**Intra-cyclic Distance per Stroke Phase, Velocity Fluctuations and Acceleration Time Ratio of a Breaststroker’s Hip: A Comparison between Elite and Nonelite Swimmers at Different Race Paces.**

**Authors**: Leblanc, H. et al


**Abstract**: Eighteen male French swimmers were divided into 2 groups based on their 100 Breaststroke PB. They swam 3 x 25m trials at 200, 100 and 50m race pace and were analysed via fixed video cameras and an instantaneous velocity meter (a similar device to the QAS Rex system). Four stroke phases were identified: Leg Propulsive Phase (velocity increase), Leg-Arm Lag Phase (velocity decrease), Arm Propulsive Phase (velocity increase) and Arm and Leg Recovery Phase (velocity decrease).

At all paces, elite swimmers travelled further than non-elite swimmers during the Arm Propulsive Phase but there was no significant difference between the distance travelled during the Leg Propulsive Phase. The duration and therefore distance covered during the Leg-Arm Lag Phase for both elite and non-elite swimmers decreased as swimming speed increased, this was significantly related with stroke length. Elite swimmers were able to maintain the distance travelled during the propulsive phases across the 3 race paces; however non-elite swimmers decreased this distance when pace decreased. There was no significant difference in the minimal velocity during the Arm-Leg Recovery Phase between both groups. Thus, to achieve a higher overall velocity, elite swimmers had a higher peak velocity during the Arm Propulsive Phase, leading to a higher velocity fluctuation. In other strokes it is generally accepted that it is more efficient to have less velocity fluctuation. However, this study found that because a faster breaststroke swimmer is under the same constraints as a slower breaststroke swimmer during the recovery phase (bringing the legs and hips up to begin the kick creates significant drag), more velocity fluctuation can be indicative of a faster swim. Elite swimmers also had a higher amount of time spent accelerating versus time spent decelerating. The combination of the increased velocity fluctuation and the better acceleration-deceleration ratio resulted in an increased stroke length.