

Isokinetic Dynamometer Leg Extensor Peak Torque Measurement: A Time-Delayed Reliability and Score Selection Analysis Study

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Abstract

Introduction: The reliability of isokinetic peak torque (PT) has been reported mostly using a short-term (<~10 day) inter-trial testing time frame. However, many studies and programs utilize a long-term (several weeks to months) inter-trial testing period. Additionally, the methods by which the PT value is selected and reported from a multiple rep testing scheme have not been well investigated for both reliability and PT absolute performance comparisons.

Purpose: The purpose of this study was to investigate the long-term reliability of isokinetic and isometric PT of the leg extensors with an emphasis on the differences among several PT score selection methods.

Methods: Thirteen men and women (age = 19.5 years) underwent two testing trials separated by 28.8 (1.8) days. Testing included maximal voluntary contractions of three sets of three reps for two isokinetic contraction conditions of 60 (Isok60) and 240 (Isok240) deg/s velocities, and three sets of one rep of isometric contractions for the leg extensors. The PT score was derived from seven different methods (see text for descriptions). Reliability as assessed from intraclass correlation coefficients (ICCs) varied widely across contraction conditions and PT score selection parameters.

Results: The Isok60 velocity overall had lower reliability (ICCs = 0.48–0.81) than Isok240 (0.77–0.87) across the conditions whereas the isometric PT variables showed moderate reliability (0.71–0.73). Overall the set 1 PT score selection parameters were generally lower ($p \leq 0.05$) than those that involved sets two and three. Systematic error ($p \leq 0.05$) was shown for 6 out of the 17 PT selection variables.

Conclusion: On a subjective interpretation basis, when taking everything into account the best overall combination of time/trial efficiency, reliability, best/highest PT score parameter, and reduced risk of systematic bias appears to be the PT variable that uses the average of the highest two reps of the first two sets of three reps—i.e., averaging the highest two values of the six total reps from the first two sets.

In long-term test-retest studies, the method that provides the best balance of reliability, efficiency and higher peak torque score is taking the average of the highest 2 reps from 2 sets.

Table 1. Reliability statistics for the peak torque (PT) selection conditions for the isokinetic at 60 and 240 deg/s velocities and isometric testing.

Variables	p-Value	ICC 2,1	SEM	MD
Isok60-Set1Highest	0.92	0.67	16.40	45.45
Isok60-Set1Highest2	0.83	0.61	17.55	48.65
Isok60-Set1Mean3	0.98	0.48	20.92	57.99
Isok60-Highest2of2sets	0.56	0.77	13.88	38.46
Isok60-Highest9	0.10	0.79	13.31	36.89
Isok60-High3Mean	0.34	0.81	12.60	34.91
Isok60-Mean9	0.59	0.78	13.29	36.84
Isok240-Set1Highest	0.07	0.80	11.15	30.91
Isok240-Set1Highest2	0.05	0.77	11.03	30.59
Isok240-Set1Mean3	0.05	0.80	9.86	27.34
Isok240-Highest2of2sets	0.06	0.87	8.17	22.65
Isok240-Highest9	0.44	0.85	8.43	23.35
Isok240-High3setMean	0.09	0.87	7.83	21.70
Isok240-Mean9	0.03	0.85	7.32	20.30
IsomHighest	0.02	0.71	14.06	38.97
IsomMean	0.07	0.77	13.45	37.28
IsomHighest2	0.03	0.73	13.88	38.48

Isok60 = isokinetic knee extension at 60 deg/s; Isok240 = isokinetic knee extension at 240 deg/s; IsomPT = isometric peak torque; see text for a full description of each of the peak torque variables.

