Relationship Between Isometric Peak Force and Maximal Sprinting in Elite Track Cyclists

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Introduction

As a strength and conditioning coach, I wanted to:

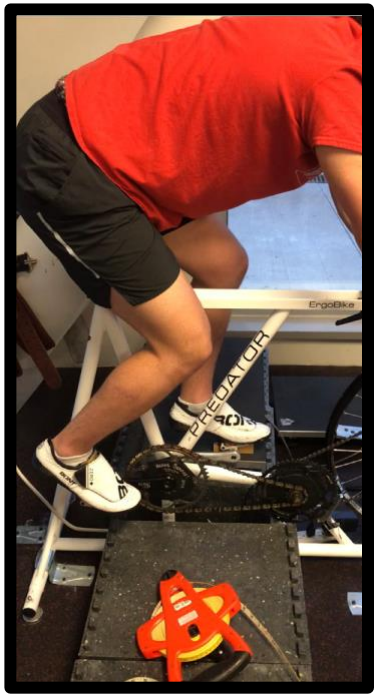
- Enhance my understanding of the transfer of training.
- Develop a practical and reliable tool to efficiently monitor and measure strength within a gym setting.
- Aim for a tool that closely relates to force and torque characteristics.
  - Sought a time-efficient solution.
  - Explored the possibility of utilizing an isometric-specific angle.

The Journey

2019

Adapted from Stone, 2014

2020



Adapted from Kordi, 2017

2022

Aim & Hypothesis

Study Aim:

- Examine the correlation between isometric strength at a specific joint angle and peak power and torque in cycling.

Hypothesis:

- We hypothesize a positive relationship between the ability to produce force in an isometric position and the ability to produce power and torque on a cycling ergometer.

Protocol Overview

- Elite track cyclists from the National **Sprint** and **Endurance Track Cycling** Teams were recruited to participate in the study.

Seated Sprints on SRM Ergometer

Single-Leg Seated Leg Isometric Test

Sprint Testing Protocol

Bike Fit:

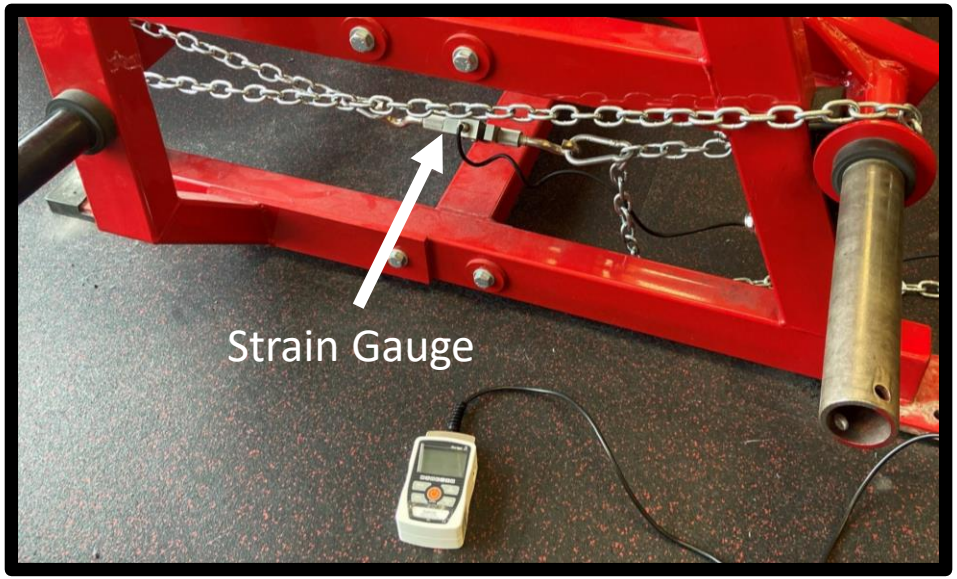
SRM ergometer fitted to cyclist based on track bike geometry

SRM Ergometer (Germany)

Sprint Testing: Analysis

- Torque-cadence relationship was determined using linear regression (Gardner et al., 2007) to derive theoretical maximal torque (T_0) and maximal cadence (C_0).
- The torque intercept of the power-cadence relationship was fitted with a second-order polynomial model to derive theoretical optimal cadence (C_{opt}) and maximum power output (P_{max}).

