47	47	0.03	29	63
Left	126	0.03	79	60	0.03	38	48
Deficit	40			22			
Work per Repetition (Foot-Pounds - Best Repetition)							
Right	81	0.05	51	46	0.07	29	57
Left	126	0.04	79	58	0.02	36	46
Deficit	36			21			
Range of Motion (Degrees)							
Right	10	0.02		89	0.02		
Left	10	0.02		90	0.00		
Isokinetic Con/Con		**Extensors (Con)**			**Flexors (Con)**		
Speed 180/180 d/s 10 Reps	**Value**	**Cof Var**	**%BW**	**Value**	**Cof Var**	**%BW**	**Ratio**

Thank You!

50 YEARS

The Bone & Joint Center