



Freestyle Arm Entry Effects on Shoulder Stress, Force Generation, and Arm Synchronization

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Everett Pacific Industrial Rehabilitation

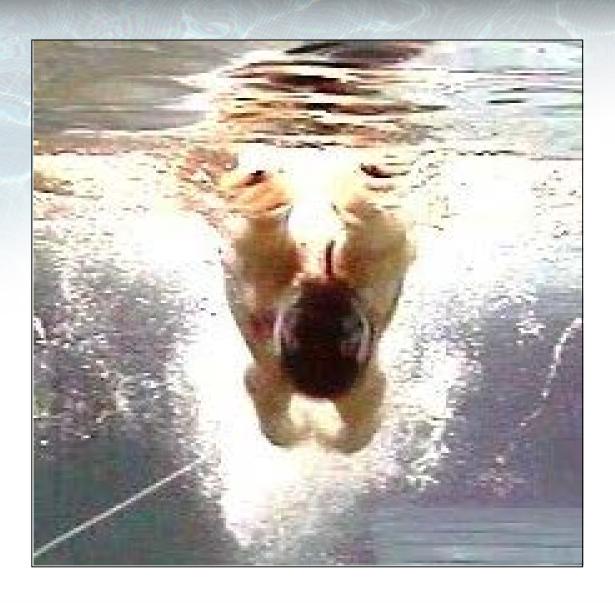
Rod Havriluk, Ph.D.

