

Skill Acquisition and Injury Prevention

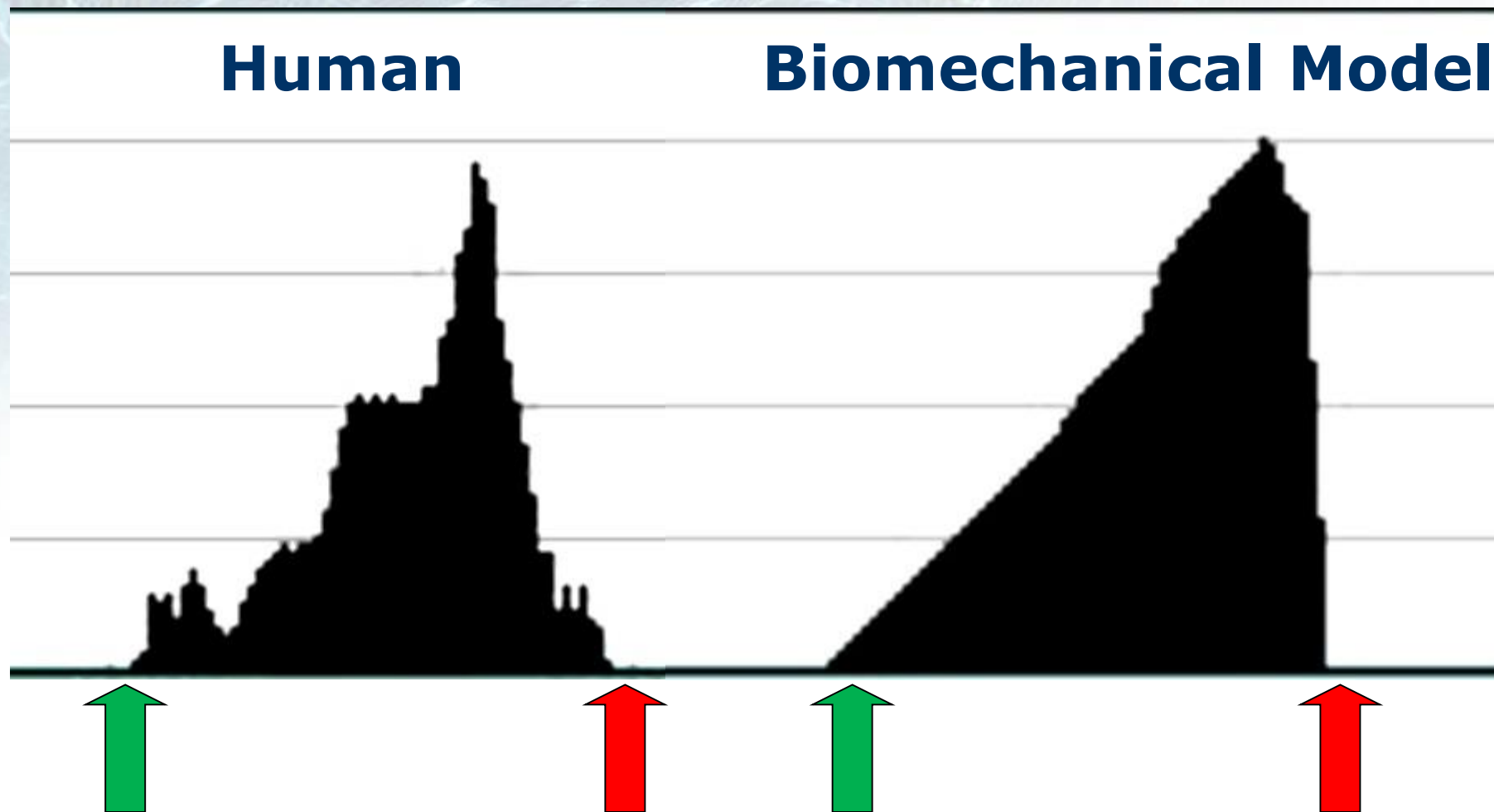
Rod Havriluk, Ph.D.

Swimming Technology Research



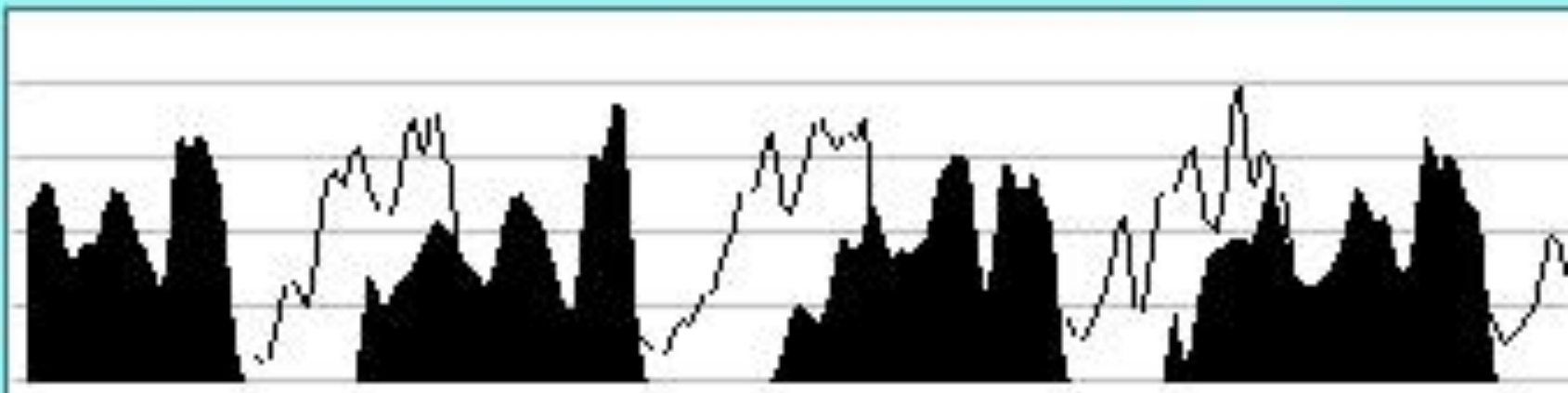
Swim Practice



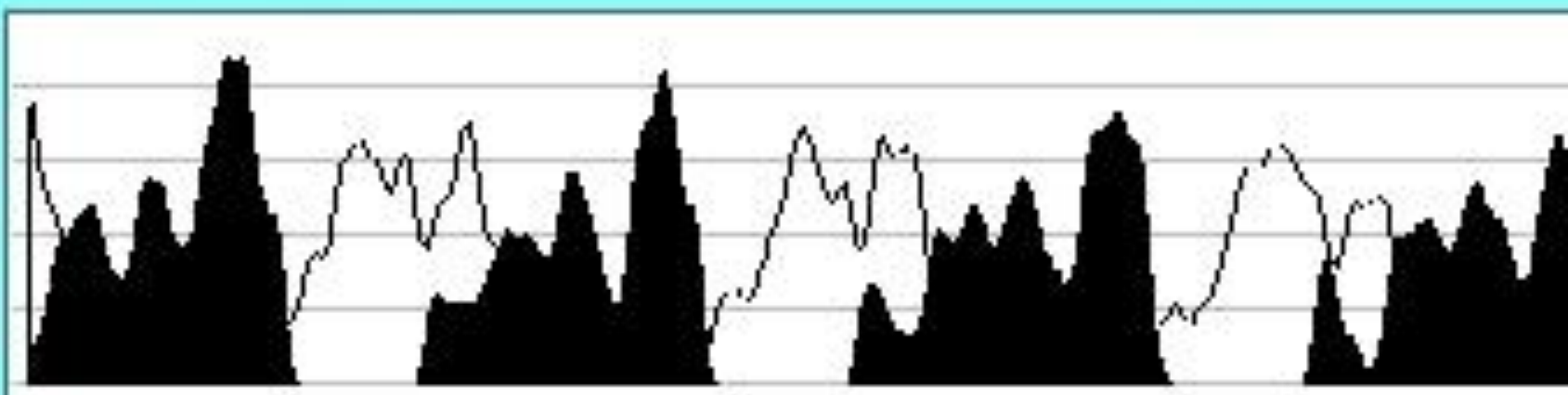


Who is the Olympian?

1

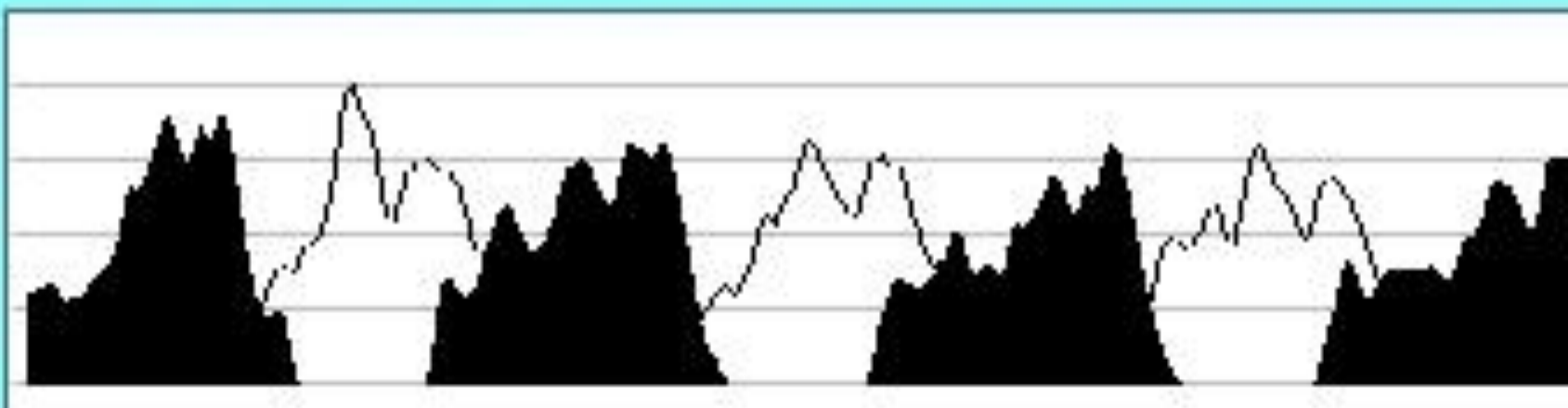
34
28
21
14
7
0

2

34
28
21
14
7
0

Who is the Olympian?

3

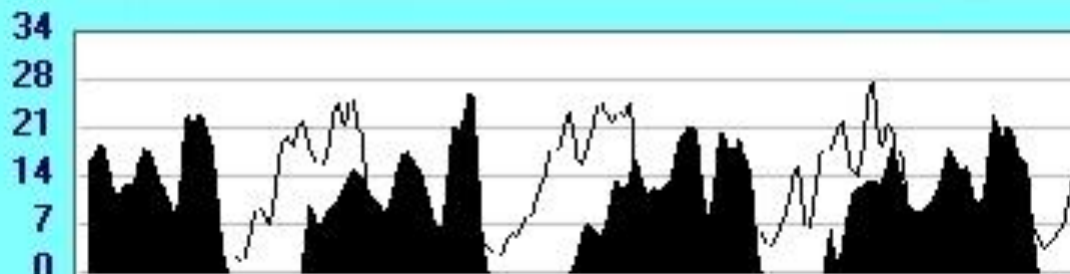
34
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21
14
7
0

4

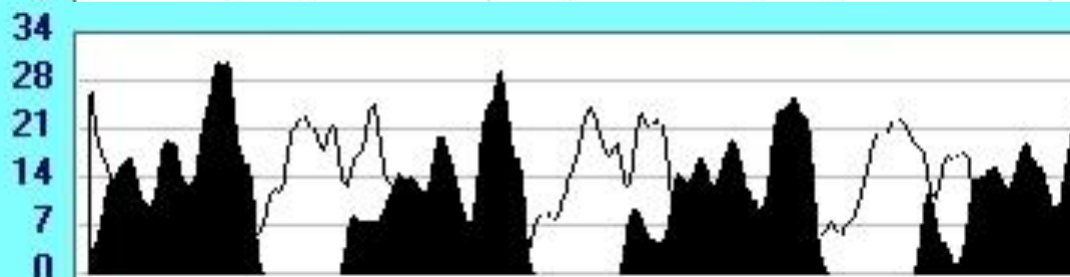
34
28
21
14
7
0

Who is the Olympian?

