The ability to produce force and the potential effects upon cycling endurance performance, a discussion based upon research carried out by The Endurance Coach LTD (Oct/Nov 2009).

Swimming, cycling and running are classed as 'aerobic sports' but they are very different in both nature and physiology. It is common for sports coaches and scientists to categorise sports as 'aerobic and anaerobic' or 'endurance and power' as this makes the teaching and understanding of physiology much easier. In reality, sports such as cycling cannot be categorised in such a way as multiple factors contribute to overall performance in a combined manner.

The story so far

We have completed a great deal of testing with both triathlon and cycle racing competitors and during the last 12 months noticed a common pattern related to cycle performance. Many athletes training for longer cycling or triathlon events were regularly scoring relatively low during maximal aerobic power testing (simple ramp test which starts at 150 watts and increases 20 watts per minute until exhaustion). For each of these athletes the following observation was made:

1. VO2 max was relatively low (for the triathlon competitors it was very low when compared to their 'running VO2 max')
2. Respiratory frequency was commonly low (this is breathing rate – breaths per minute)
3. The most common feedback from the athletes was: 'my heart and lungs feel ok but my legs just wouldn't go any further..'

We made a simple presumption that the aerobic energy system was well conditioned (supported by the fact that the triathlete running VO2 scores were generally much higher) and during the cycle test, athletes were simply unable to produce enough 'force' to turn the pedals.

Use the force

By 'force' we are referring to the ability of the muscles to contract and produce a high number of watts during a short sprint. In simple terms, when many riders reached 200-250 watts during the test, they simply couldn't produce enough force in their legs to turn the pedals, despite the fact their cardiovascular system was not even close to its maximum work limit.

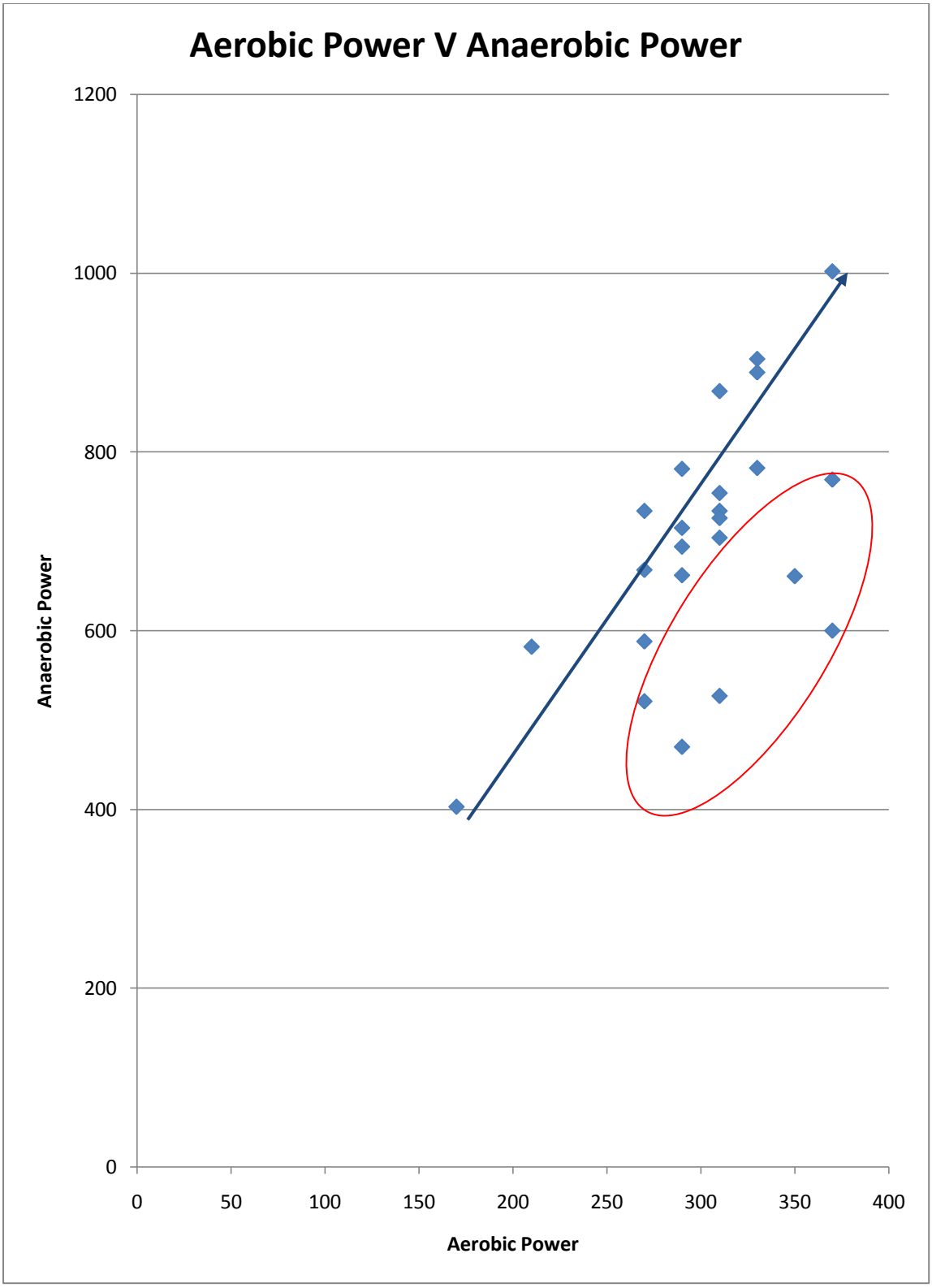
Out of curiosity, we decided to test 25 subjects (competitive cyclists and triathletes) and compare scores for maximal aerobic power (ramp test starting at 150 watts and increasing every minute by 20 watts) against maximal anaerobic power (peak power in 20 seconds sprint).