Swimming Technology Research



Shoulder Stress

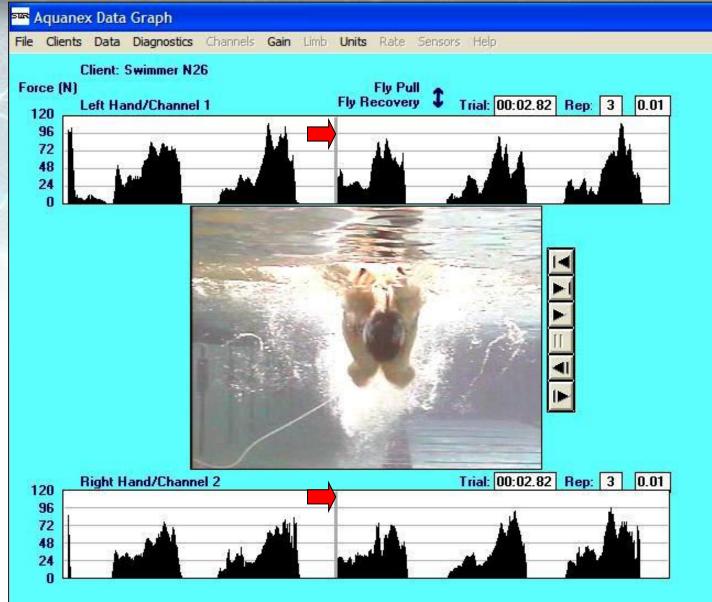






Shoulder Stress

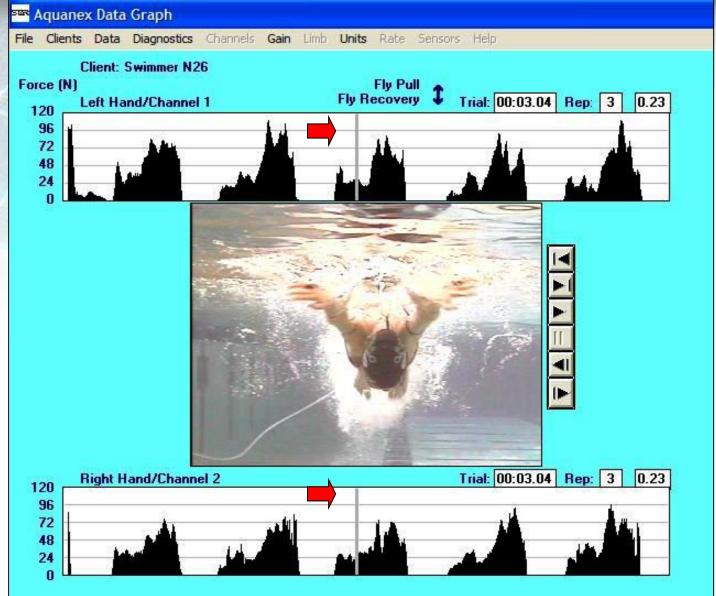






Minimal Force

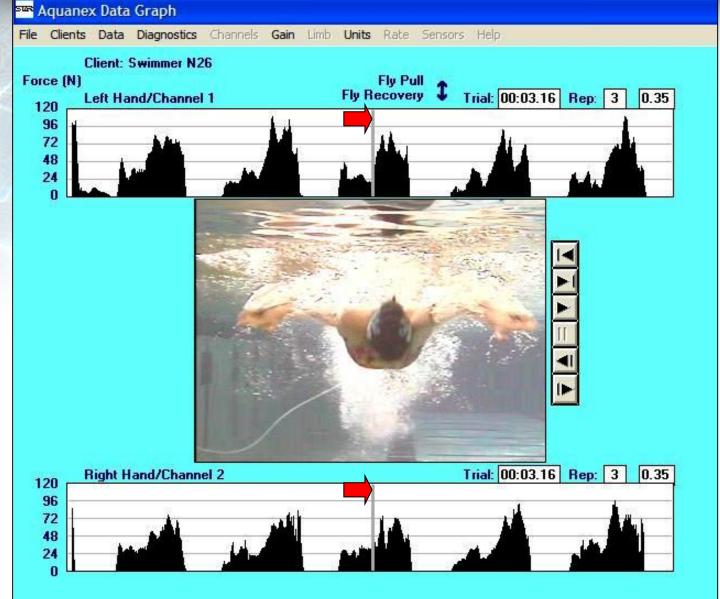






Exposure Time = .35 sec

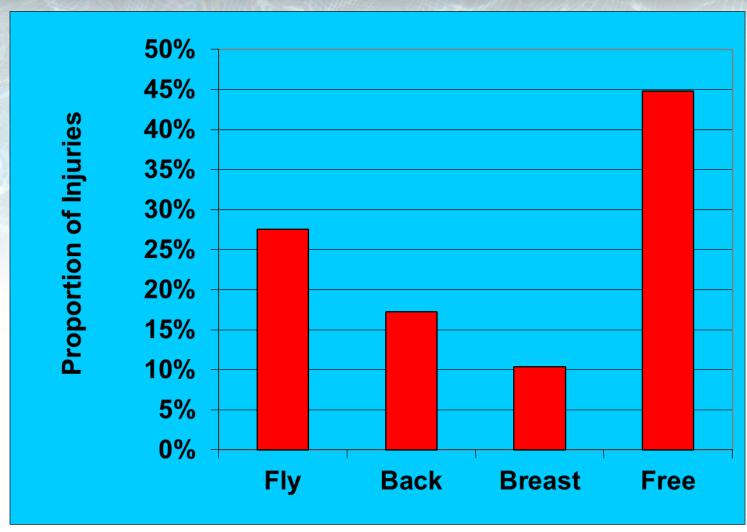






Injury by Specialty





Haupenthal et al, 2006



Hand Entry Position



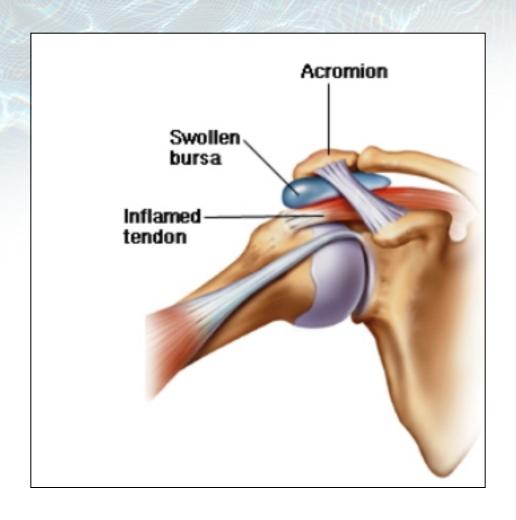


Becker & Havriluk, 2011



Shoulder Anatomy







Effects of Arm Entry



- 1. Shoulder Stress
- 2. Arm Synchronization
- 3. Force Generation



University Swimmers



Gender	n	Height (cm)	Mass (kg)
Male	20	186 ± 5.6	85.6 ± 8.3
Female	20	165 ± 5.6	61.9 ± 7.3