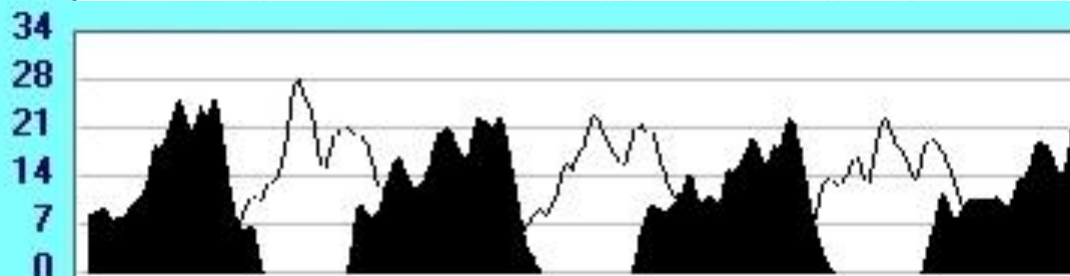
1



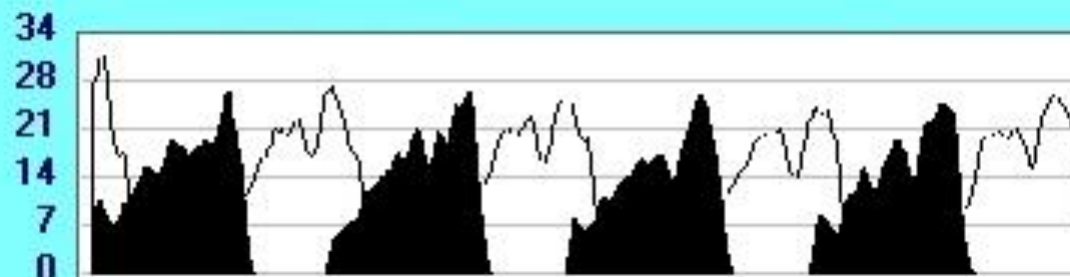
2



3



4

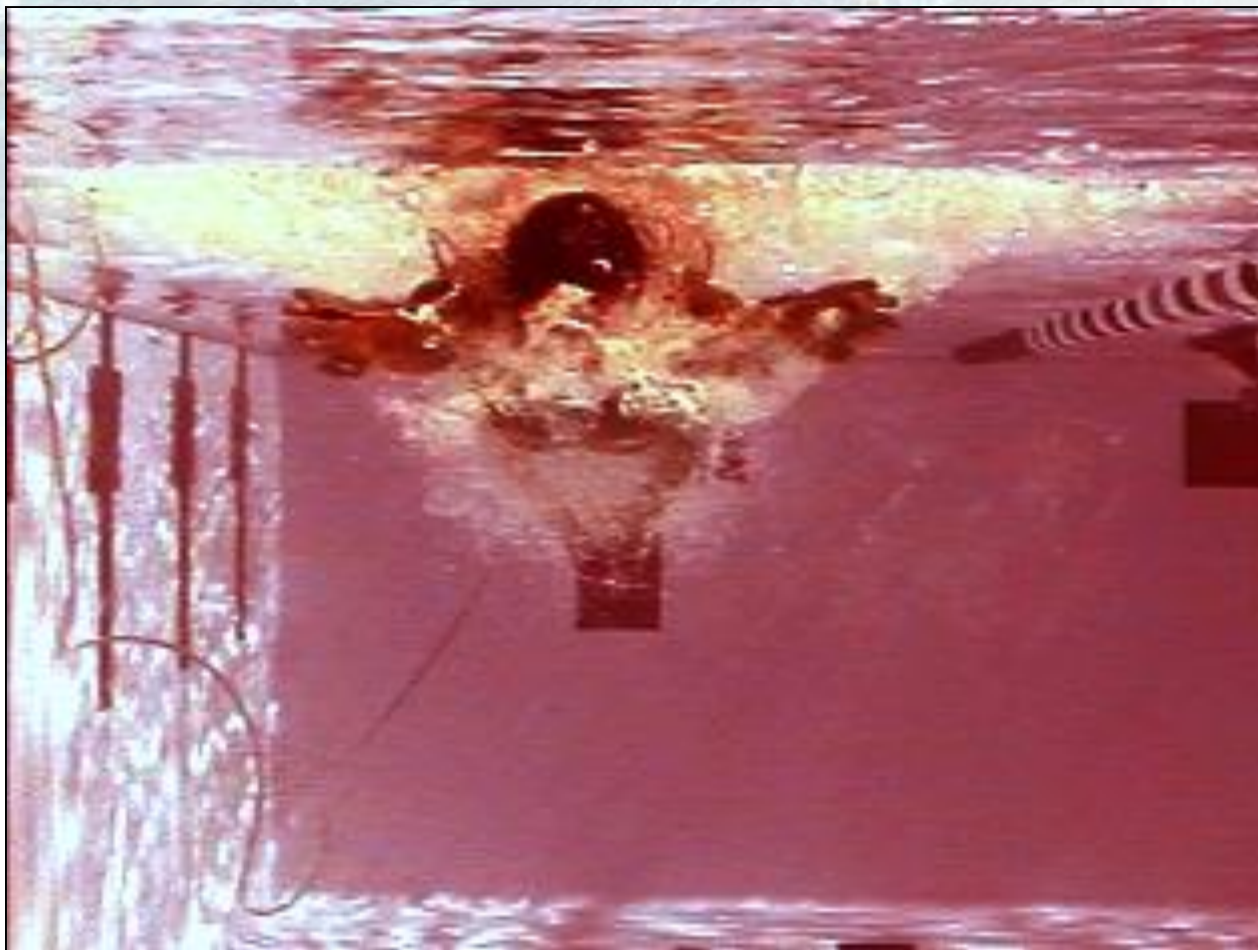


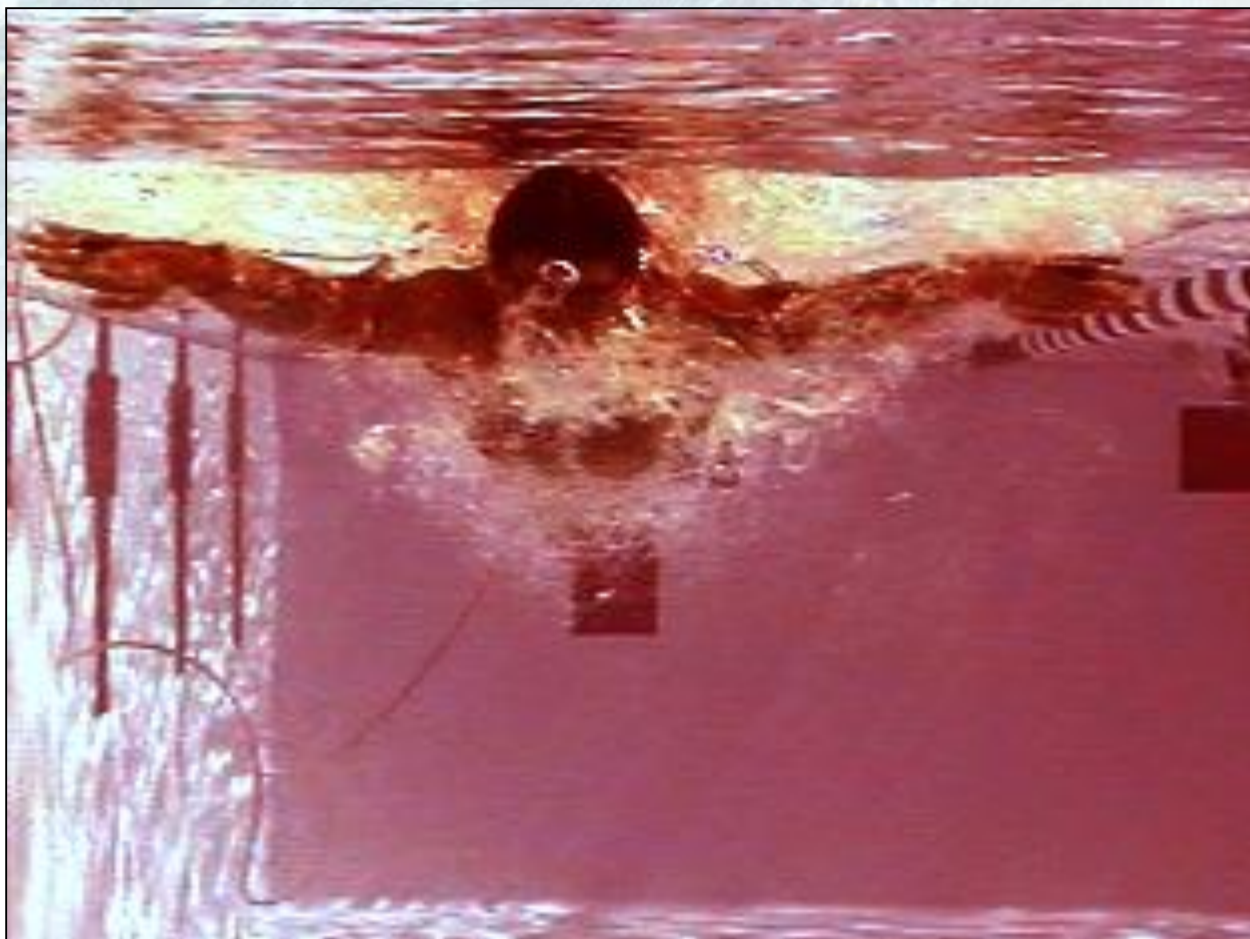


Performance Factors

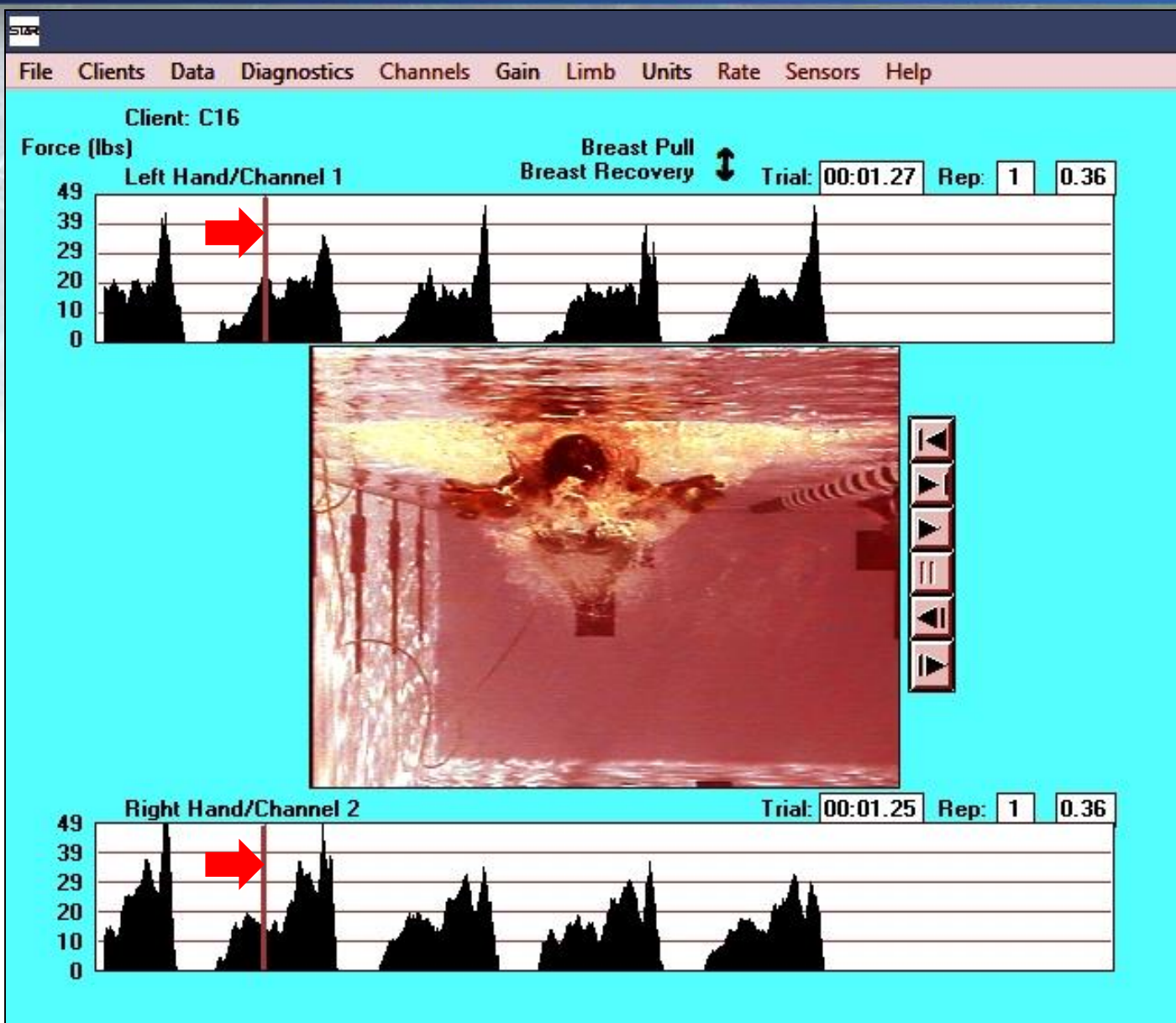
	Less Competitive	Average	More Competitive
Strength <i>Peak Hand Force (lbs)</i>	30	40	50
Conditioning <i>Max Oxygen Uptake (ml/kg/min)</i>	40	50	60
Technique <i>Drag Coefficient</i>	1.2	1.0	.8

Model Olympians?

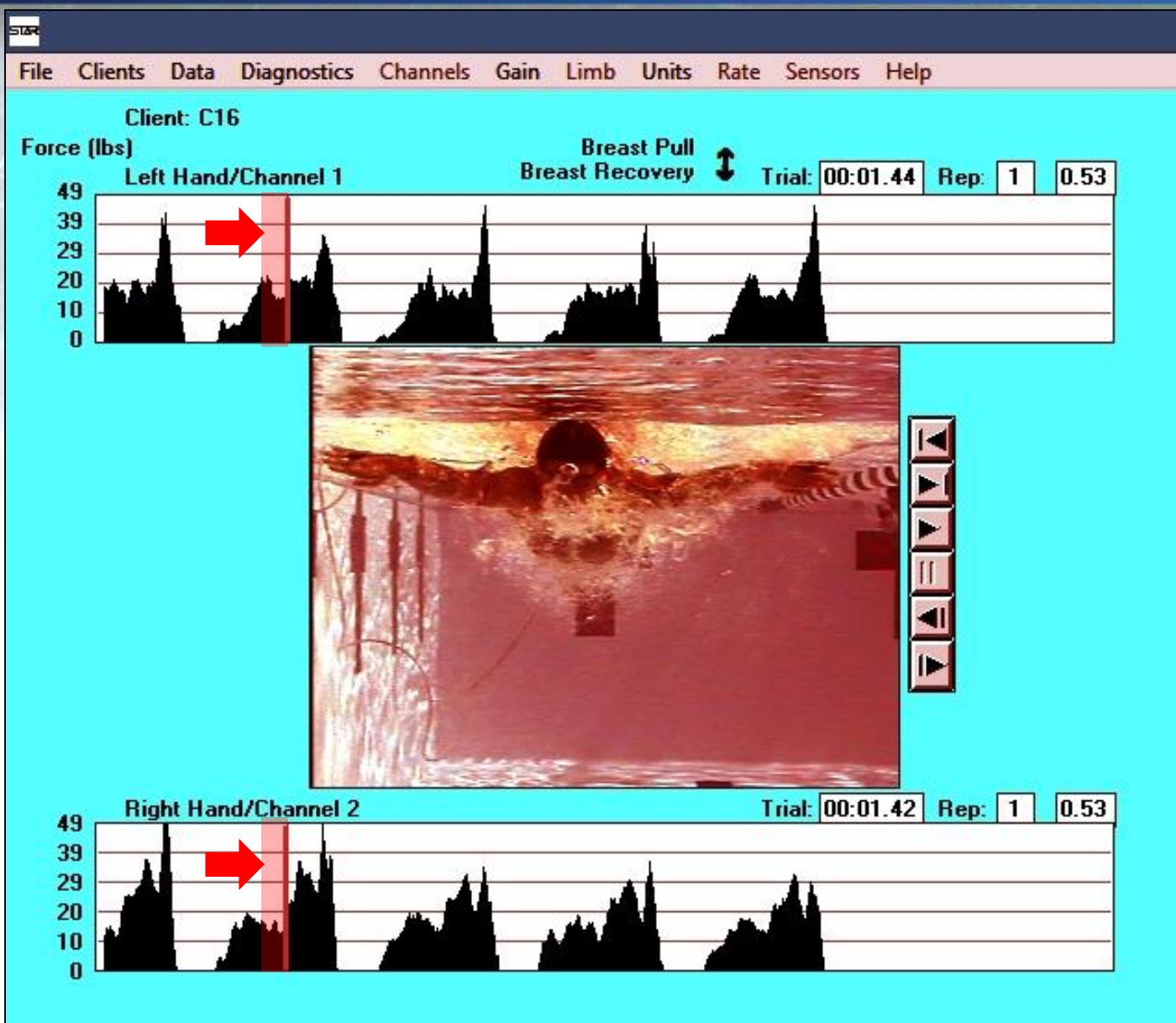




Breaststroke Olympian



Breaststroke Olympian



Model Olympians?

Quantify Technique

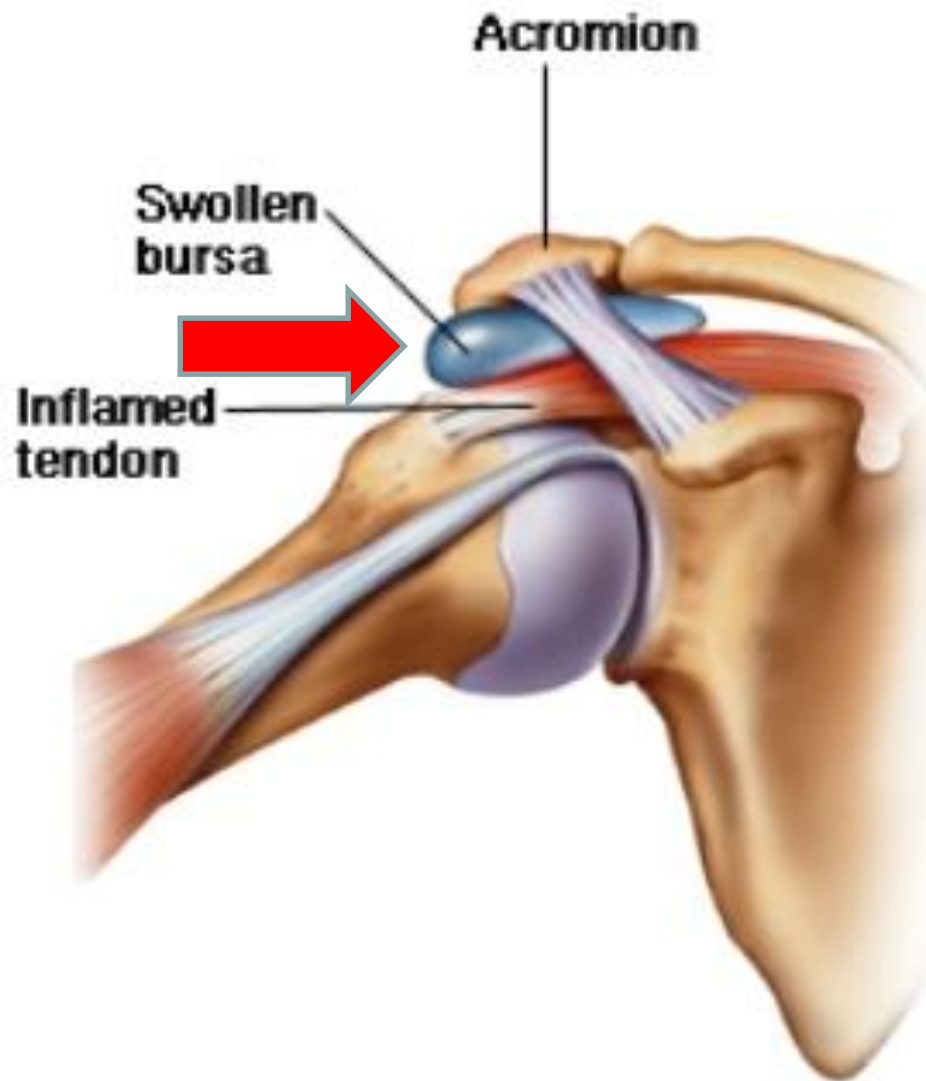
Model Superhumans?

Swim like _____.

Apply Physics

Quantify Technique

Shoulder Anatomy



- ▶ **Over 50% Reported Injury**
(Haupenthal, et al., 2006)
- ▶ **Over 67% Suffered Injuries**
(Rodeo, 2011)
- ▶ **Up to 80% Experienced Pain**
(McMaster & Troup, 1993)
- ▶ **Up to 65% Suffer Problems**
(Cleveland Clinic, 2014)