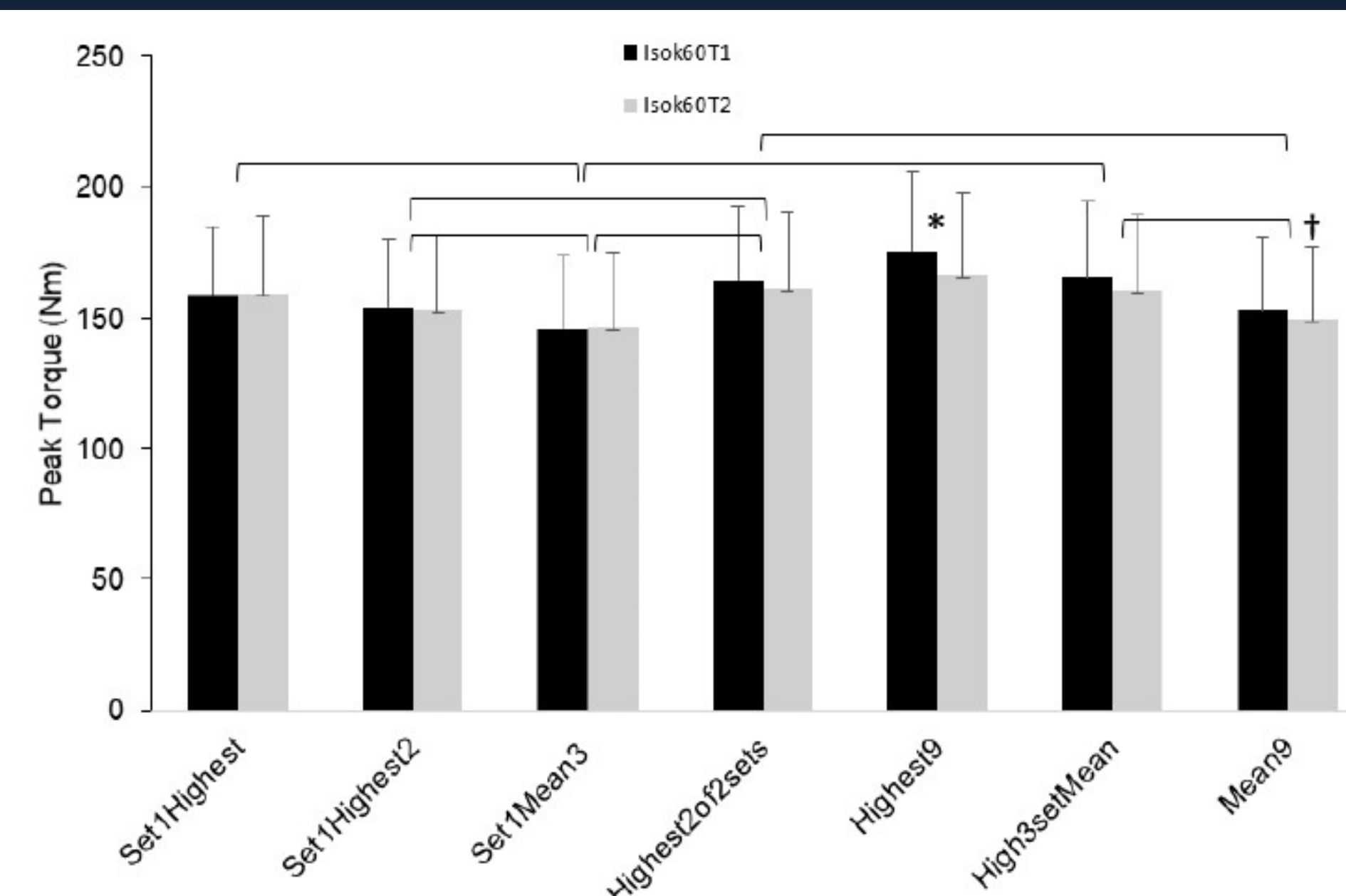


Figure 1. Mean (error bars are SD) peak torque (PT) values for the isokinetic 60 deg/s (Isok60) testing condition for trials 1 (T1) and 2 (T2) for each of the PT score selection parameters. * indicates higher than all other conditions. † indicates lower than “Set1Highest” condition only for Isok60T2. Isok60 trials 1 and 2 showed the same results (bracket symbols combine the two trials with respect to denoting significance) in all cases except one (noted by ‡).