Test Preparation







Video and Force Data

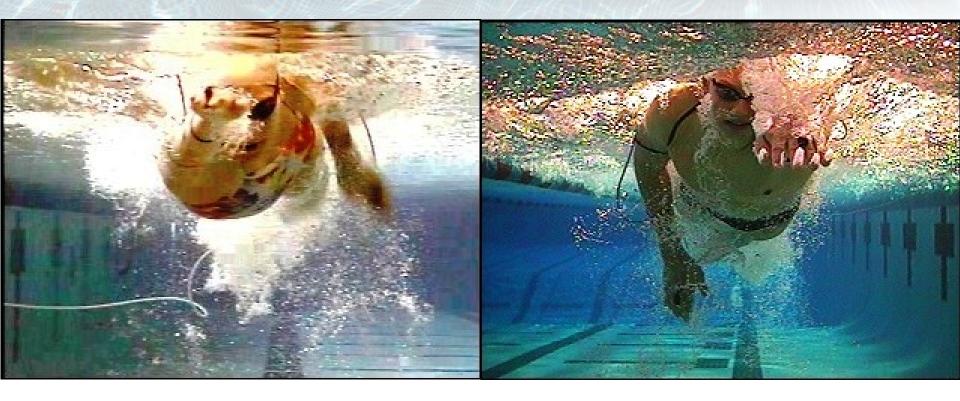






Typical Arm Entry





Female

Male



Typip till alt directed Alternative yy

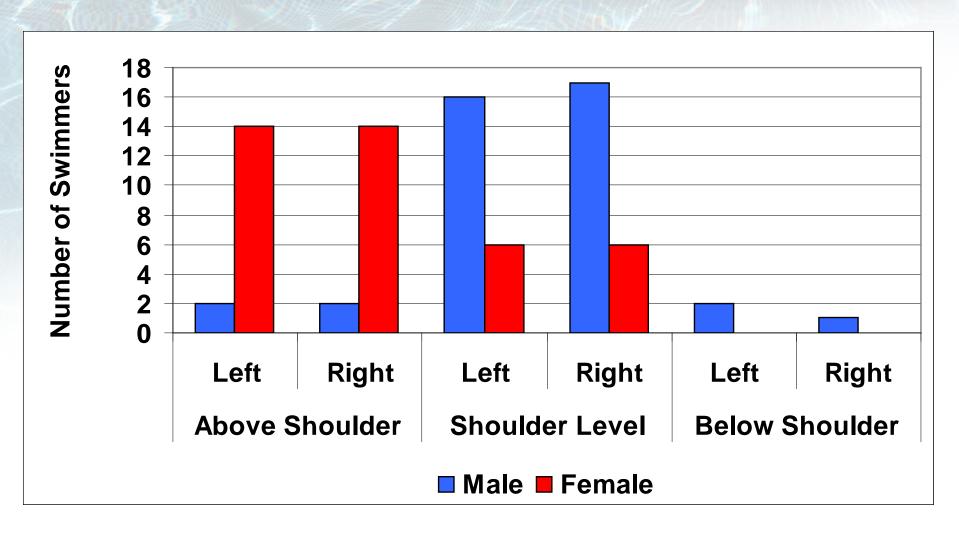






Hand Entry Position

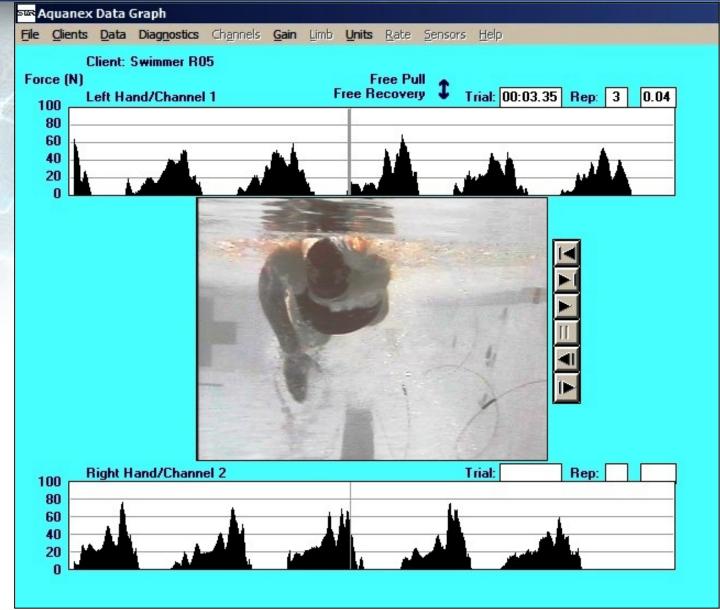