More Shoulder Stress

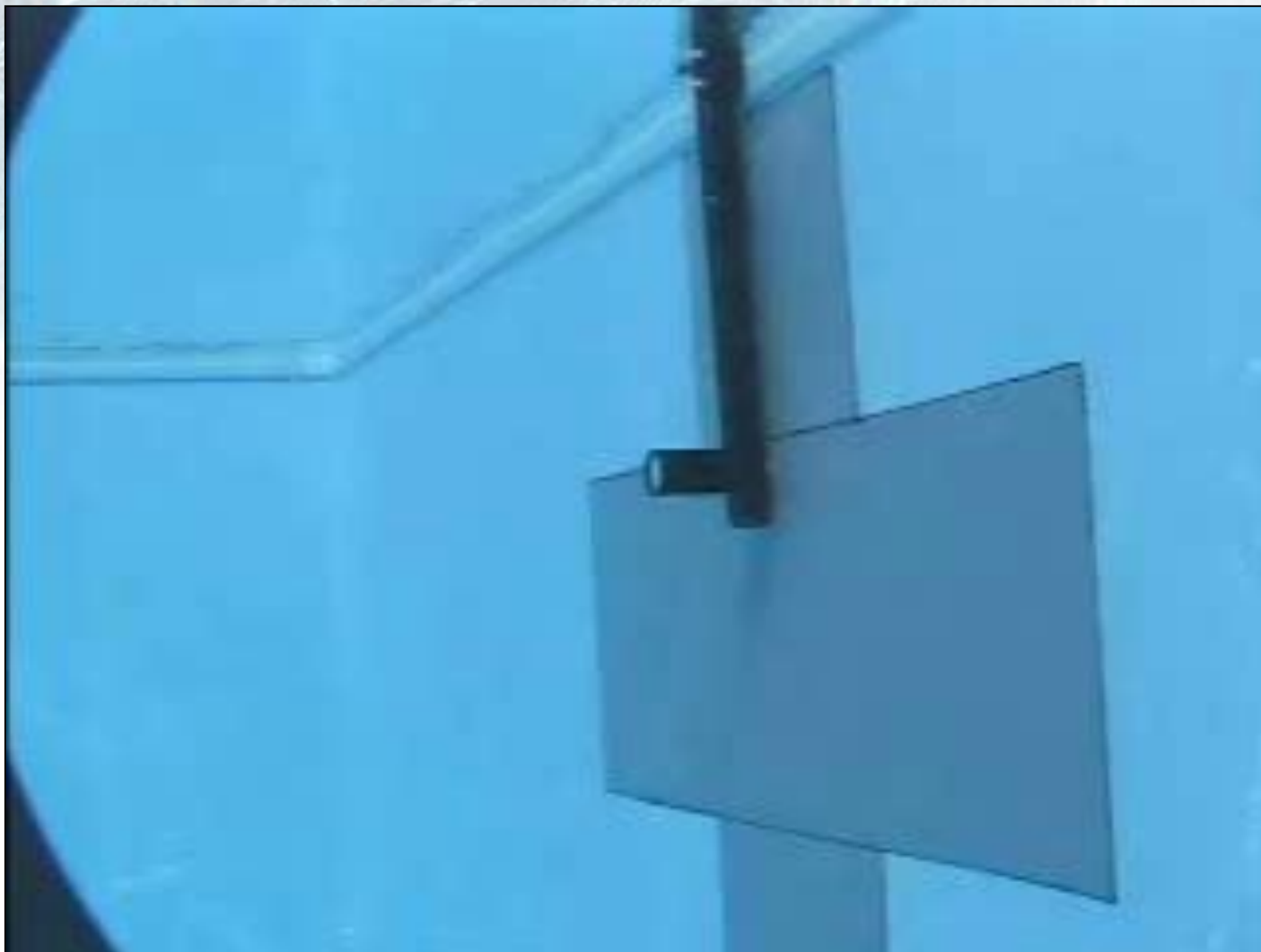






Test Preparation



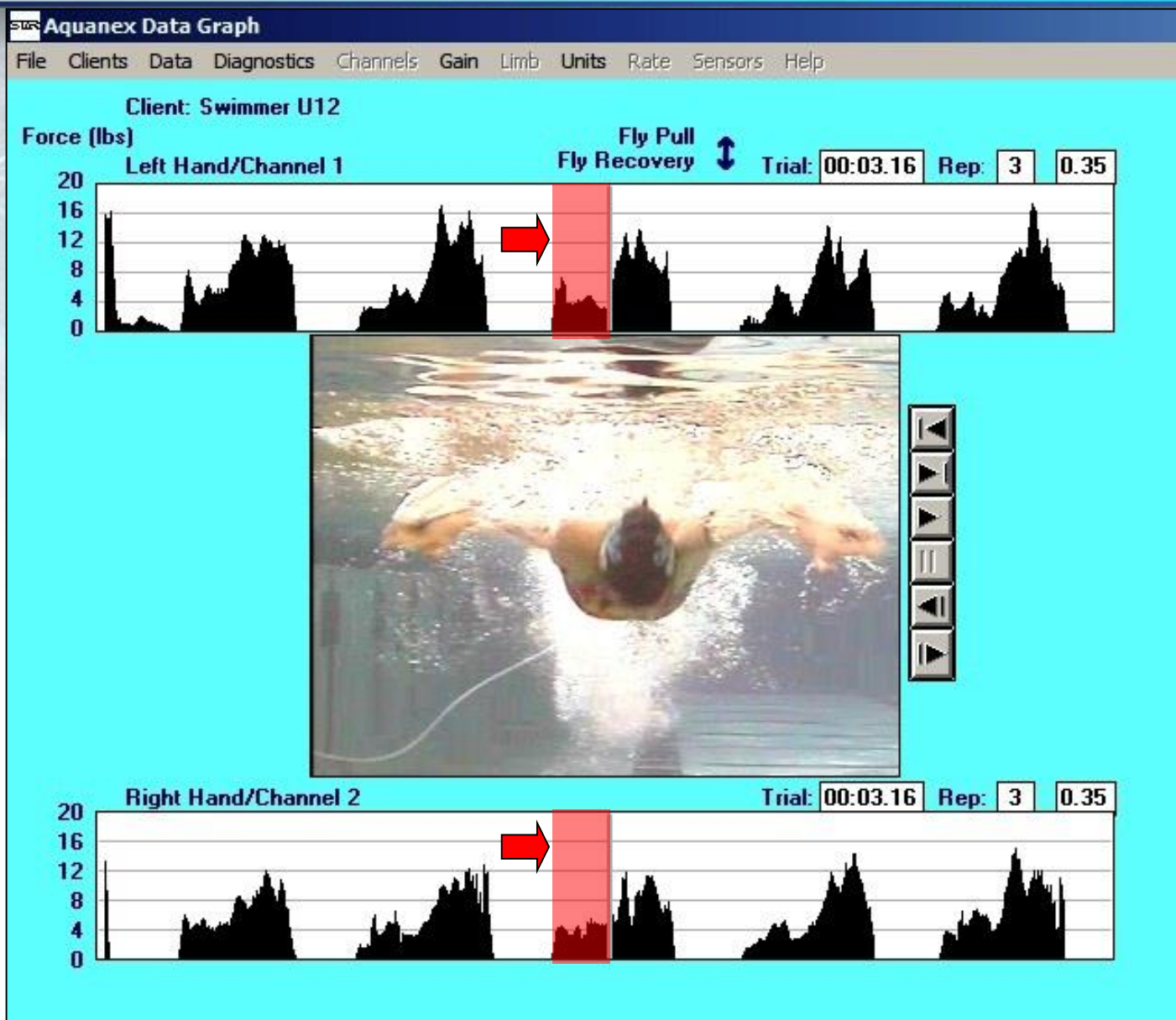








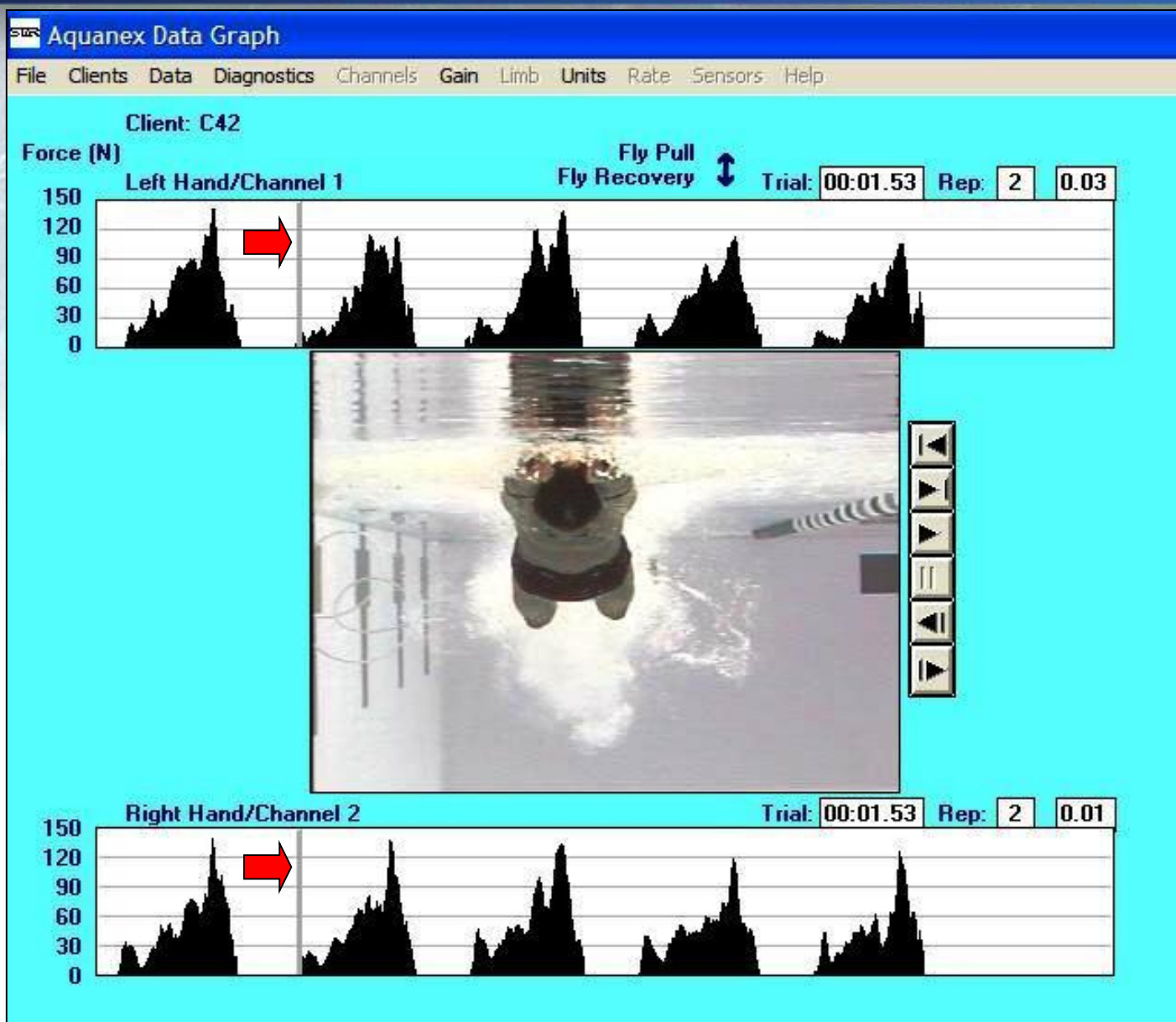
Exposure Time = .35 sec



Less Stressful Entry

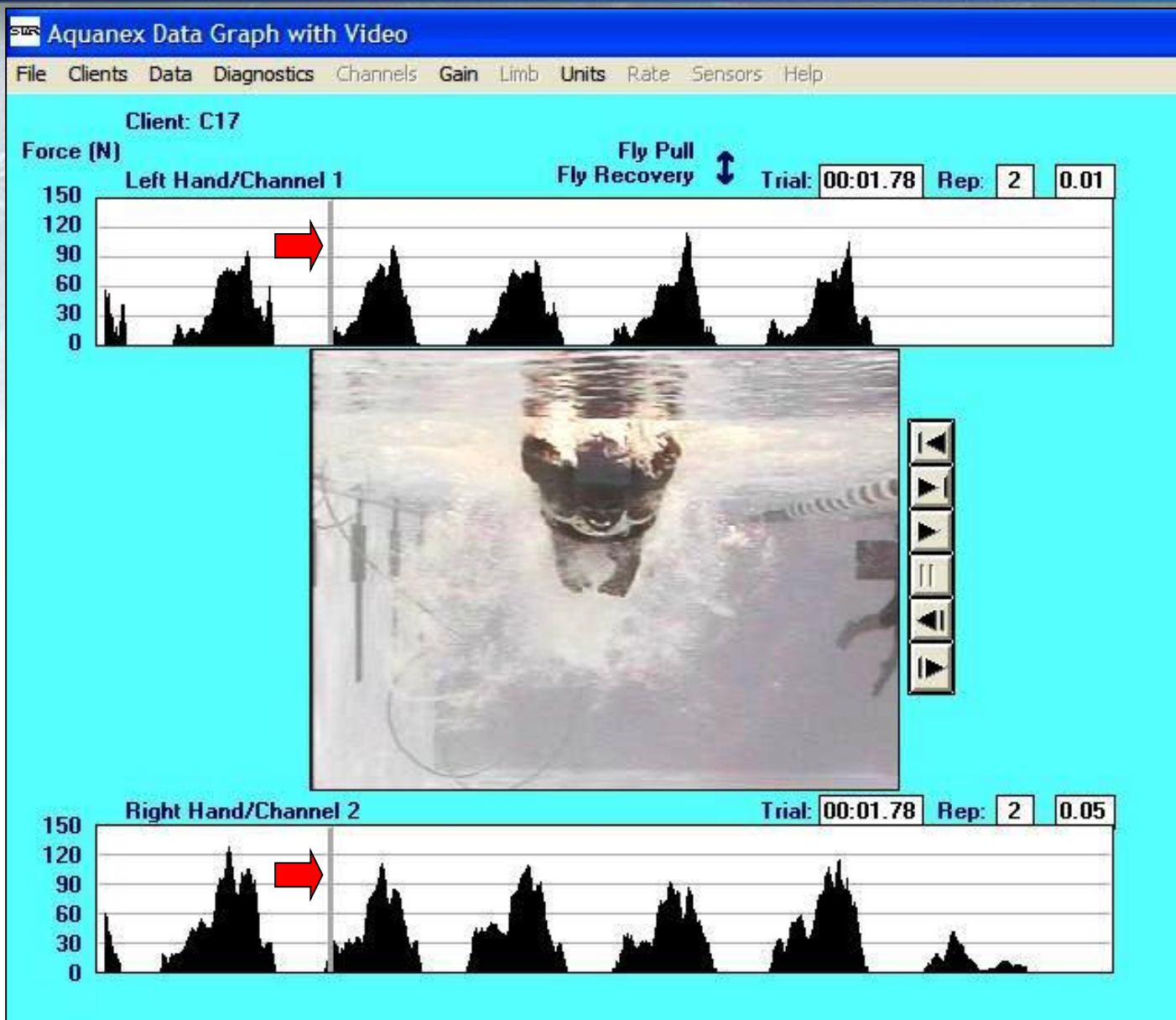


Less Stressful Entry

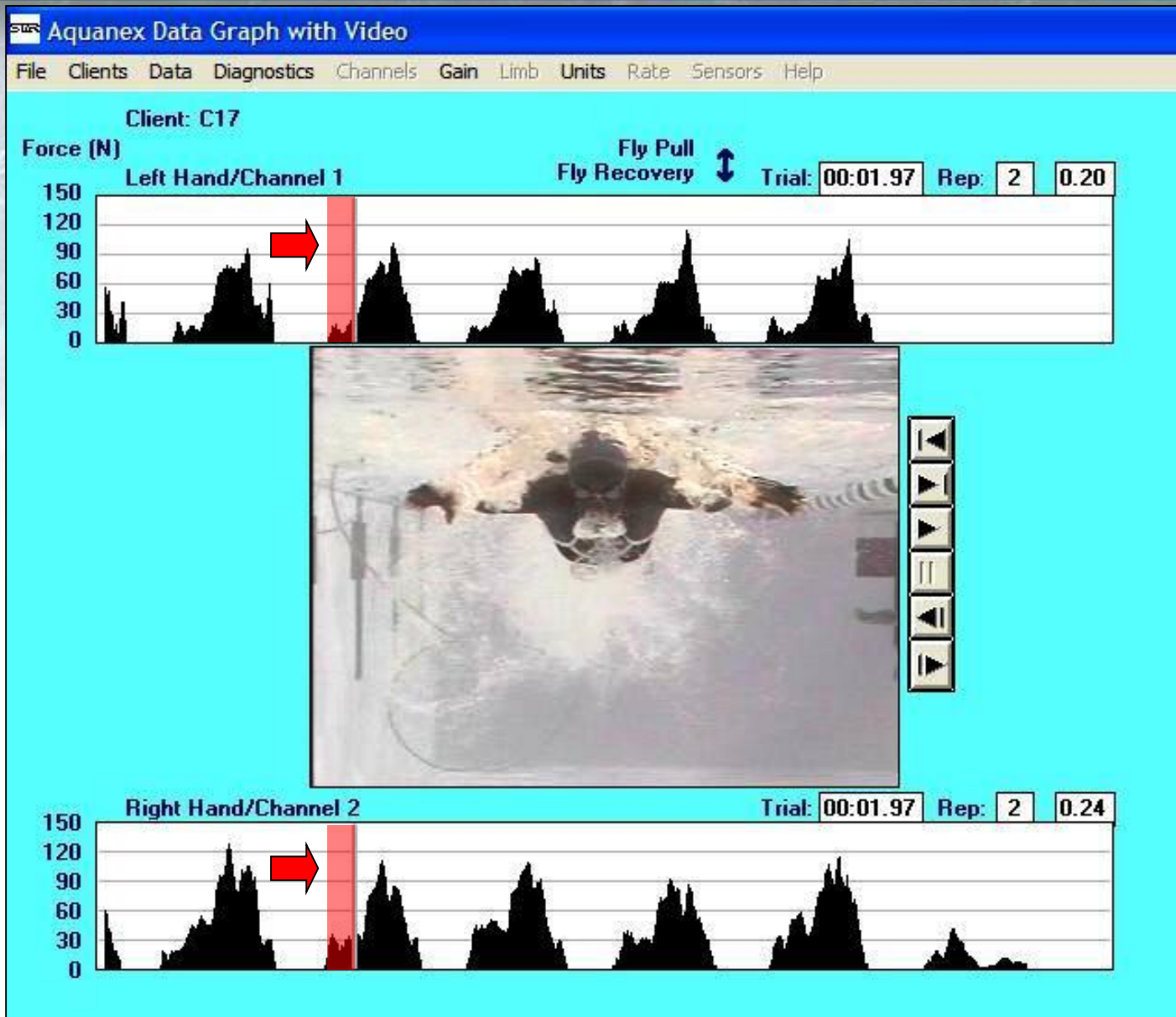




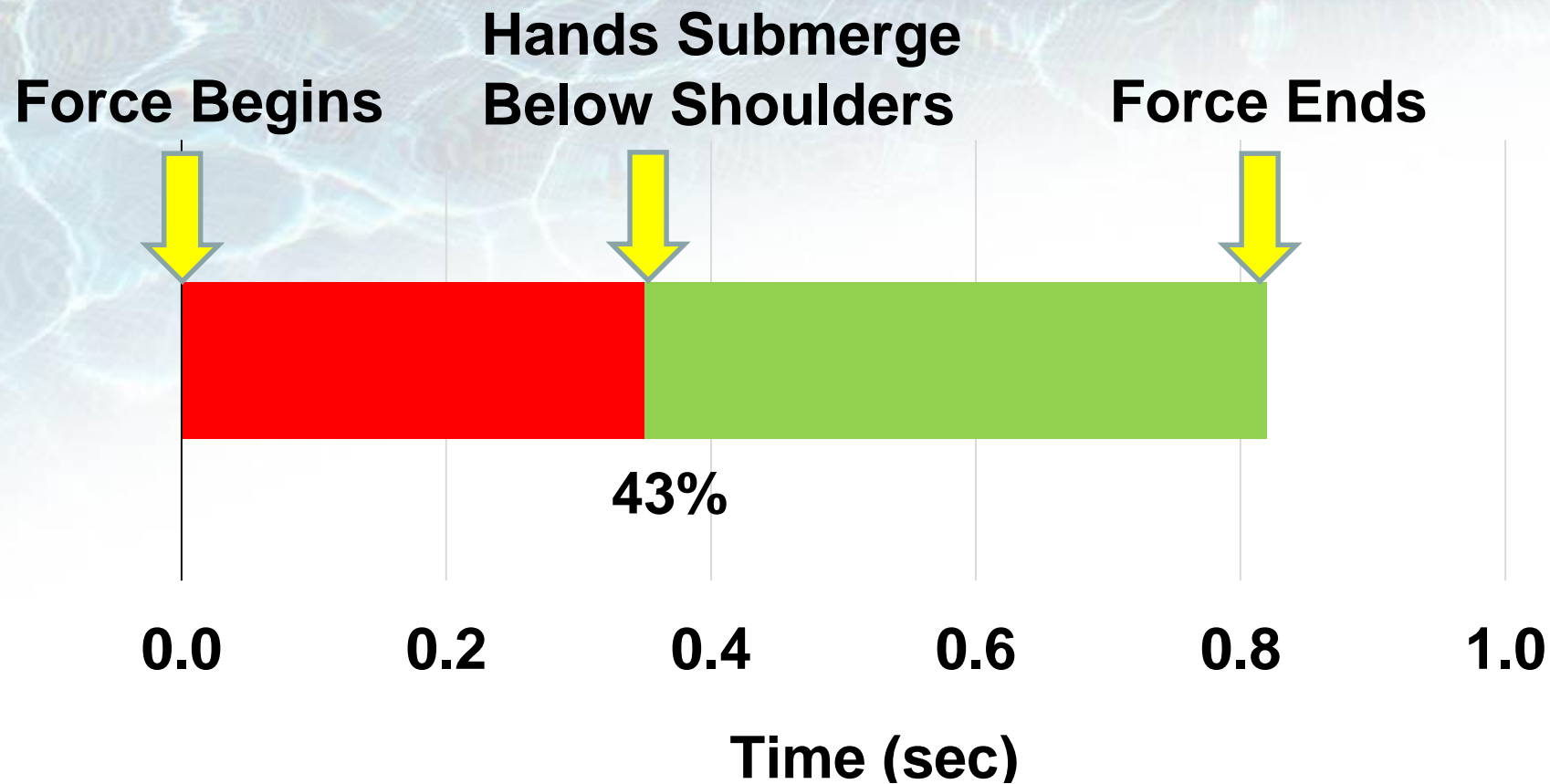
Less Stressful Entry



Exposure Time



Exposure Time



Becker & Havriluk, 2010

Effective Entry



Elbows Above Hands



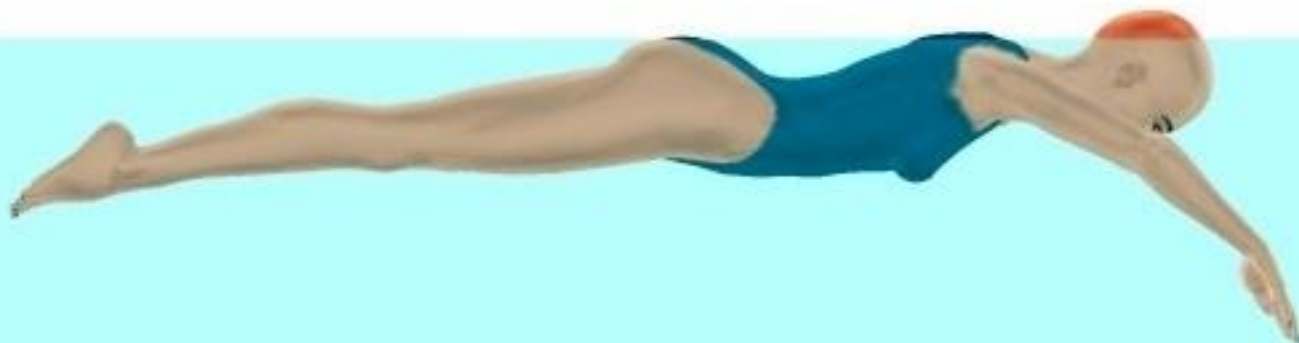
Downward Angle