Isometric Testing: Protocol

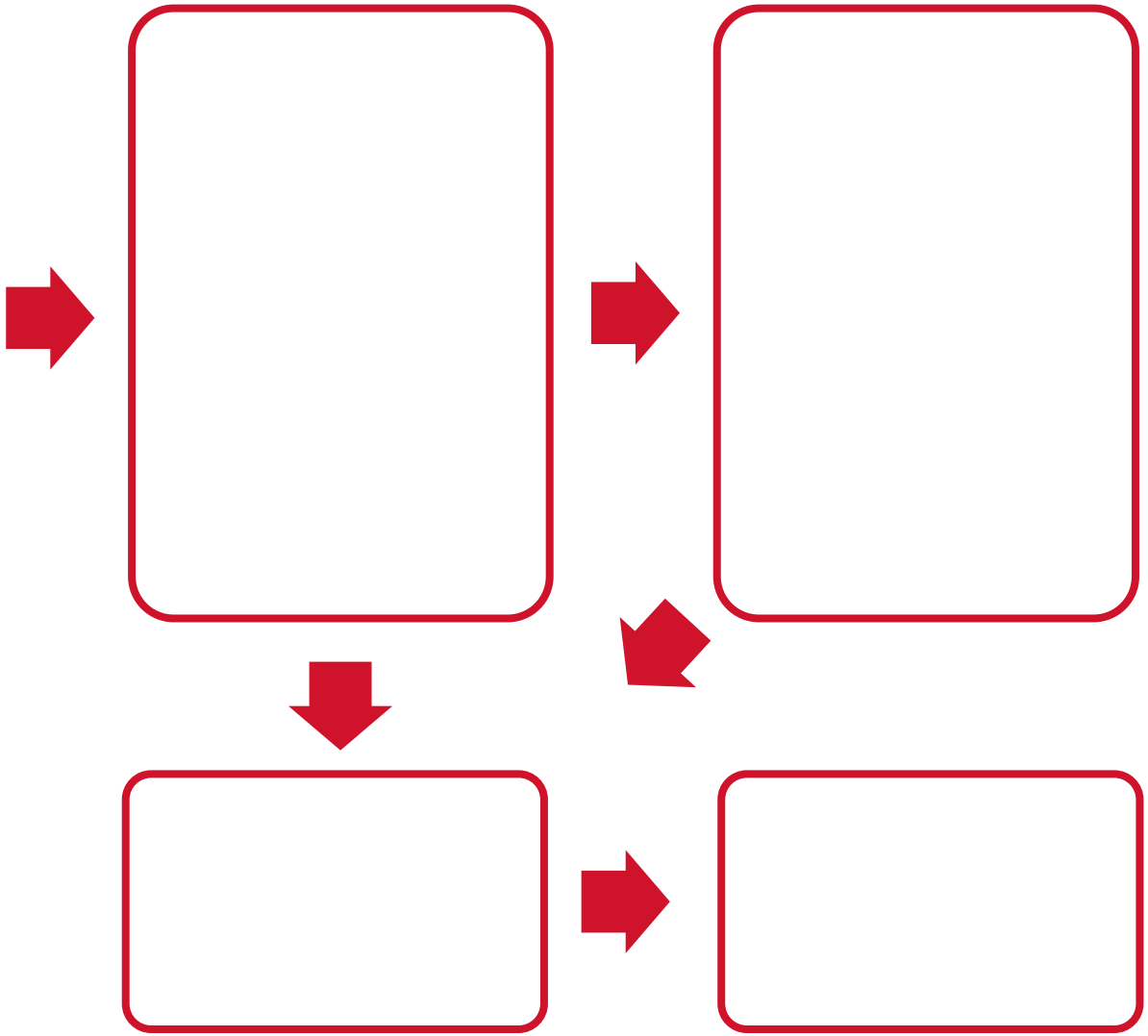


- Strain gauge (Mark-10, USA) affixed to leg press using a chain
- The athlete's position was adjusted to ensure ~90° knee angle using three landmarks
- Seatbelt secured the hips across the top of the pelvis
- Internal testing showed **good reliability** (ICC: 0.99**;** 95% CI: 0.92, 0.99) and no systemic bias (2-Way Repeated Measures ANOVA, *P* > 0.05)

Isometric Testing: Protocol

Warm-Up:

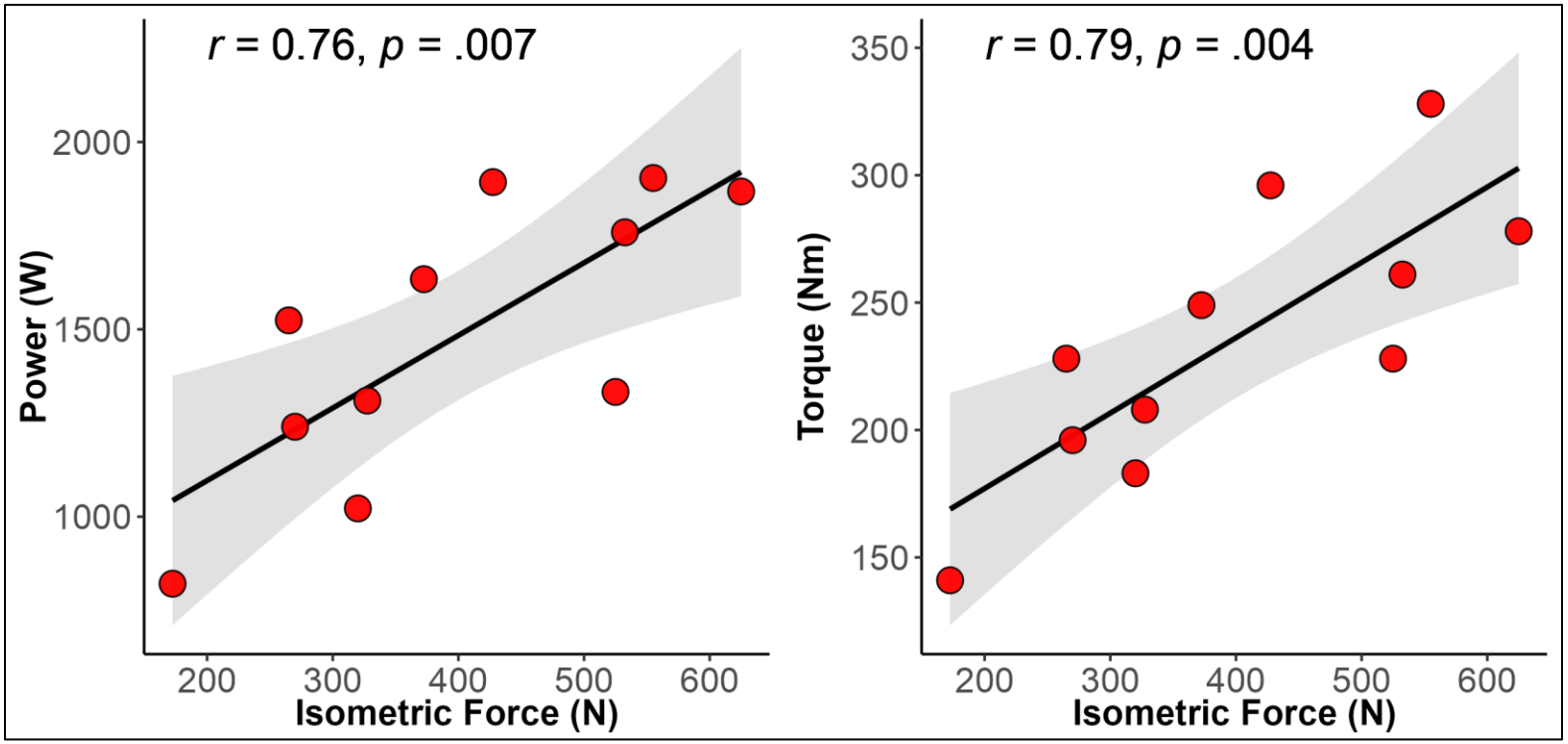
Prior to trials, athletes built up to **one** 50% effort 5-sec warm-up rep for each leg.



Results: Participants

Athlete Characteristics (N = 11)	
Sex	3 Female; 8 Male
Discipline	7 Sprint; 4 Endurance
Age	24 ± 4 years
Body Mass	82.3 ± 12.6 kg

Results: Correlations



Metric	Mean ± SD
Peak Isometric Force (N)	399 ± 144
Peak Power (W)	1483 ± 368
Torque (Nm)	236 ± 54

Discussion

Conclusions:

- Significant correlations suggest isometric force is related to peak torque and power during maximal sprints.
- Alternative way to monitor athletes and their strength levels related to cycling performance.

Limitations:

- Knee angle (Peak Torque = ~104 +/- 11.0 crank angle)
- Limited generalizability of the sample due to size
- Noise with pre-tension; inability to assess rate of force development (RFD)

Discussion

Practical Applications:

- Easy-to-administer, task-specific, and safe.
- Feasible solution for practitioners to track force as it relates to torque and power.
- Practical application for strength coaches to monitor without custom-built cycling ergometers.
    - *Use the information for isometric programming and strength specific work.*

Discussion

Future Directions:

- Future work is needed with a larger cycling population and longitudinal utility of peak isometric force.
  - Explore other joint angles
- Must investigate how many trials are needed to capture the best effort
- **How strong is strong enough?**
  - Change in peak isometric force versus change in peak torque

Questions?

Thank You!

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