Typical Female Arm Entry







Exposure Time = .25 sec

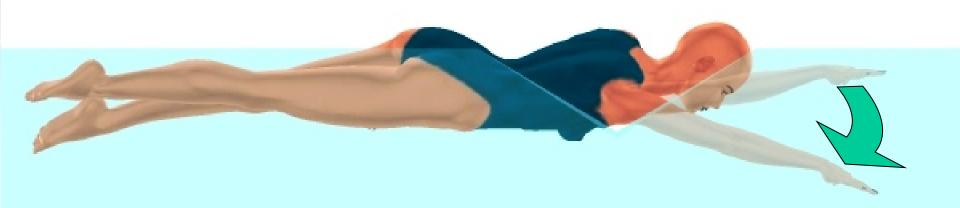






Exposure Phase

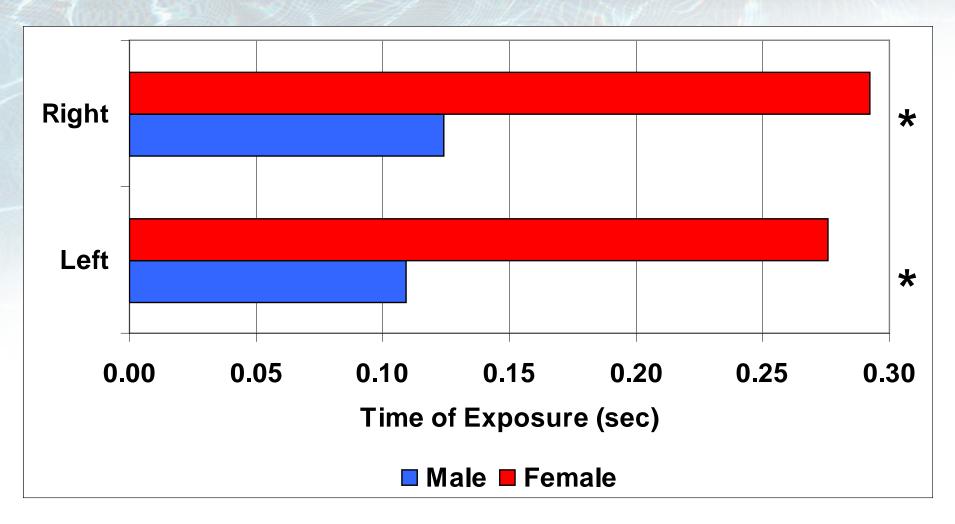






Exposure Time

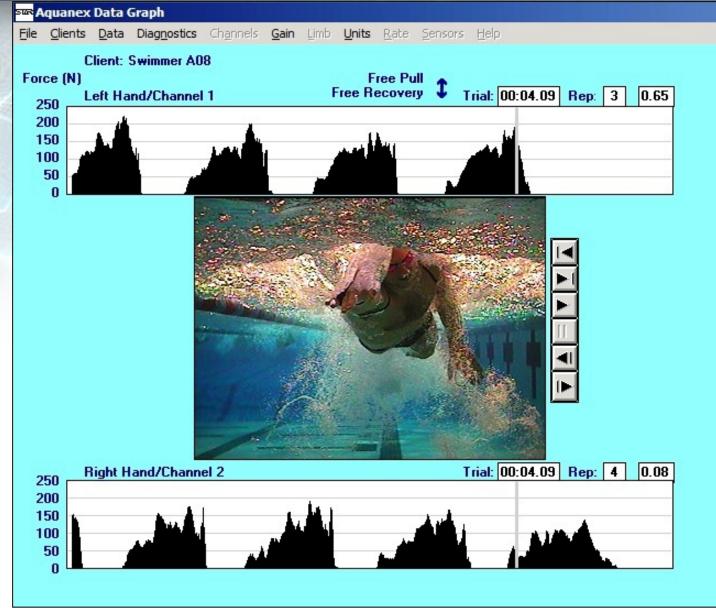






Typical Male Overlap