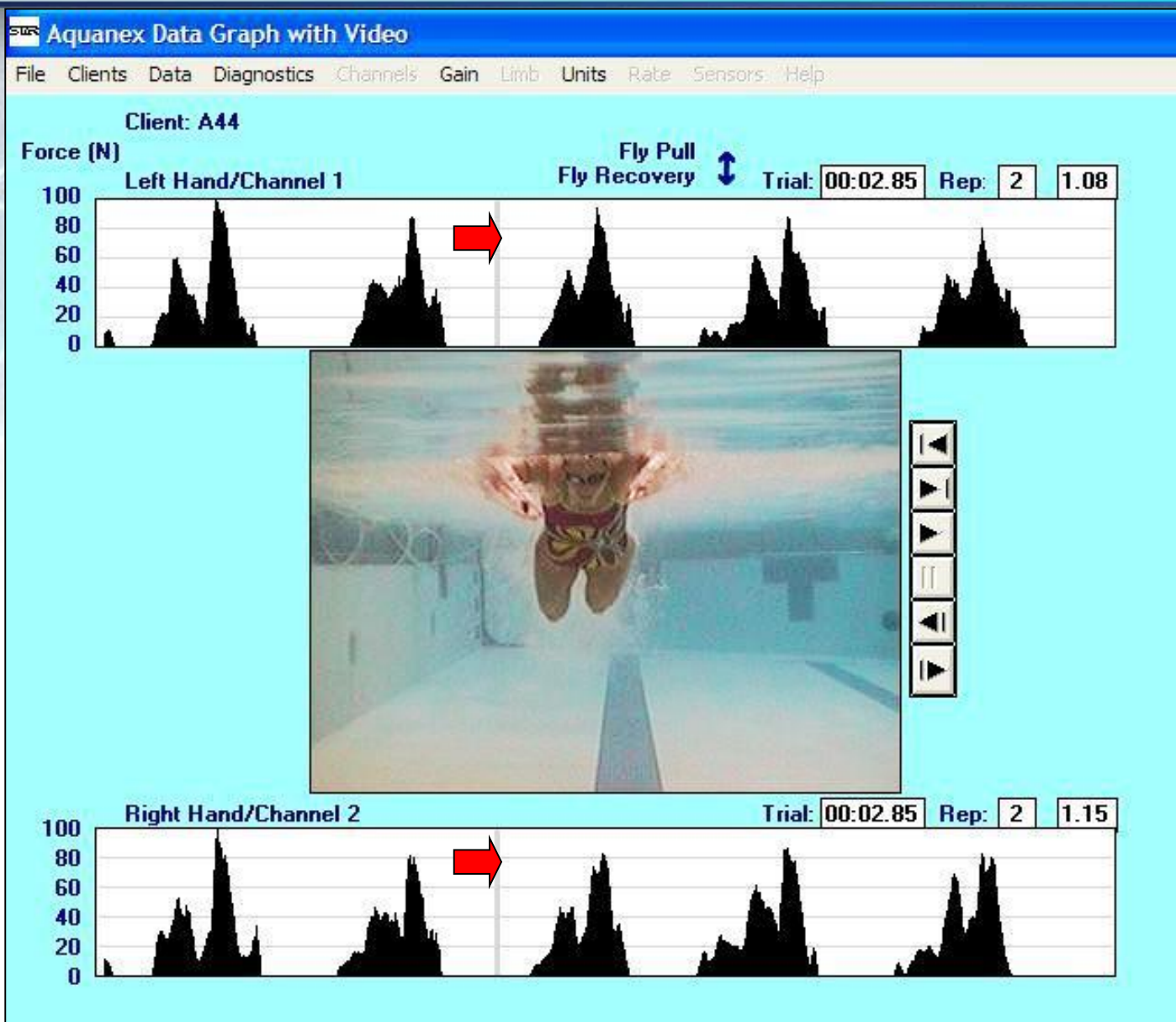
Hands Below Shoulders



Begin Pull

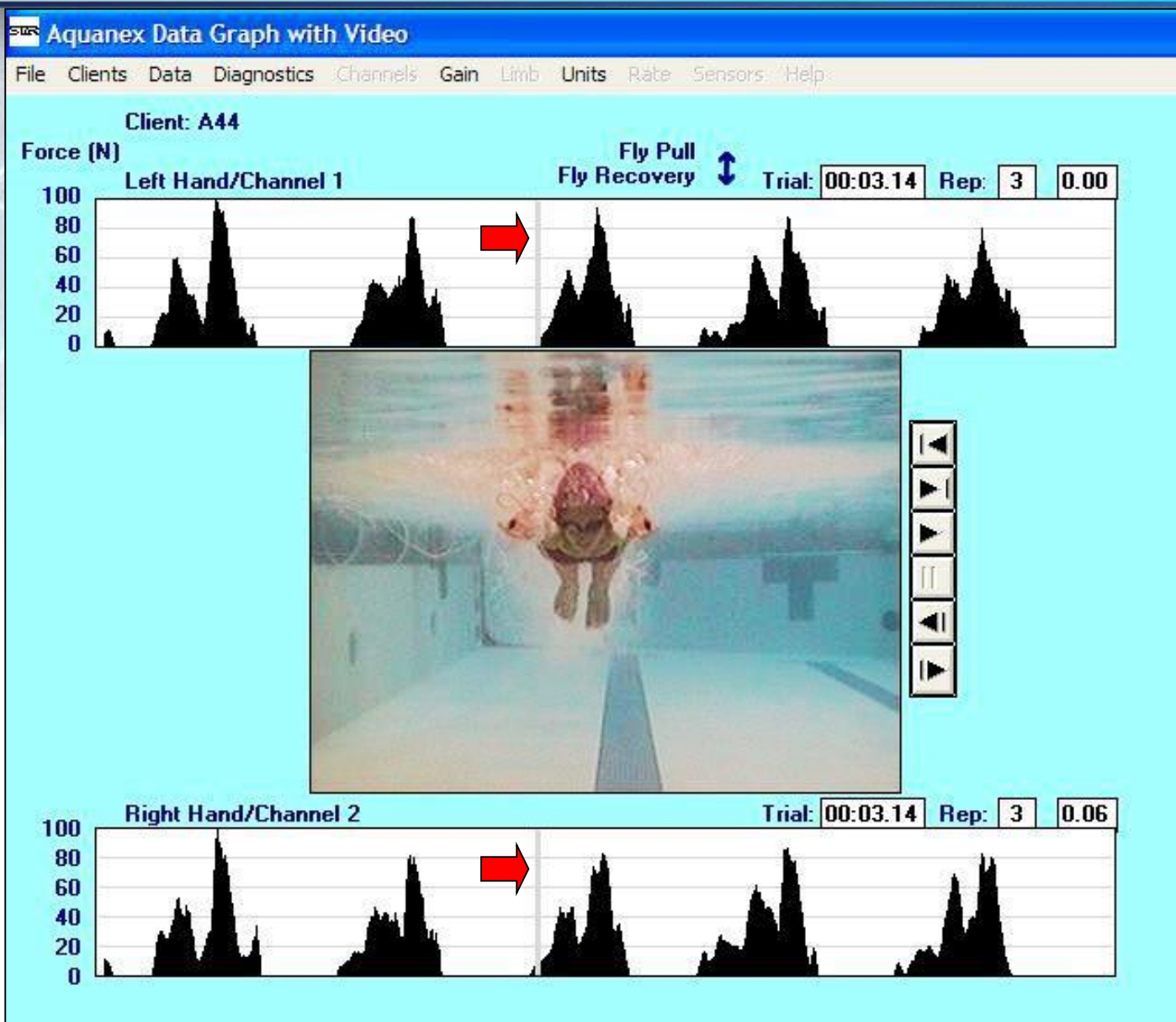


Downward Entry Angle

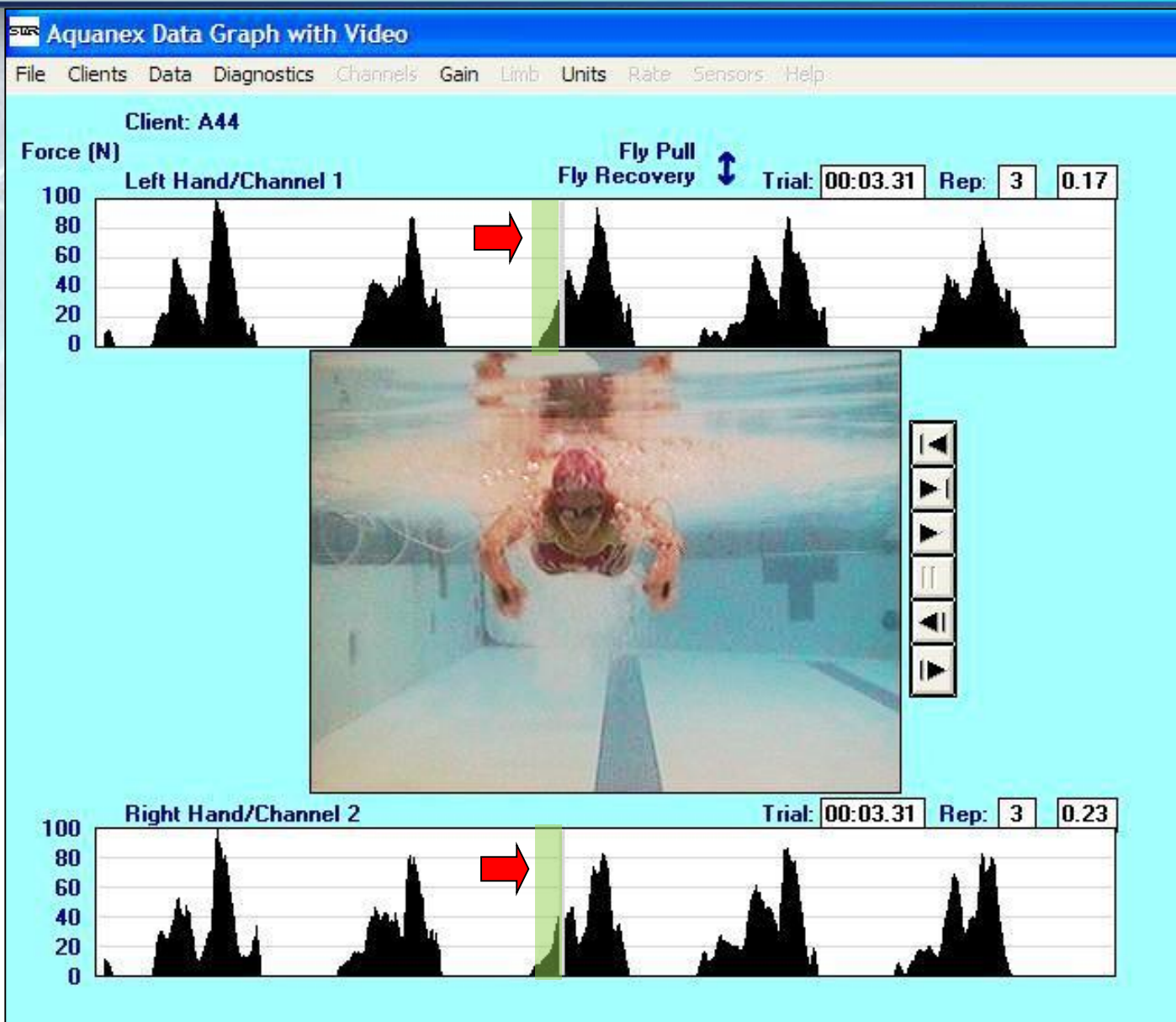




Eliminate Exposure Time



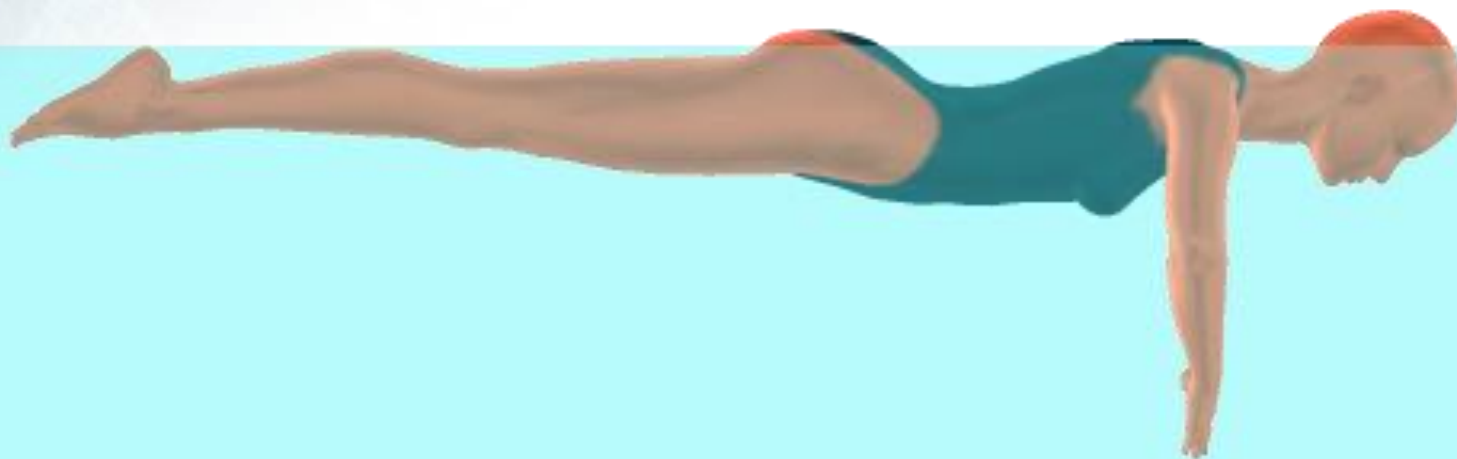
Begin Pull



Butterfly Arm Drill



Butterfly Arm Drill



Butterfly Arm Drill



Butterfly Arm Drill



Butterfly Arm Drill





Butterfly Arm Drill

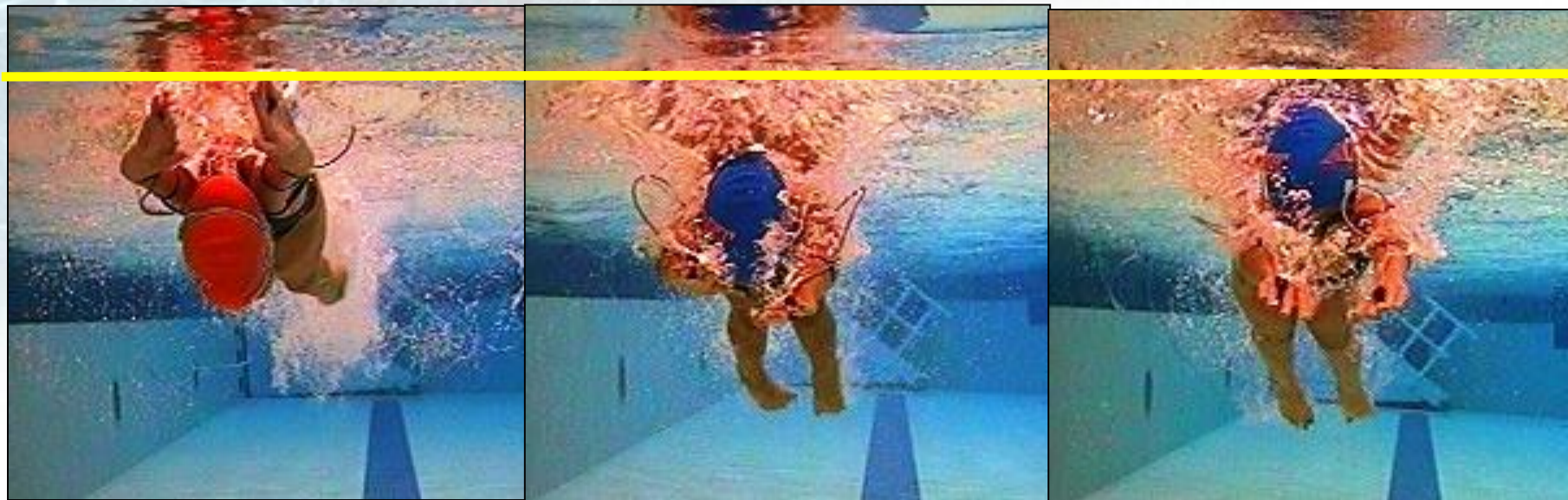


Butterfly Arm Drill



- 1. Only 3 arm motions**
- 2. No head, body, or leg motion**
- 3. Watch arm entry**
- 4. Don't swim fly!**