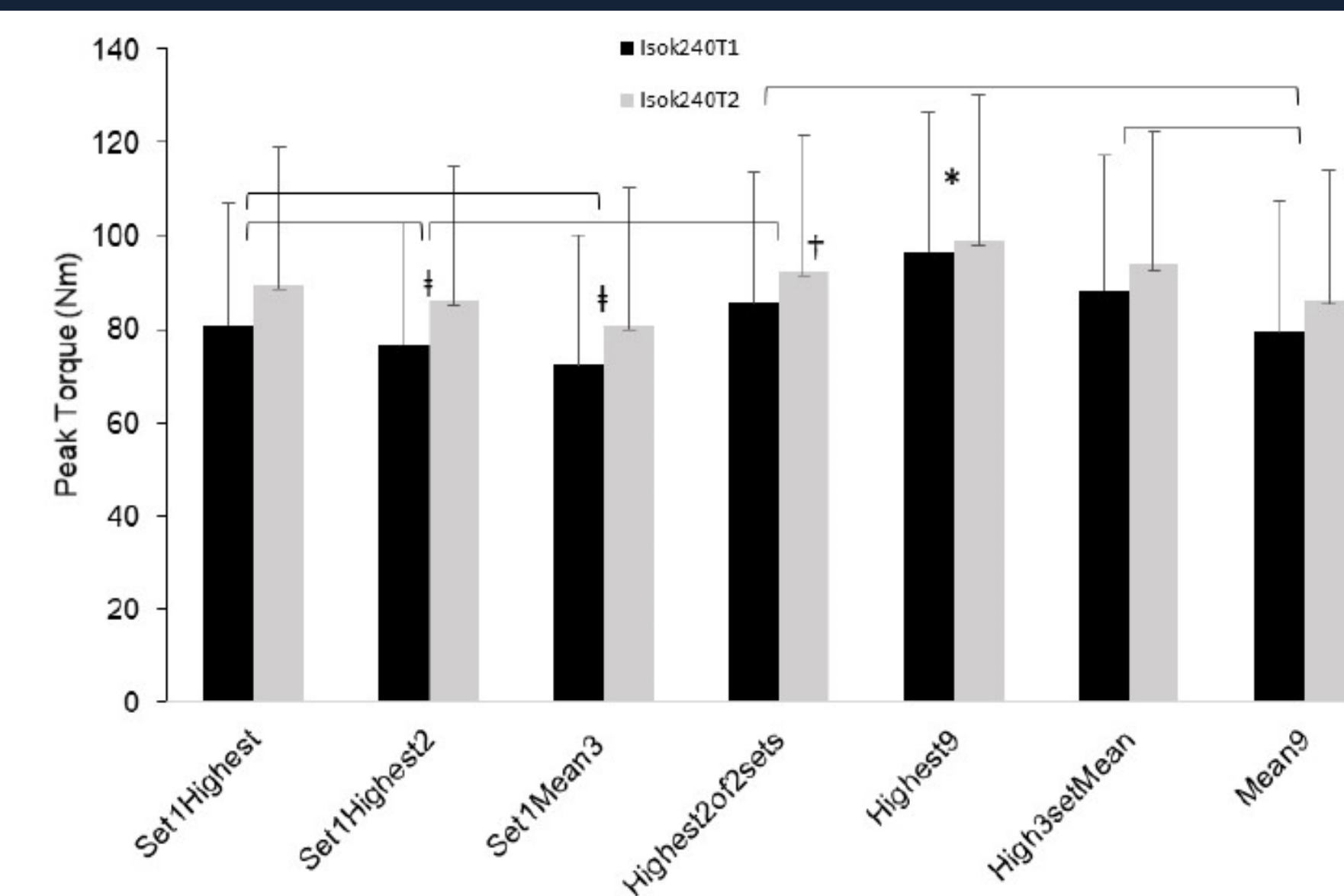


Figure 2. Mean (error bars are SD) peak torque (PT) values for the isokinetic 240 deg/s (Isok240) testing condition for trials 1 (T1) and 2 (T2) for each of the PT score selection parameters. ‡ significantly different from all other conditions except for the “mean9” condition. † significantly different from “High3setMean” condition only for Isok240T2. * indicates significantly higher than all other conditions except for “Set1Highest” condition for both trials 1 and 2, and the “Highest2of2sets” condition for Isok240T1 only. Isok240 trials 1 and 2 showed the same results (bracket symbols combine the two trials with respect to denoting significance) in all cases except as noted by † and * cases.

Isokinetic 60 deg/s

Isokinetic 240 deg/s

Introduction

- Reliability of long term isokinetic peak torque has been reported for short term studies, but not much for long term.
- Purpose:** Find the long term test-retest reliability and best score measures for isokinetic and isometric tests

Methods

- 13 university club sport (water polo) athletes
- 2 visits 28 days apart with 3 tests:
 - 3 sets of 1 isometric contraction
 - 3 sets of 3 isokinetic at 60 deg/s
 - 3 sets of 3 isokinetic at 240 deg/s
- Peak torque derived from 7 different methods with reliability shown using ICC’s

Results

- Isokinetic contractions at 60 deg/s were overall less reliable than at 240 deg/s
- All measures involving only the first set were least reliable
- All measures involving multiple sets were comparable in reliability and offered higher peak torque scores than those with one set
- For isometric peak torque, using the mean of all 3 sets seems to be best

Conclusion

- Subjectively, taking the 2 highest reps from 2 sets of 3 is just as (or very near) reliable as the measures from 3 sets, but is more time efficient and they offer higher peak torque scores than 1 set

Practical Application

- To measure isokinetic peak torque values in a long term test-retest study, researchers may want to use 2 sets of 3 reps at a speed of 240 deg/s with 1 min rest between sets as a testing protocol.

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