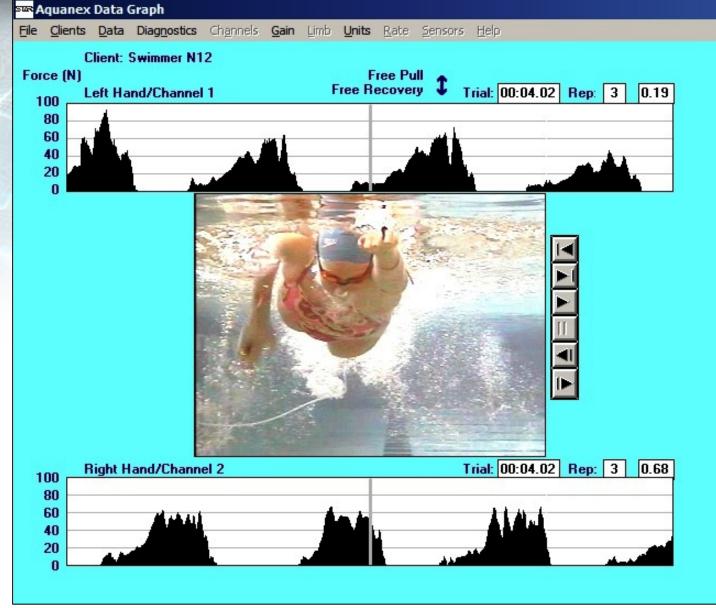






Typical Female Overlap

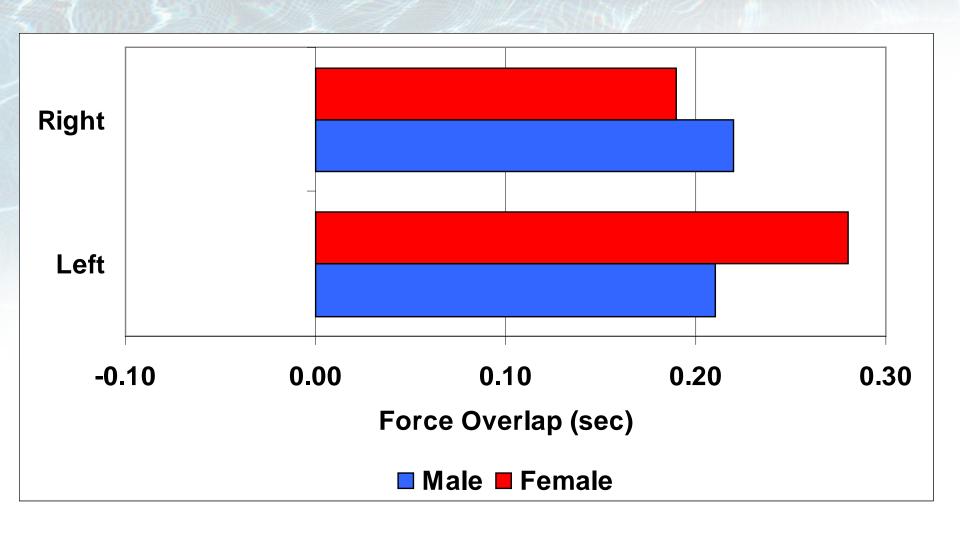






Force Overlap

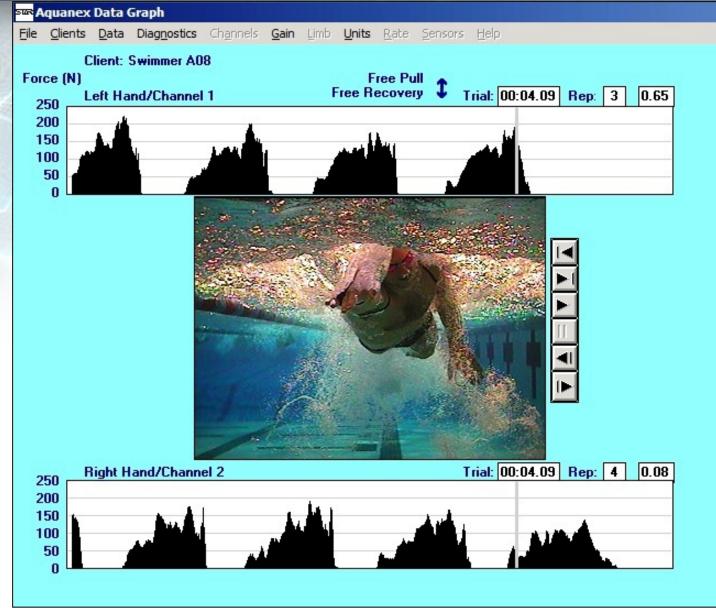






Typical Male Overlap

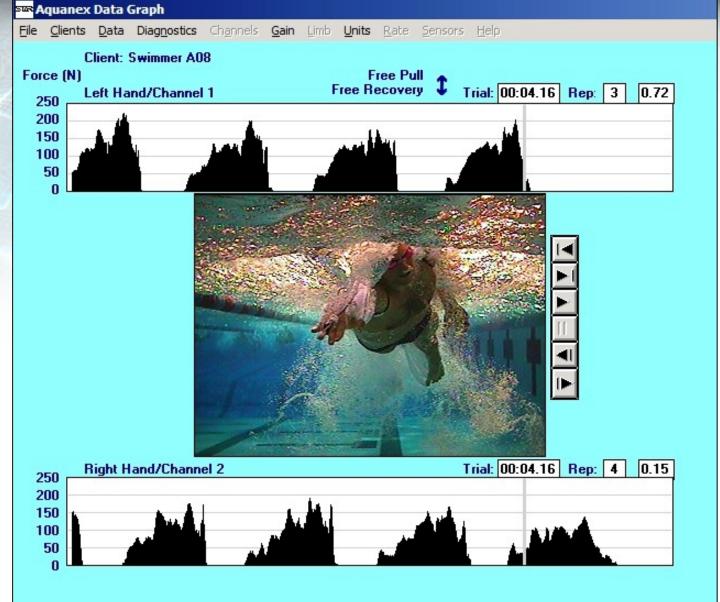






Typical Male Overlap