Improvement Example



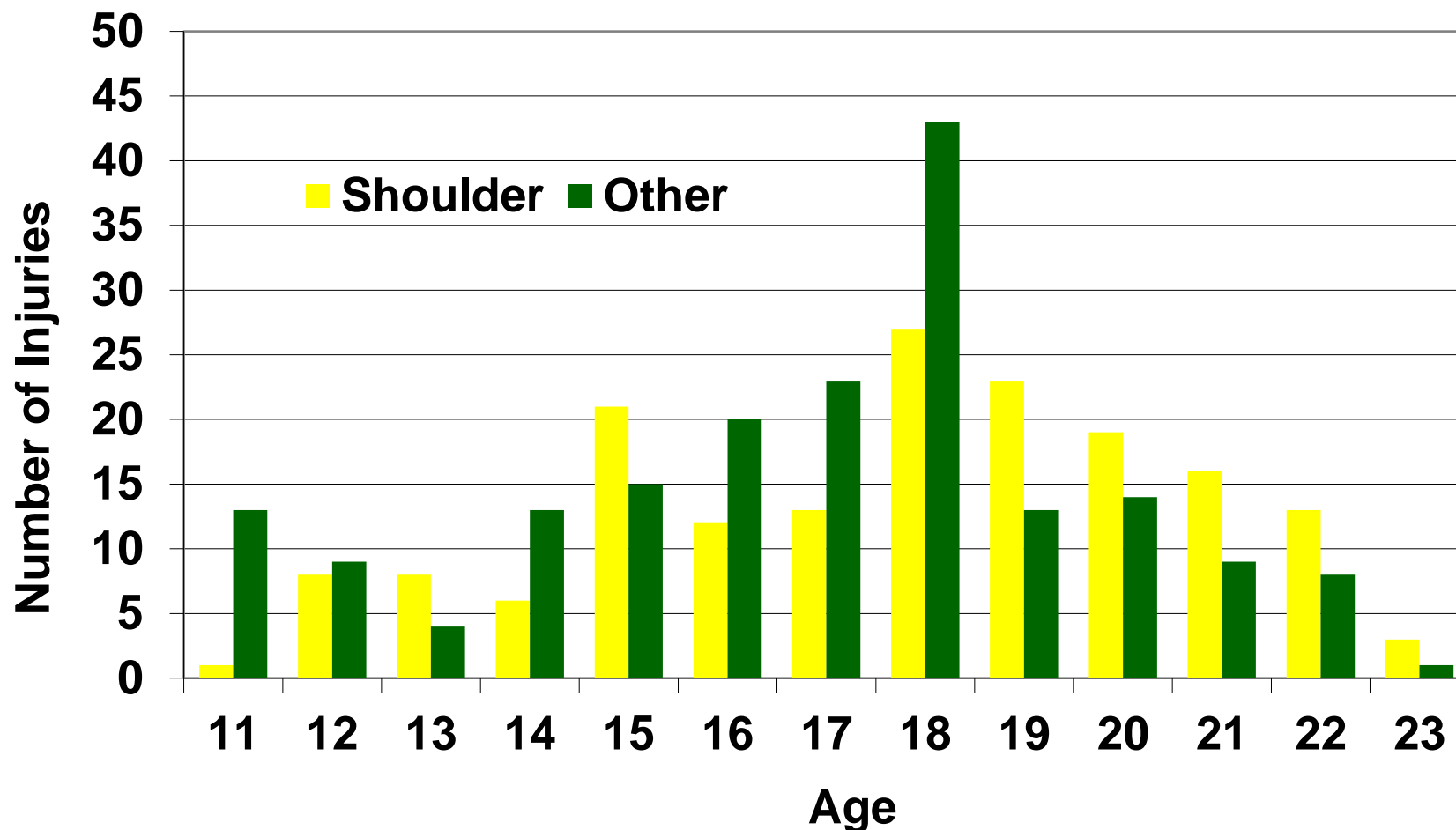
March

June

December

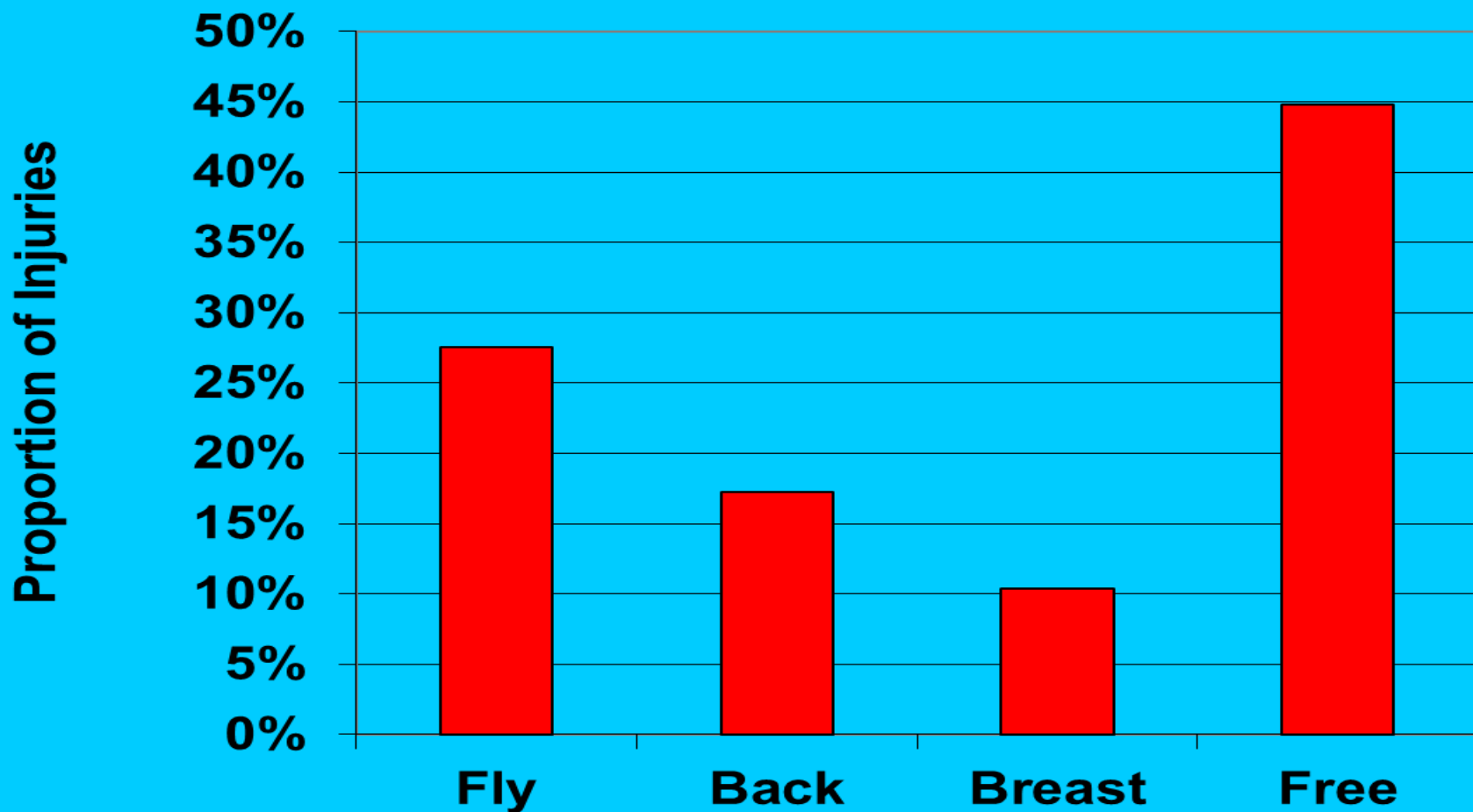
2013

Injury by Age



Abgarov, 2012

Injury by Specialty



Haupenthal et al, 2006

Freestyle Arm Entry



Hand Entry Position



Becker & Havriluk, 2011

Typical Arm Entry

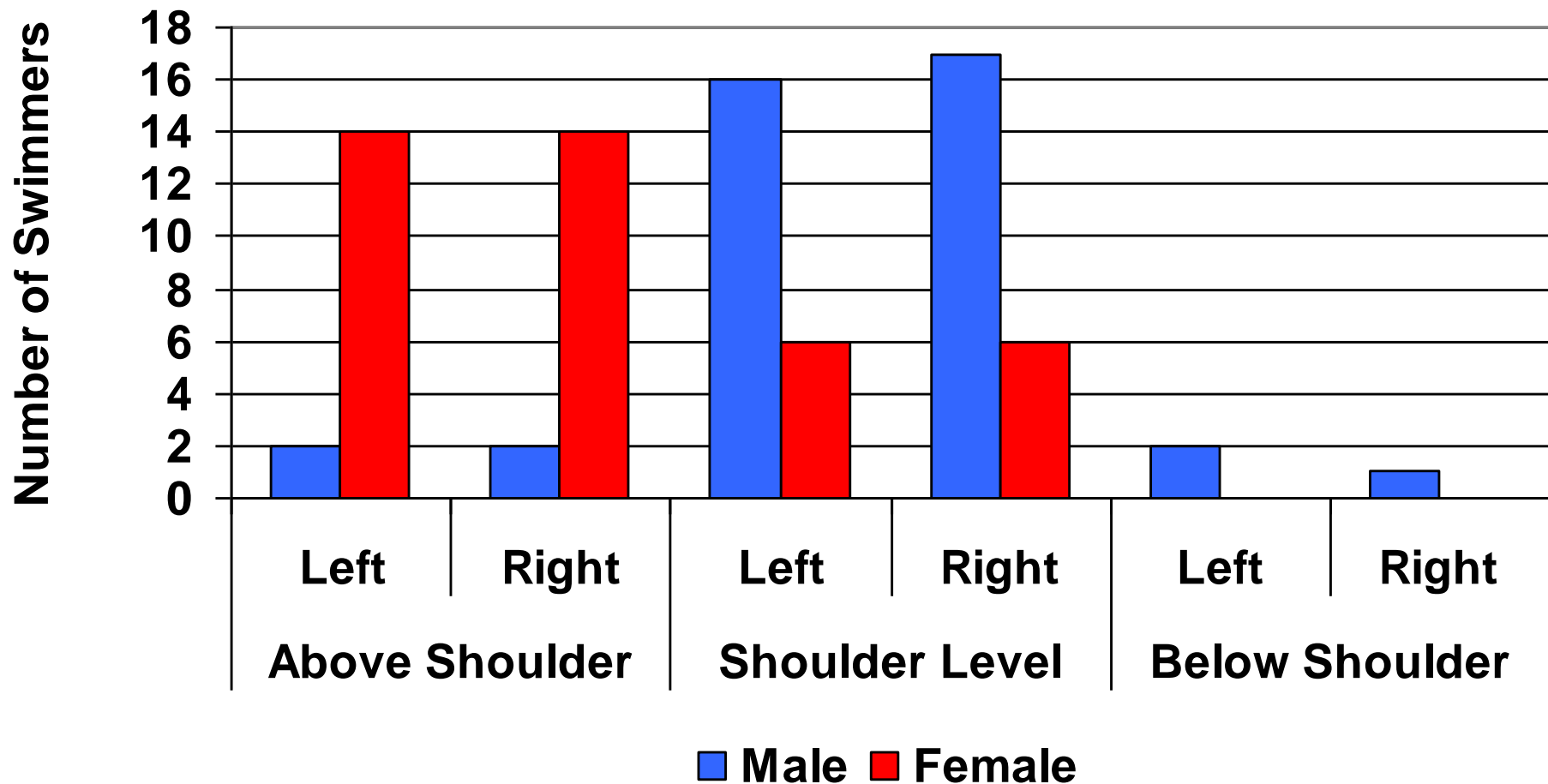


Female



Male

Hand Entry Position



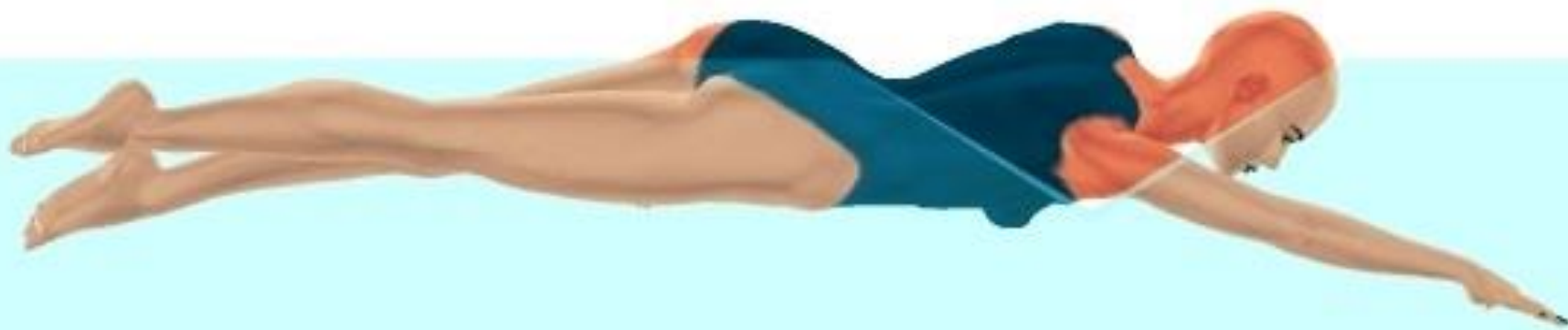
Becker & Havriluk, 2014

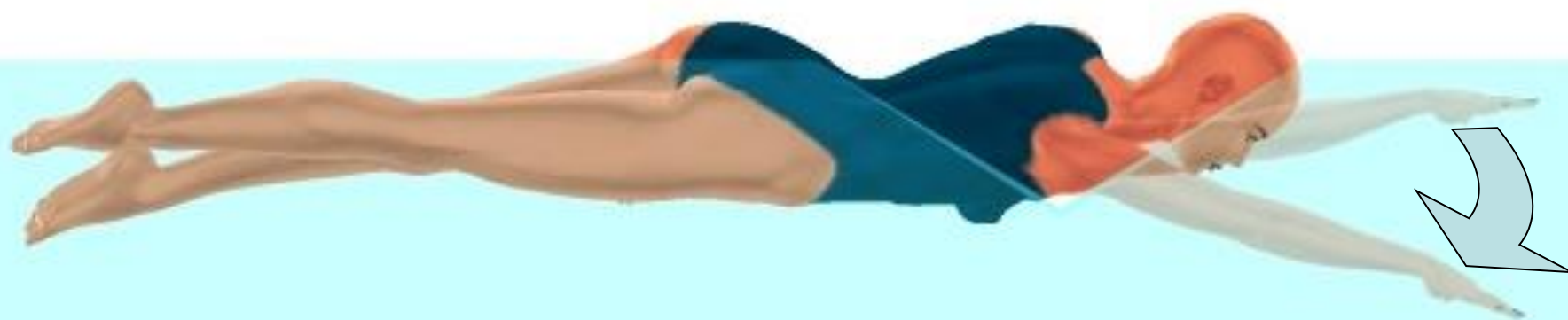
Typical Female Arm Entry