The ramp test is an 'aerobic' test relevant for triathlon and cycle endurance racing and the sprint test is 'anaerobic' and should be less relevant for such events. If this was the case, there would be no relationship between the two tests.

Interesting results

The graph below shows the relationship between maximal aerobic and anaerobic power. Initially the relationship was a little hazy, but when we removed those athletes circled in red from the equation, a much stronger correlation / relationship between aerobic and anaerobic power is displayed.

Who's circled in red? One of the most interesting discussion points is 'who are the athletes circled in red?' Those circled in red are almost identical in terms of competition and performance history, they are long distance athletes who (at risk of offending them!) can ride all day at a very slow speed but lack the ability to go fast and amongst them are multiple ironman triathlon competitors.



The conclusion

We hypothesise from the results that the ability of the athletes to score high on the maximal aerobic power (ramp) test is influenced by their ability to produce a high amount of force in a 20 second sprint (maximal anaerobic power). In essence, those who scored highest on the aerobic test also scored highest on the anaerobic test and vice versa. Those who did not follow this pattern are the athletes

circled in red who displayed almost identical training and competition backgrounds (long and slow) and this can potentially explain their poor correlation.

We also hypothesise that their low VO2 max scores are not their 'true' VO2 max scores. The inability to produce force lead to the test ending early for many athletes prior to them actually reaching their VO2 maximum: 'my heart and lungs feel ok but my legs just wouldn't go any further'. This is supported by the fact that following the initial research, training techniques put in place to enhance 'force production' lead to increases in both maximal aerobic power **AND** scores for VO2 max.

It is important to stress that we are working with a specific population group, the athletes were age group triathletes, sportive riders and amateur time trial cyclists, we believe that the findings are specific to this population and is unlikely to be found in professional cyclists or triathletes. We also believe that this is more common in long distance triathletes and cyclists compared to short course athletes and is potentially damaging in terms of performance.

For more information relating to the potential effects see the article relating to aerobic base produced for the November 2009 newsletter:

http://www.theendurancecoach.com/PDF/morepower.pdf

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