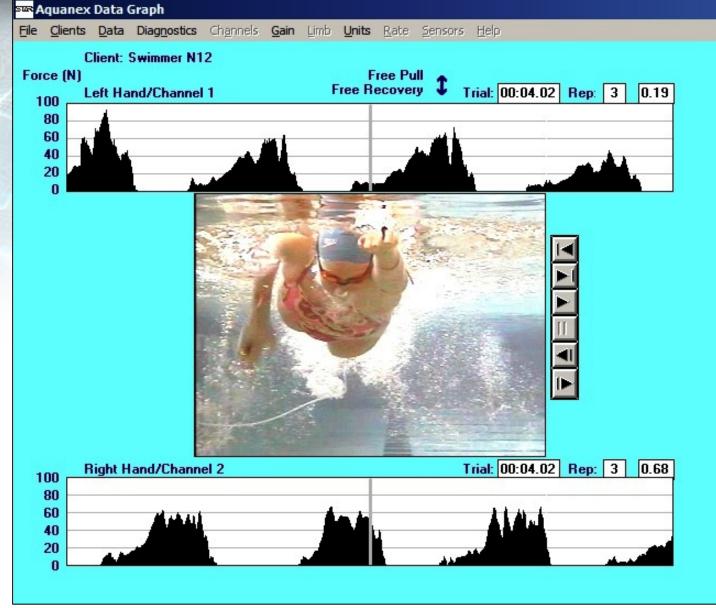






Typical Female Overlap

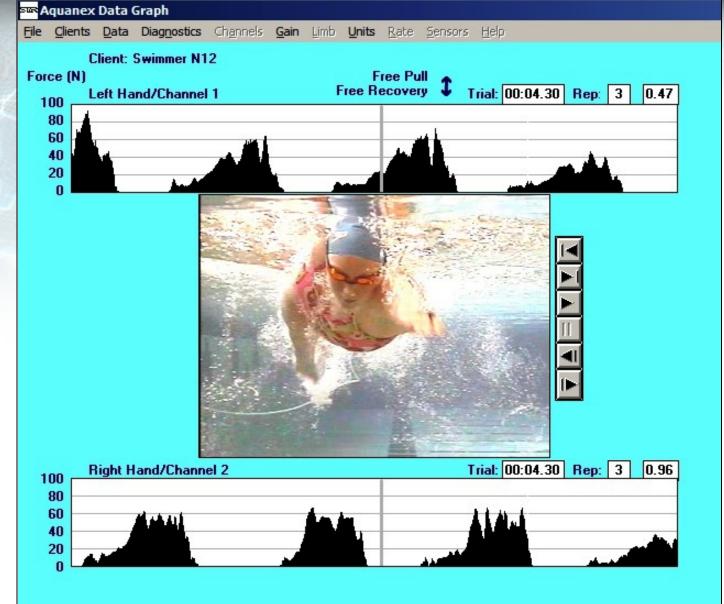






Typical Female Gap

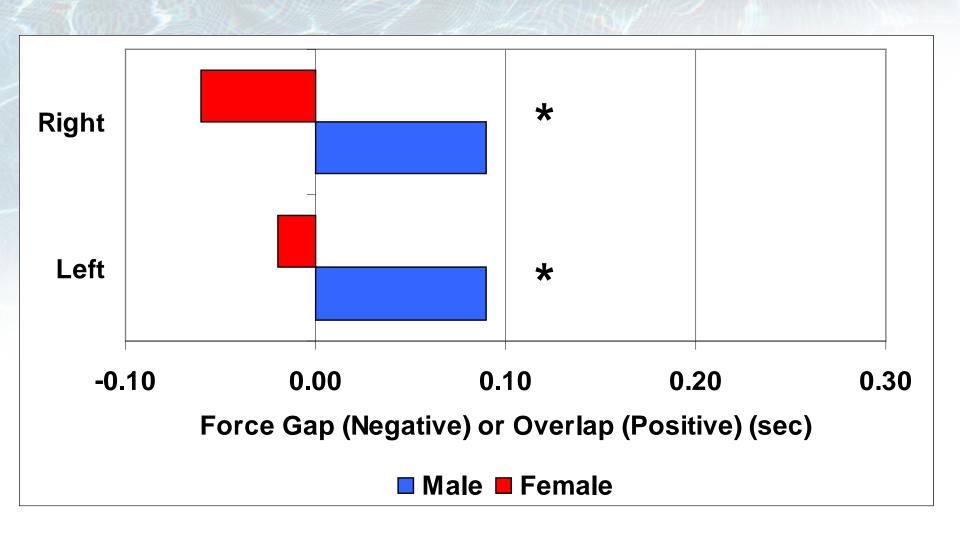






Force Gap/Overlap

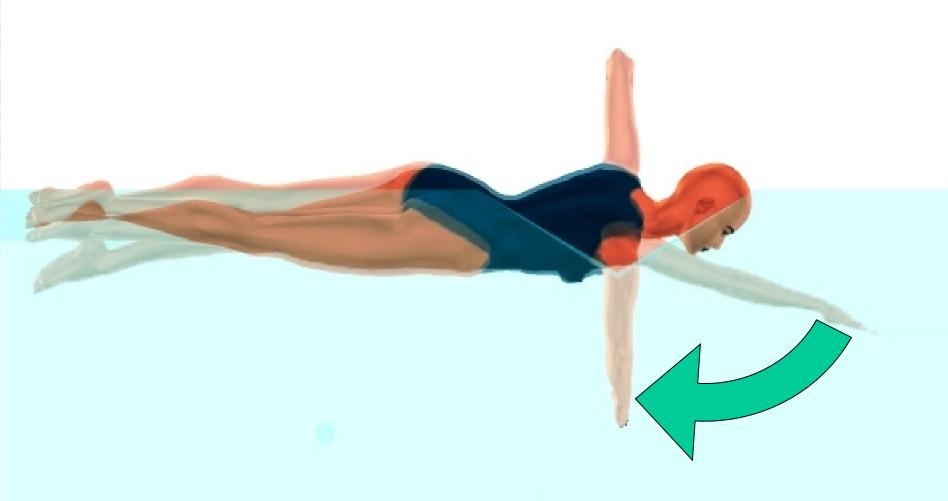






Pull Phase

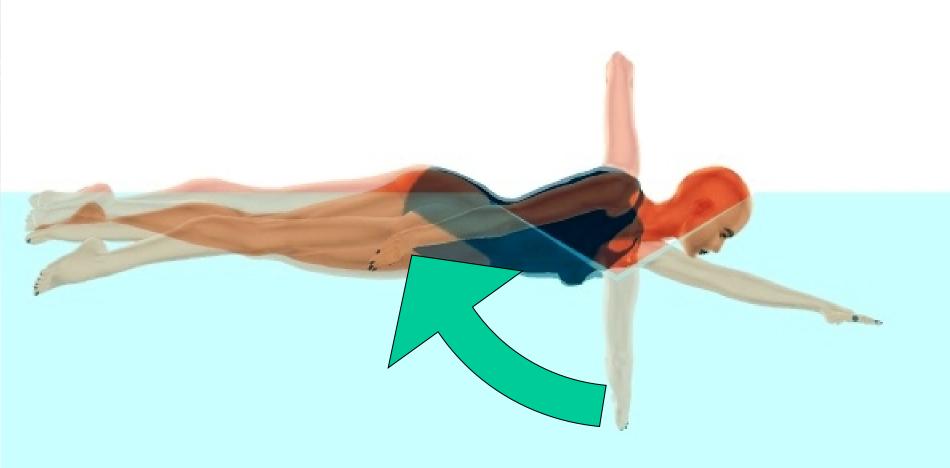