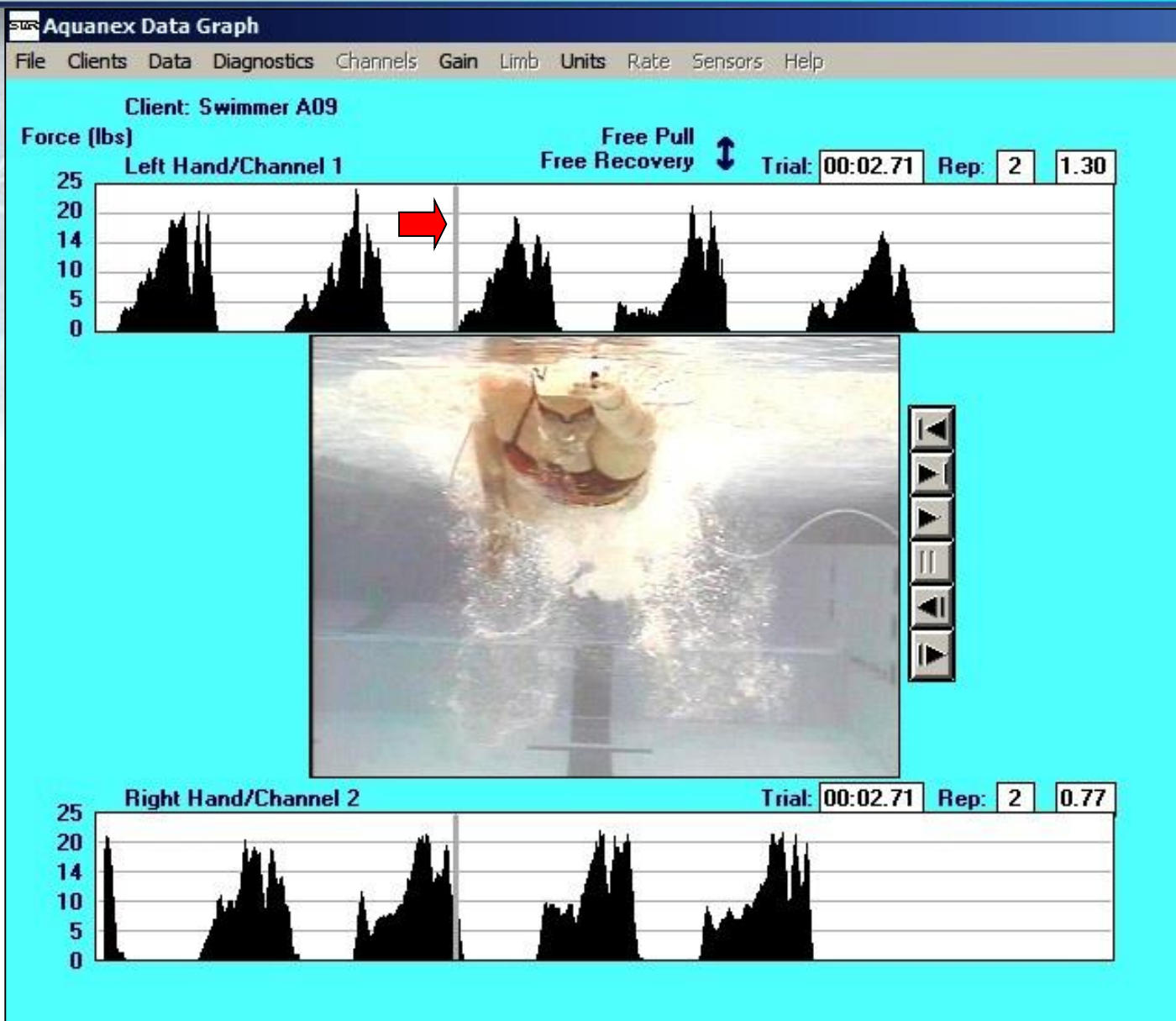
Typical Male Arm Entry



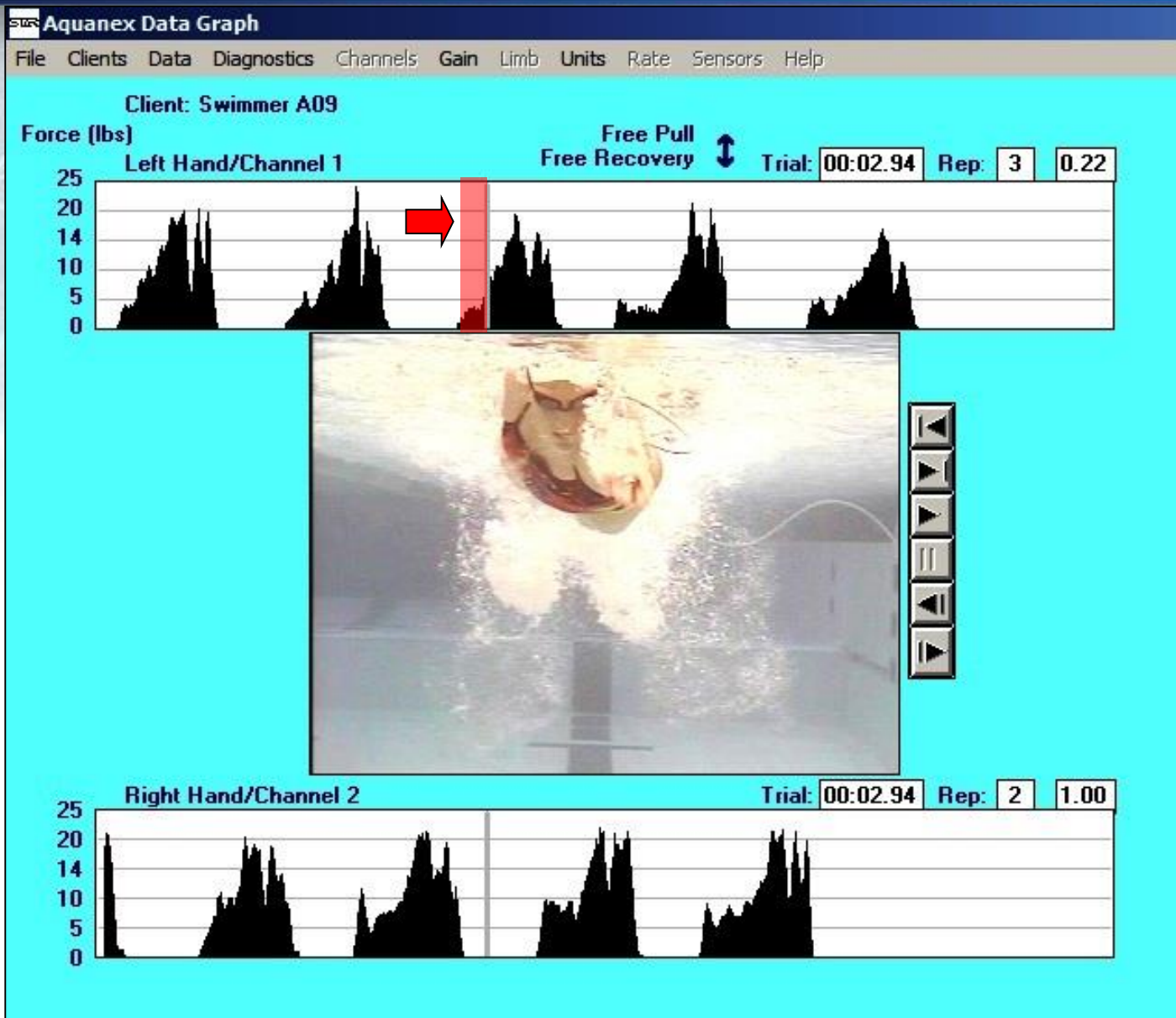




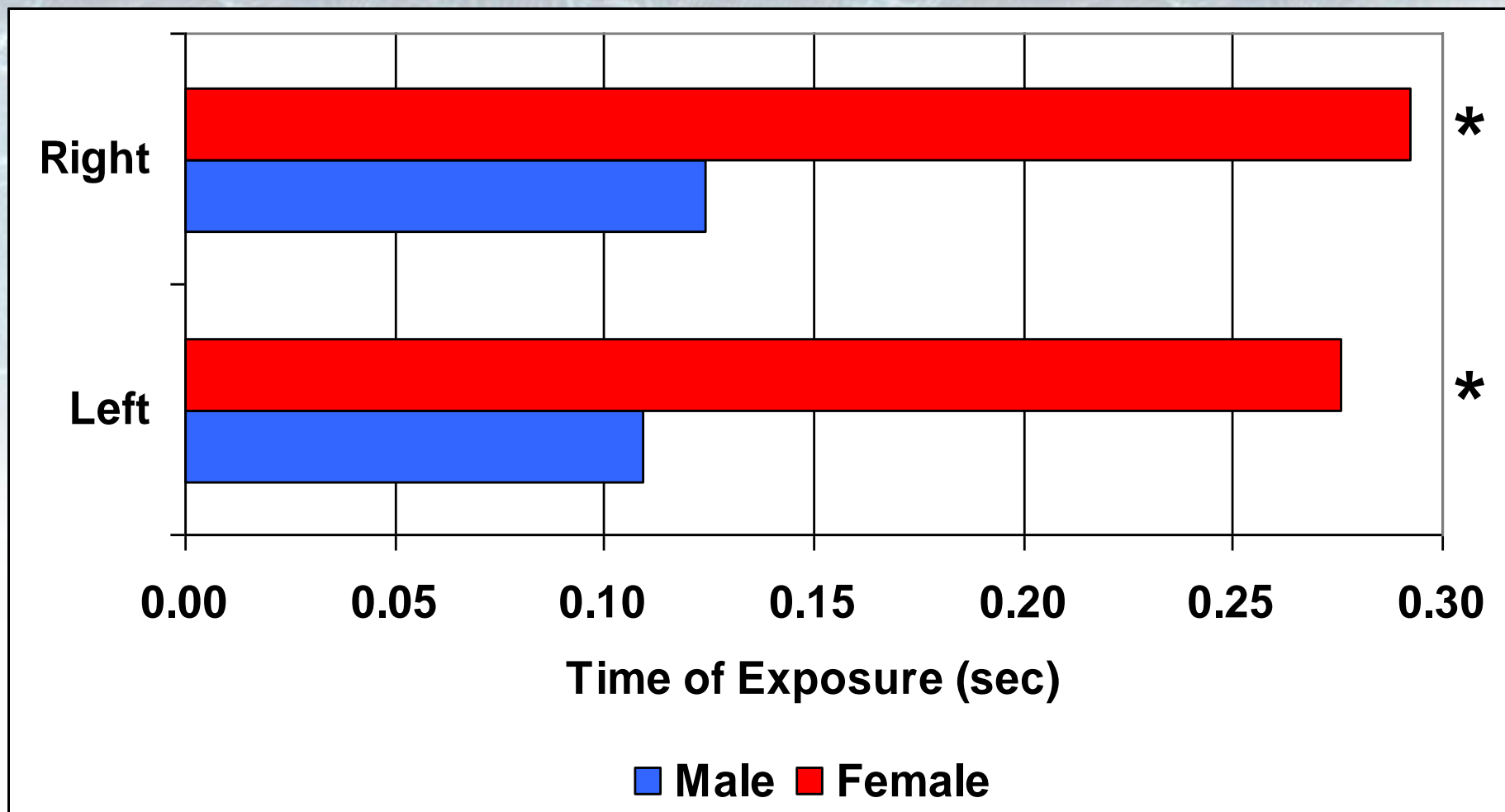
Typical Arm Entry



Exposure Time = .2 sec



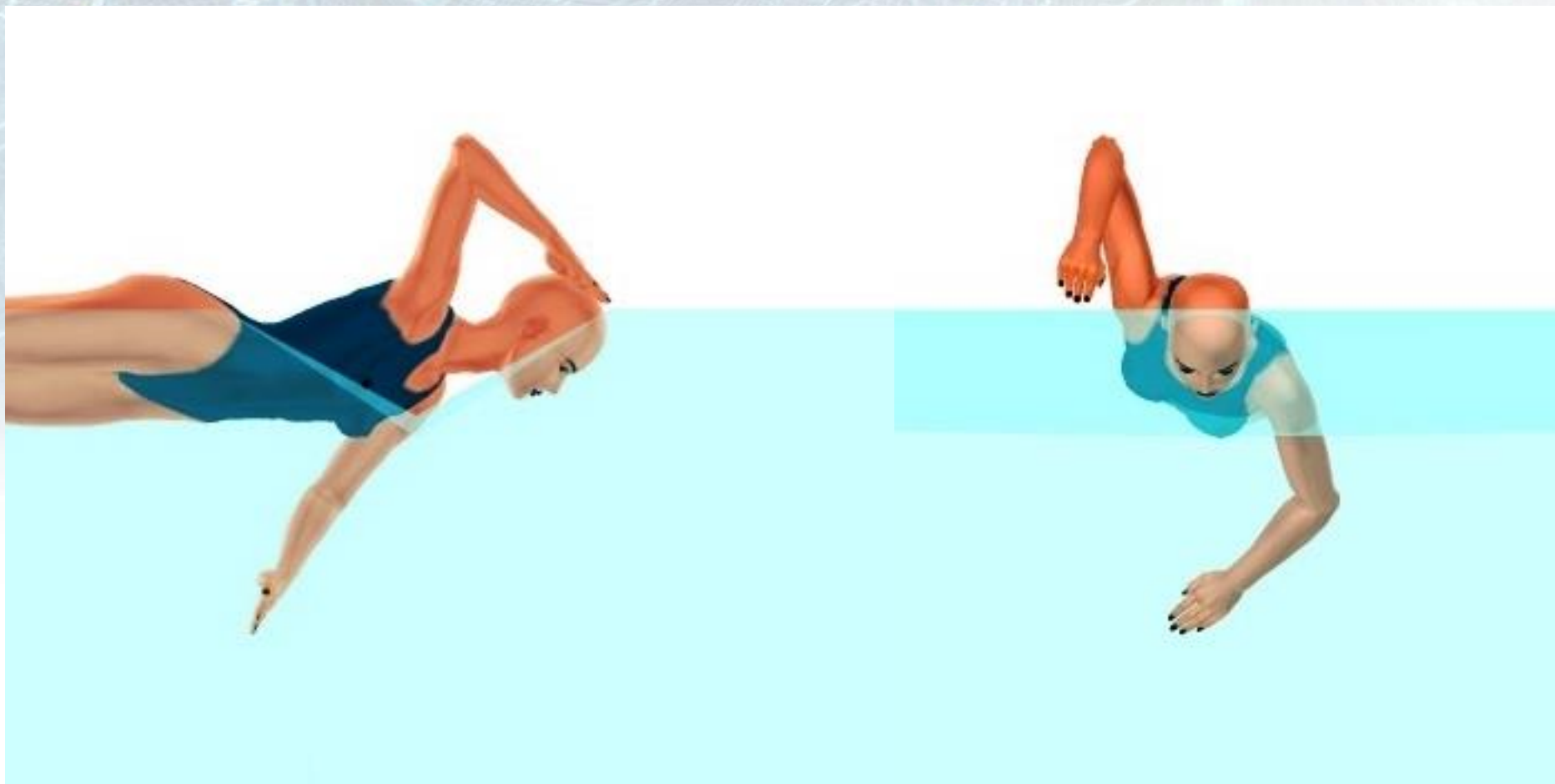
Exposure Time



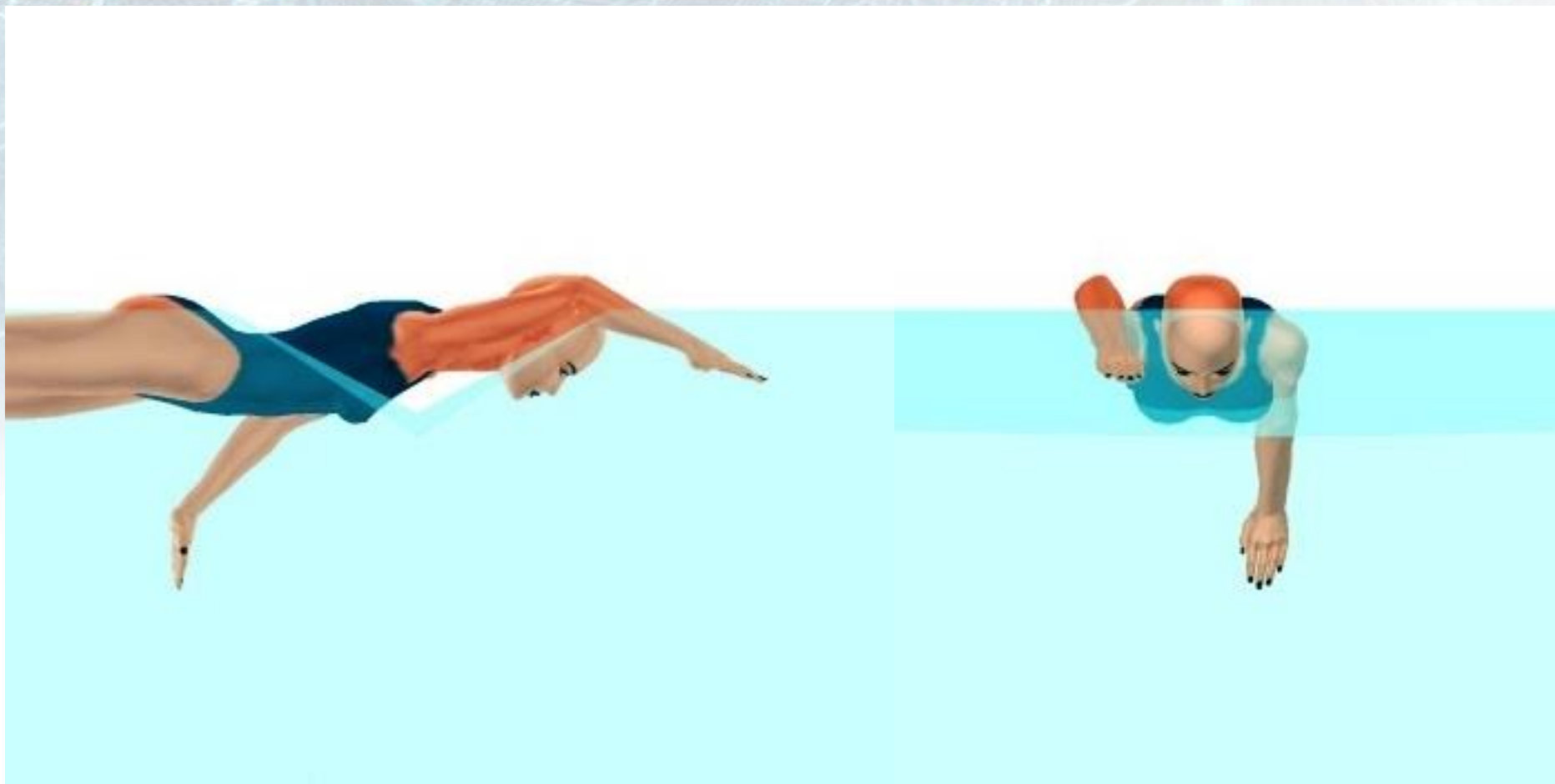
Becker & Havriluk, 2014



Elbow Above Hand



Downward Angle



Hand Below Shoulder

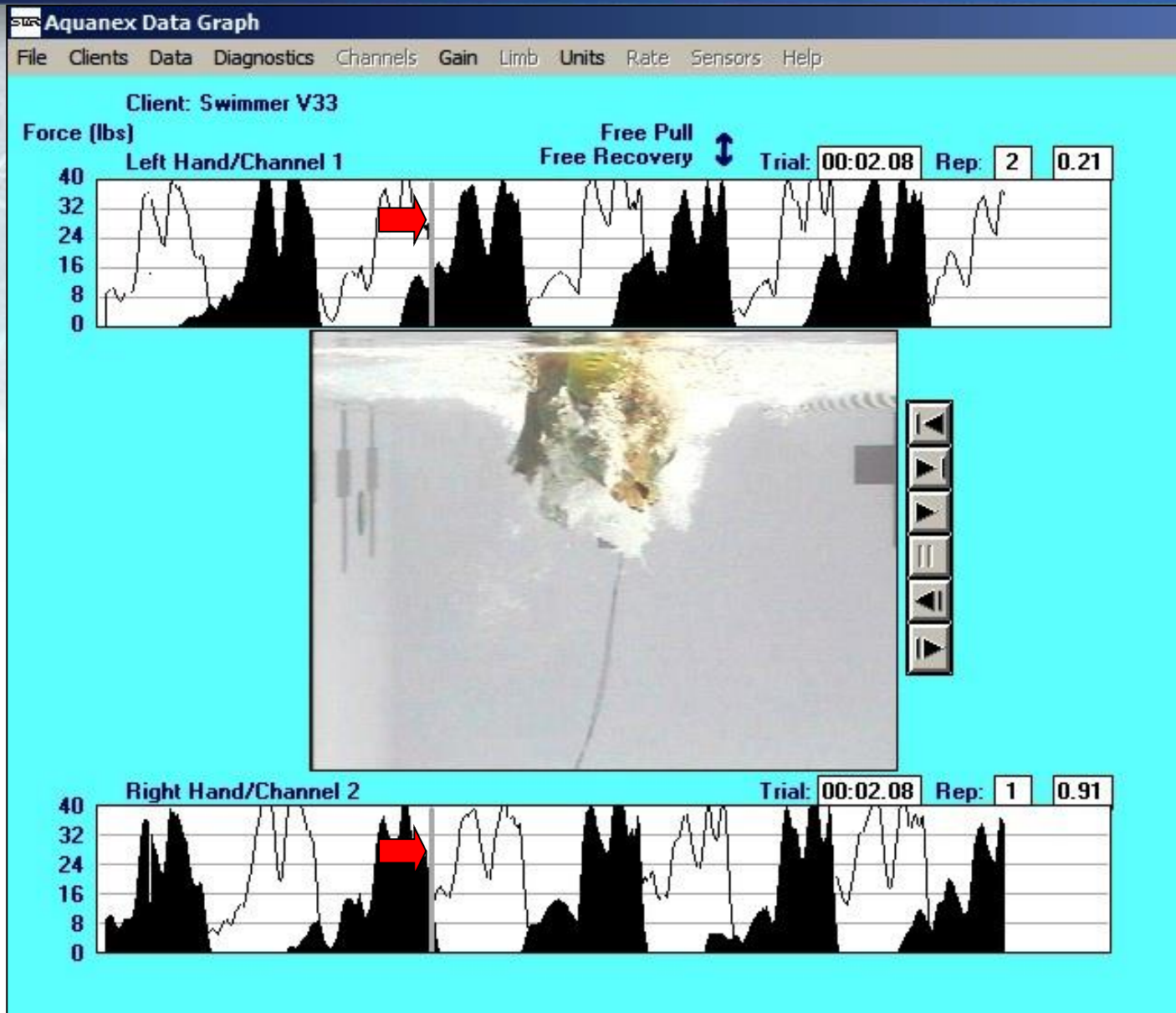


Begin Pull



- 1. Short-distance swims**
- 2. Slow stroke rate**
- 3. Minimal breathing**
- 4. Watch arm entry**







Traditional Practice



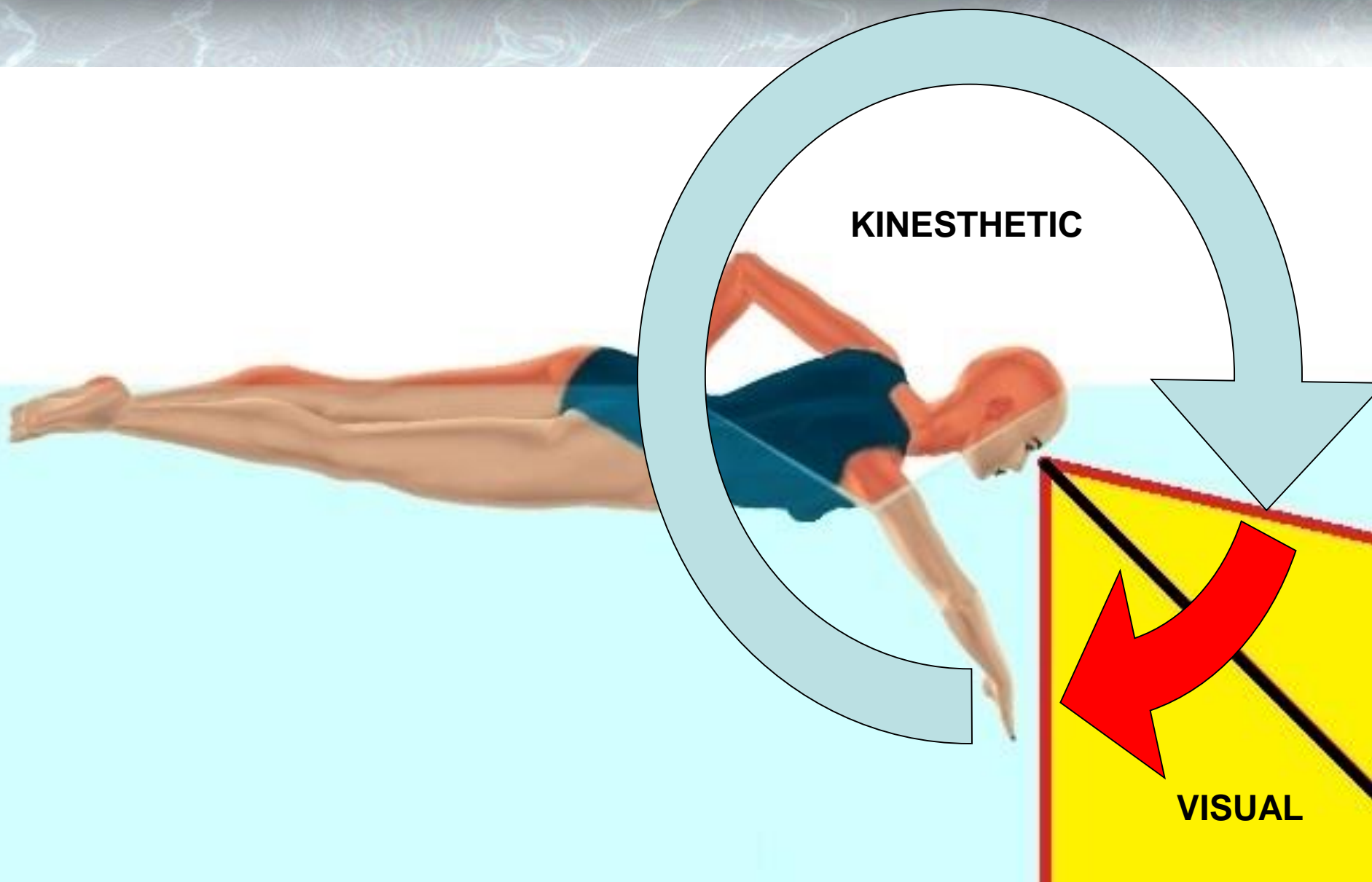
- ▶ **Traditional**
- ▶ **Deliberate**
(Ericsson et al, 1993)
- * **System for Skill Learning**
(Hiddlestone, 2014)

**“There were 30 swimmers at Olympics . . .
10 or more could not streamline properly.”**

Canadian Coach, 2014

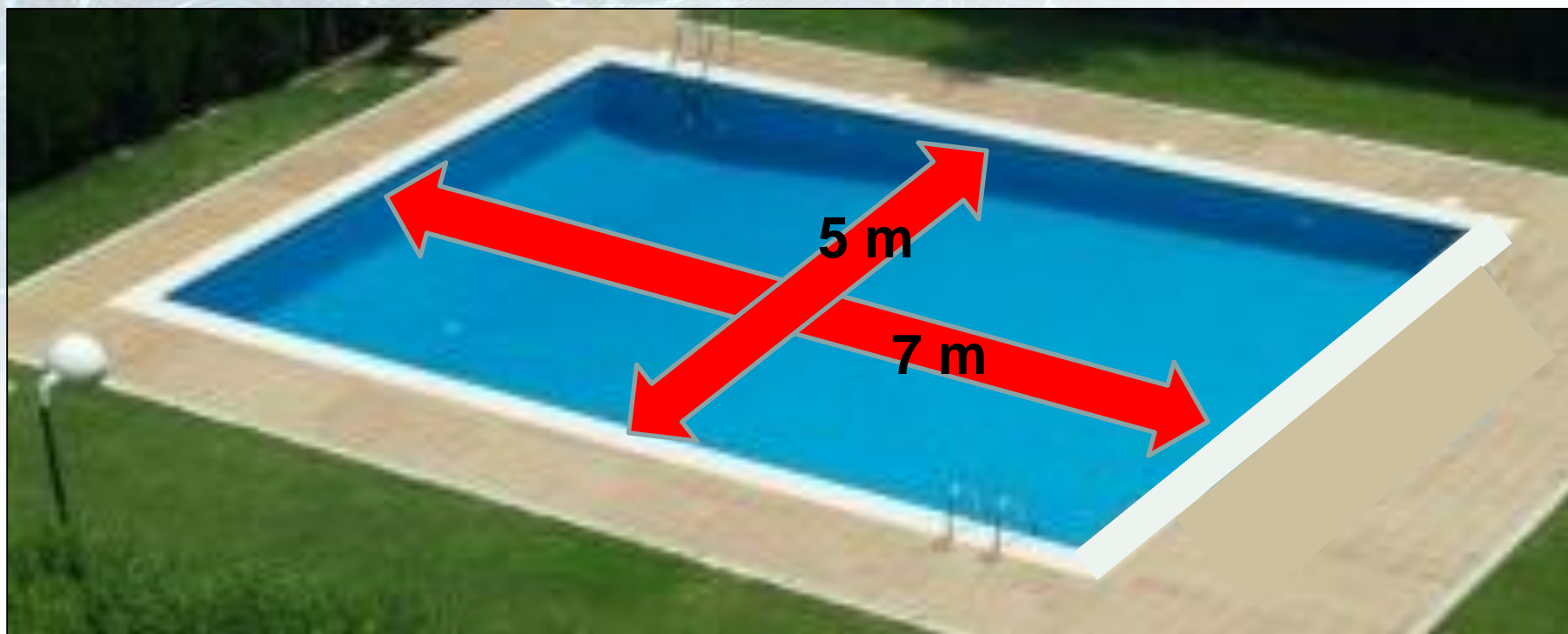


➤ **Clear instructions**



- **Clear instructions**
- **Appropriate task difficulty**

Course Length





Butterfly Arm Drill





Butterfly Arm Drill



Butterfly Arm Drill





Butterfly Arm Drill



- **Clear instructions**
- **Appropriate task difficulty**
- **Sufficient number of repetitions**

- ▶ **Control Adjustment**
- ▶ **Make Adjustment Permanent**

- **Clear instructions**
- **Appropriate task difficulty**
- **Sufficient number of repetitions**
- **Immediate feedback**

- ▶ **Individual**
- ▶ **Group**
- ▶ **Reinforce Positive Elements**
- ▶ **Adjust Limiting Factors**
- ▶ **System to Evaluate and Track**
- ▶ **Skill Competitions**

- **Clear instructions**
- **Appropriate task difficulty**
- **Sufficient number of repetitions**
- **Immediate feedback**
- **Individualized supervision**

Ultra-Short Race-Pace Training

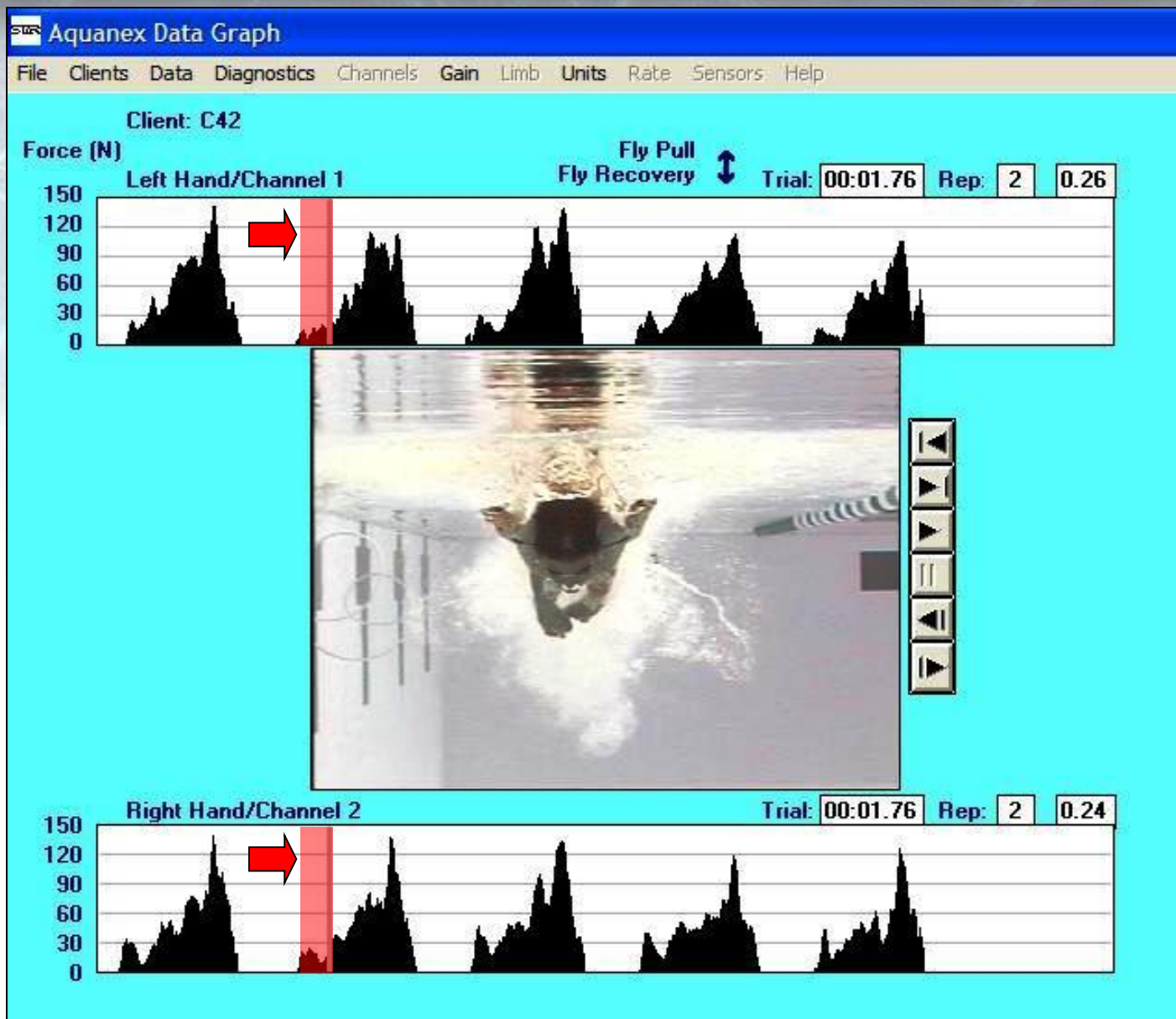
(Rushall, 2013)

- ▶ **More Time for Skills**
- ▶ **Maintain Technique at Race Pace**

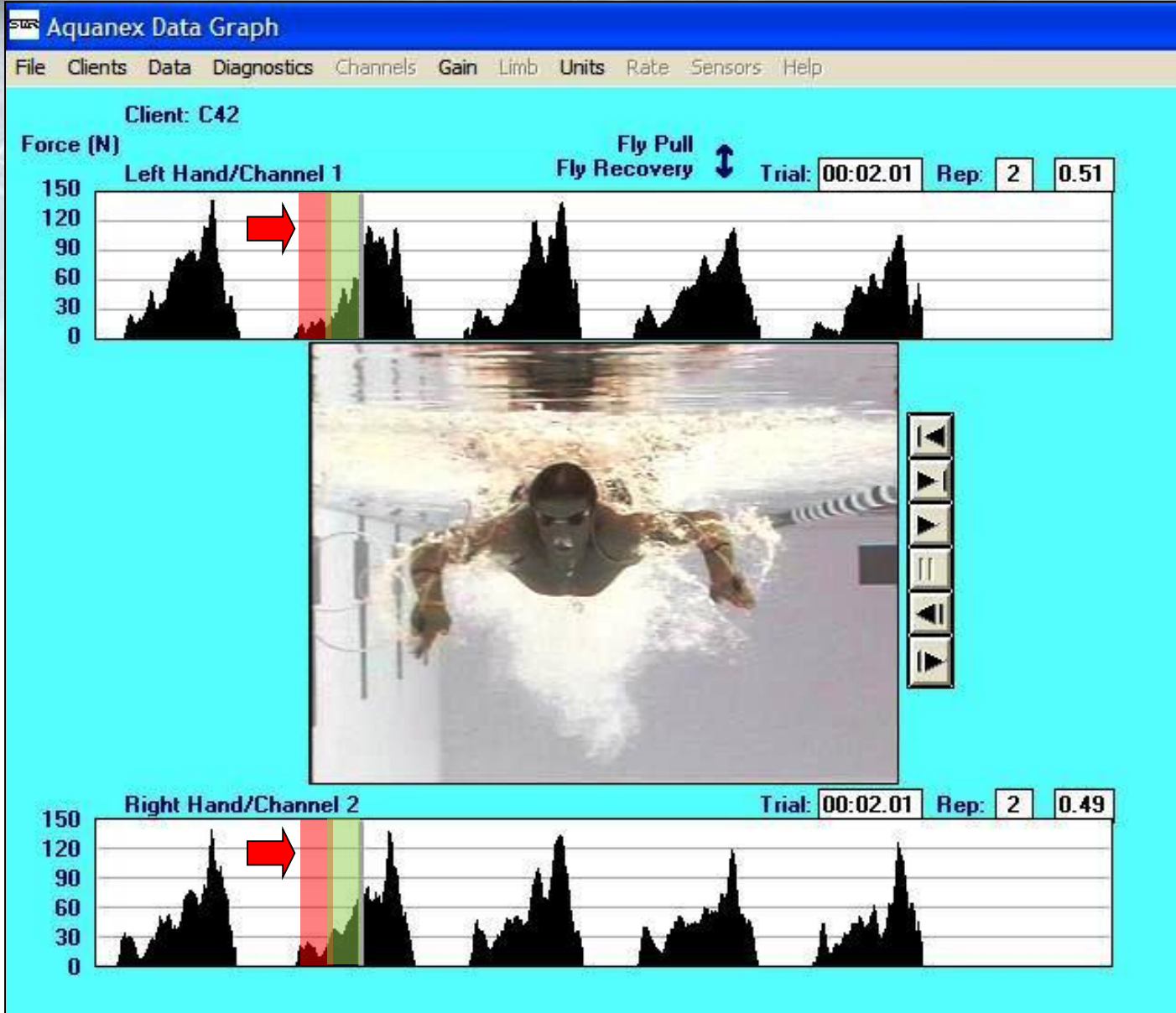
- **Clear instructions**
- **Appropriate task difficulty**
- **Sufficient number of repetitions**
- **Immediate feedback**
- **Individualized supervision**
- **Variety of learning strategies**