Push Phase

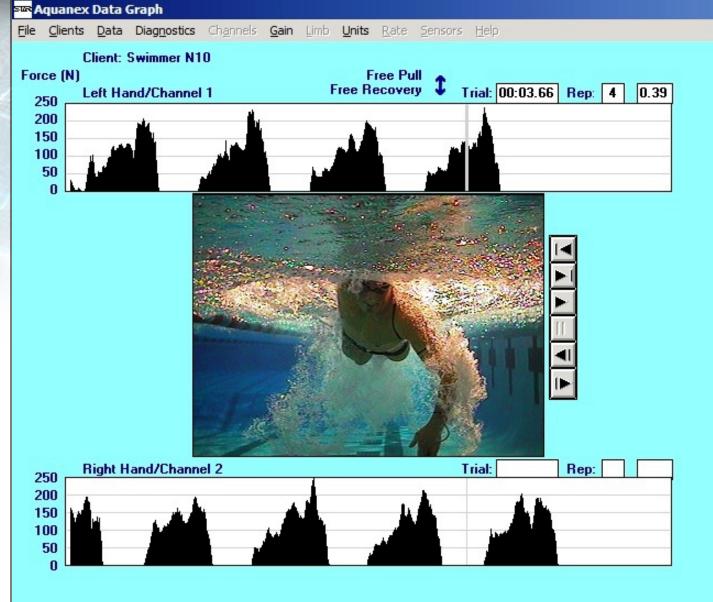






Typical Male Push Phase

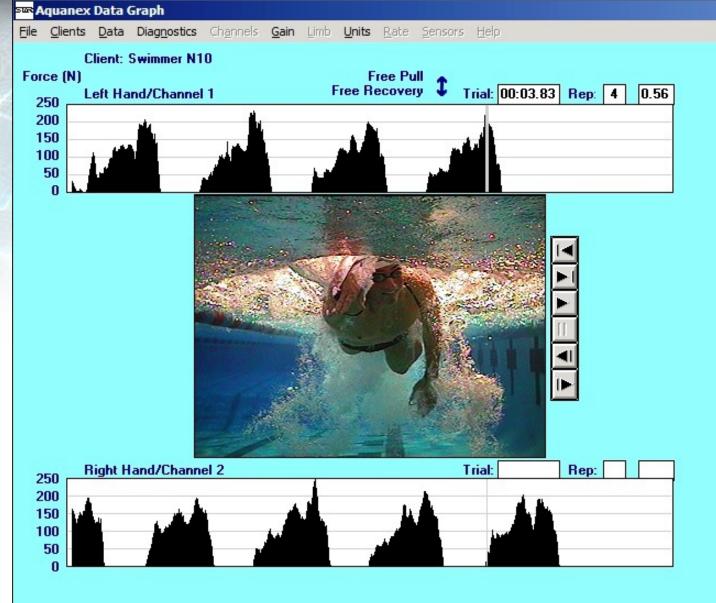




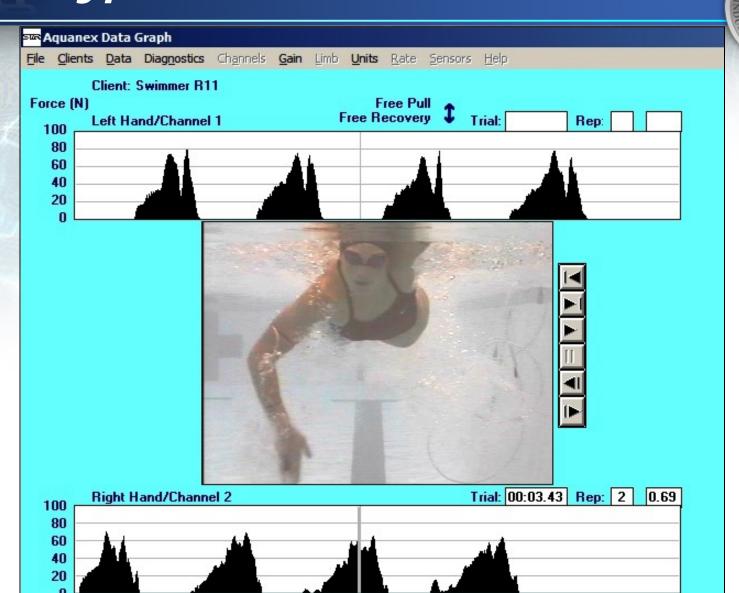


Force Increase





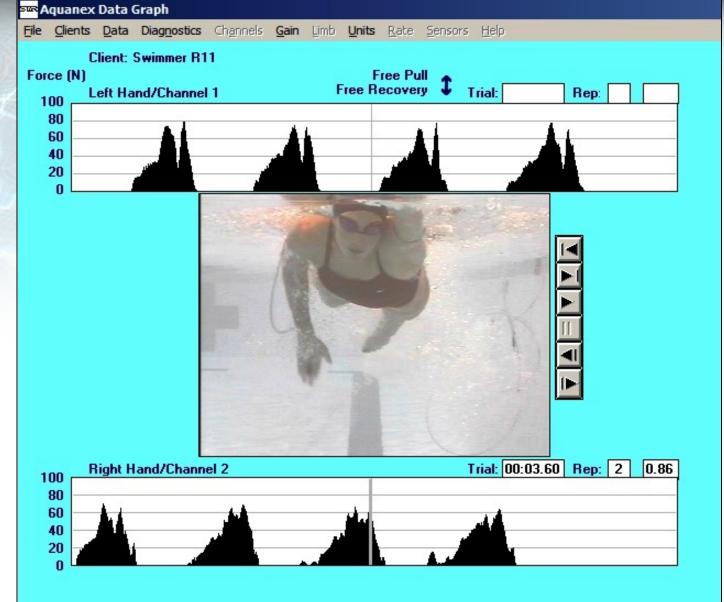
Typical Female Push Phase





No Force Increase







Average Force by Phase







Conclusions



- Minimize Shoulder Stress Modify Arm Entry
- Arm Synchonization -Immediately Begin Pull
- Force Generation Increase Hand Force on Push





Thank You!

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