Exposure Time

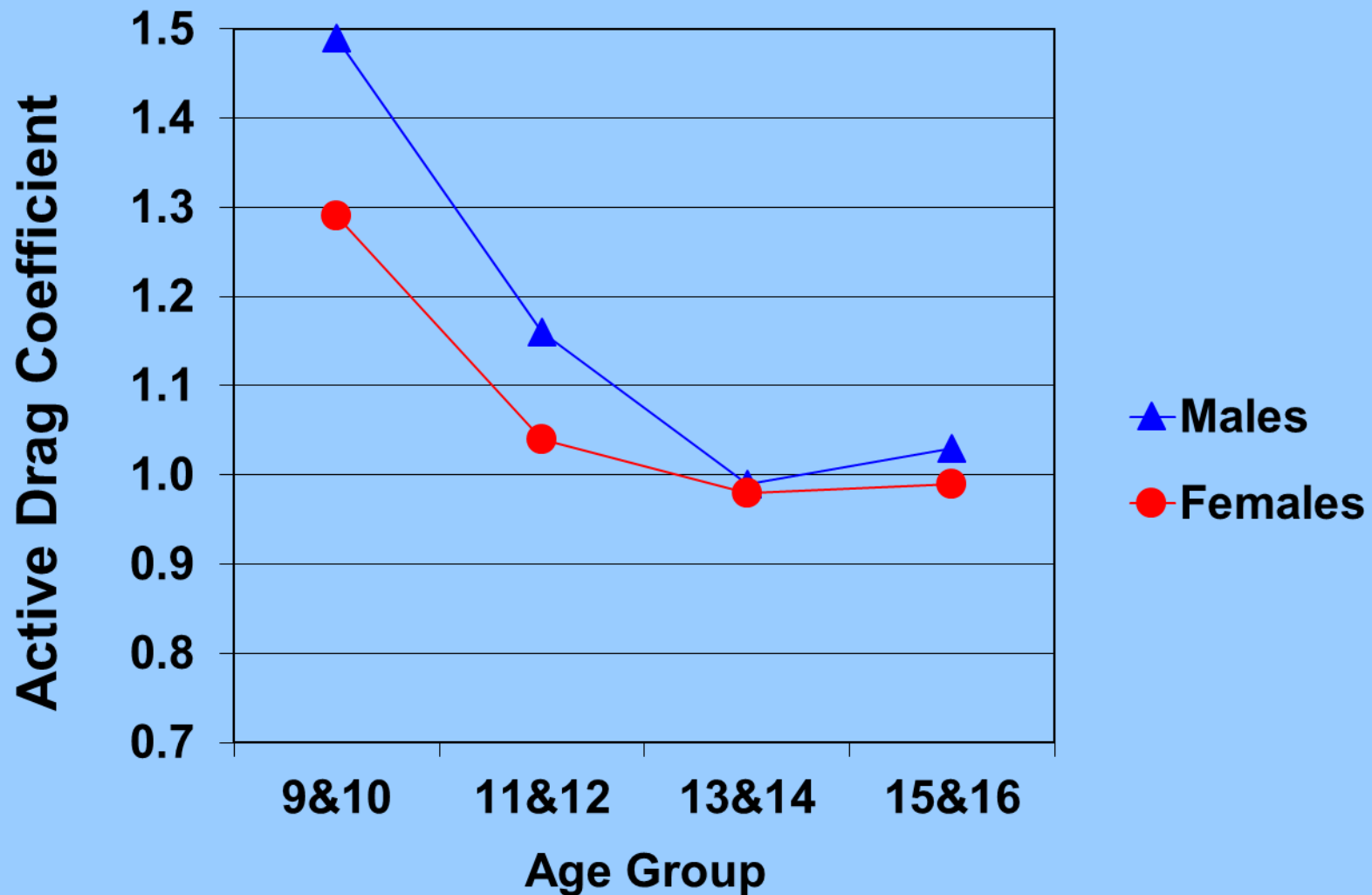


Effective Motion



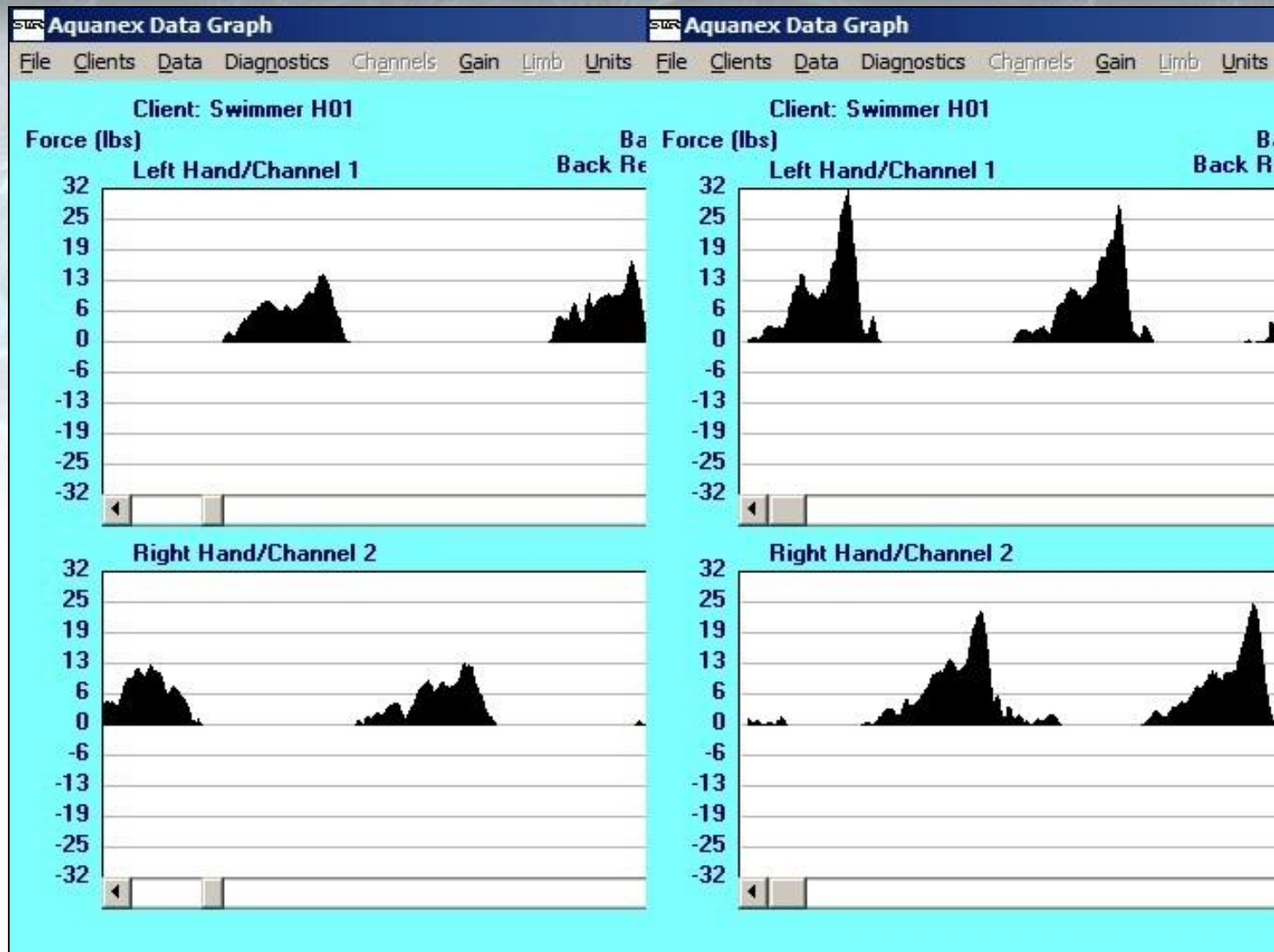
- **Clear instructions**
- **Appropriate task difficulty**
- **Sufficient number of repetitions**
- **Immediate feedback**
- **Individualized supervision**
- **Variety of learning strategies**
- **Stay in cognitive and associative stages**

- **Clear instructions**
- **Appropriate task difficulty**
- **Sufficient number of repetitions**
- **Immediate feedback**
- **Individualized supervision**
- **Variety of learning strategies**
- **Stay in cognitive and associative stages**
- **Replicate superior performance**



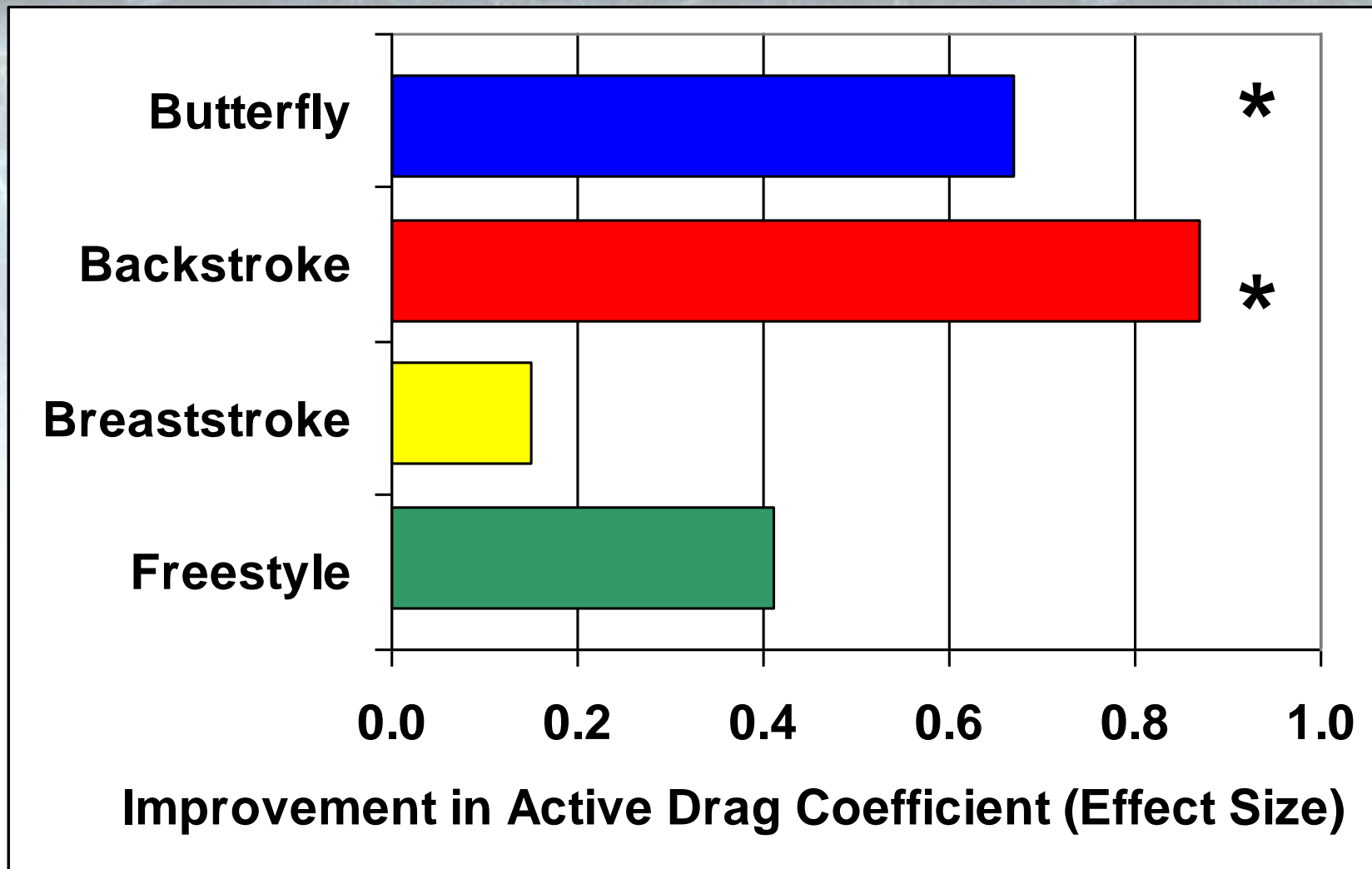
Havriluk, 2003

Deliberate Practice



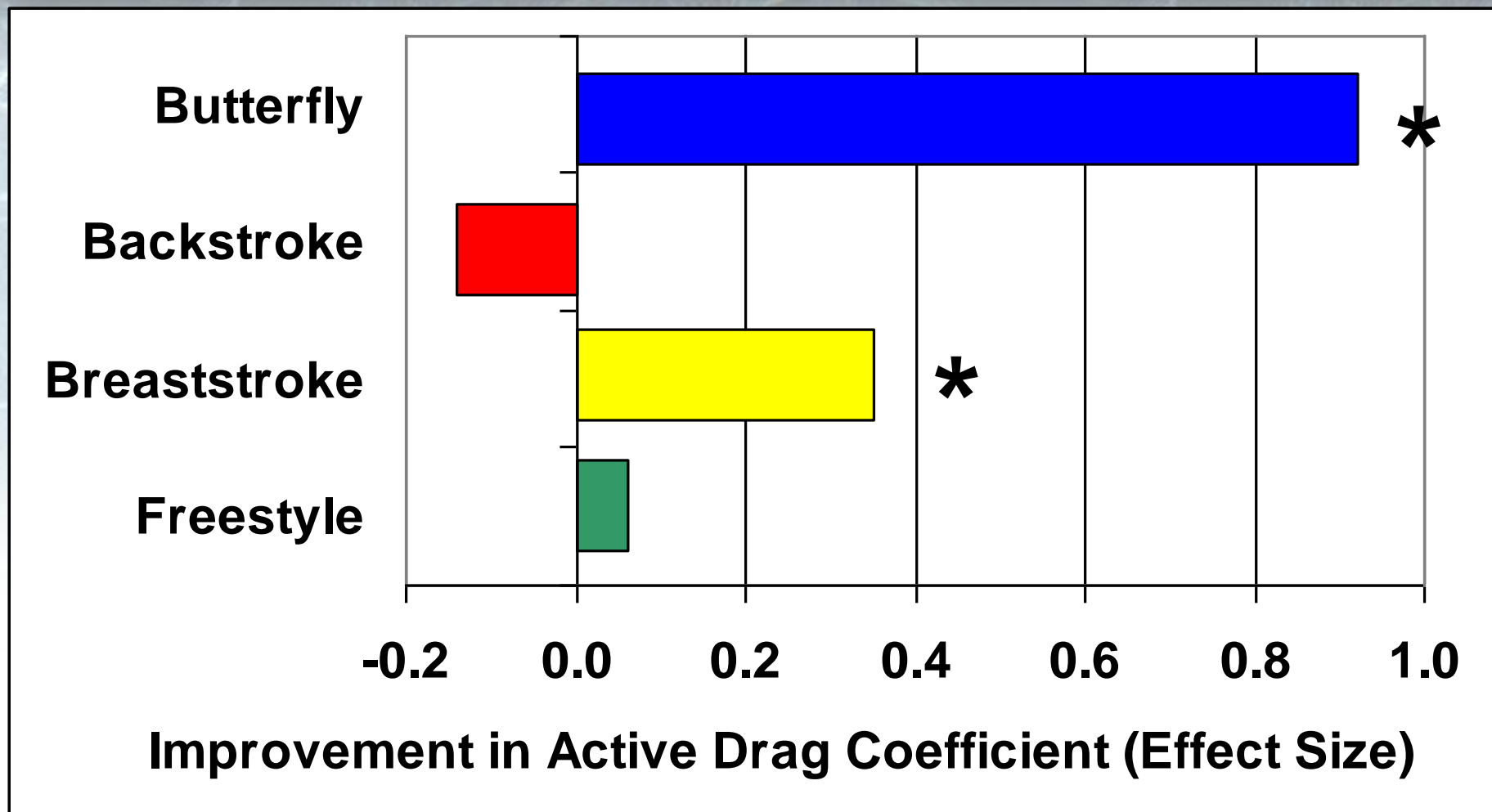
Jefferies, et al 2012

Deliberate Practice

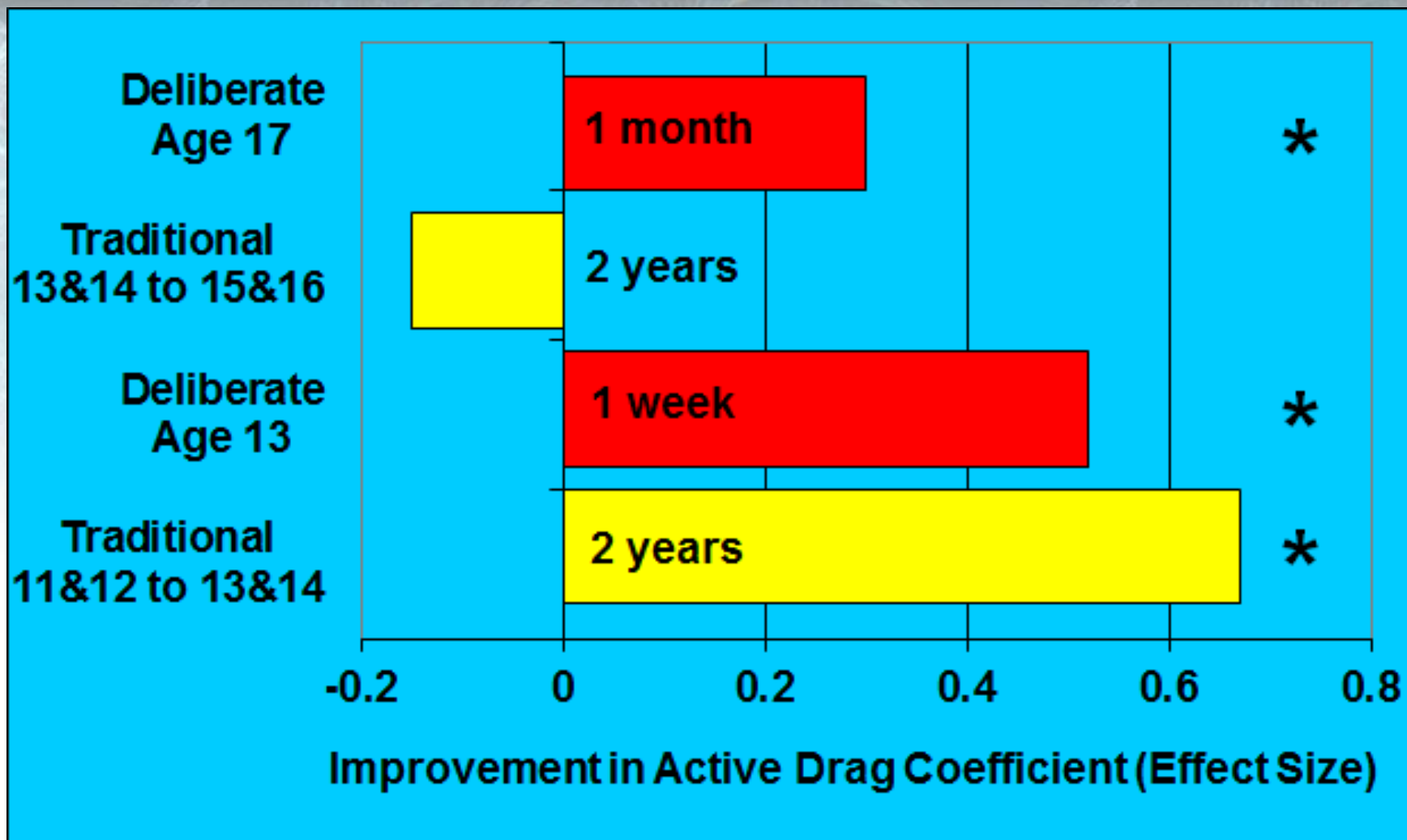


Havriluk, 2006

Deliberate Practice



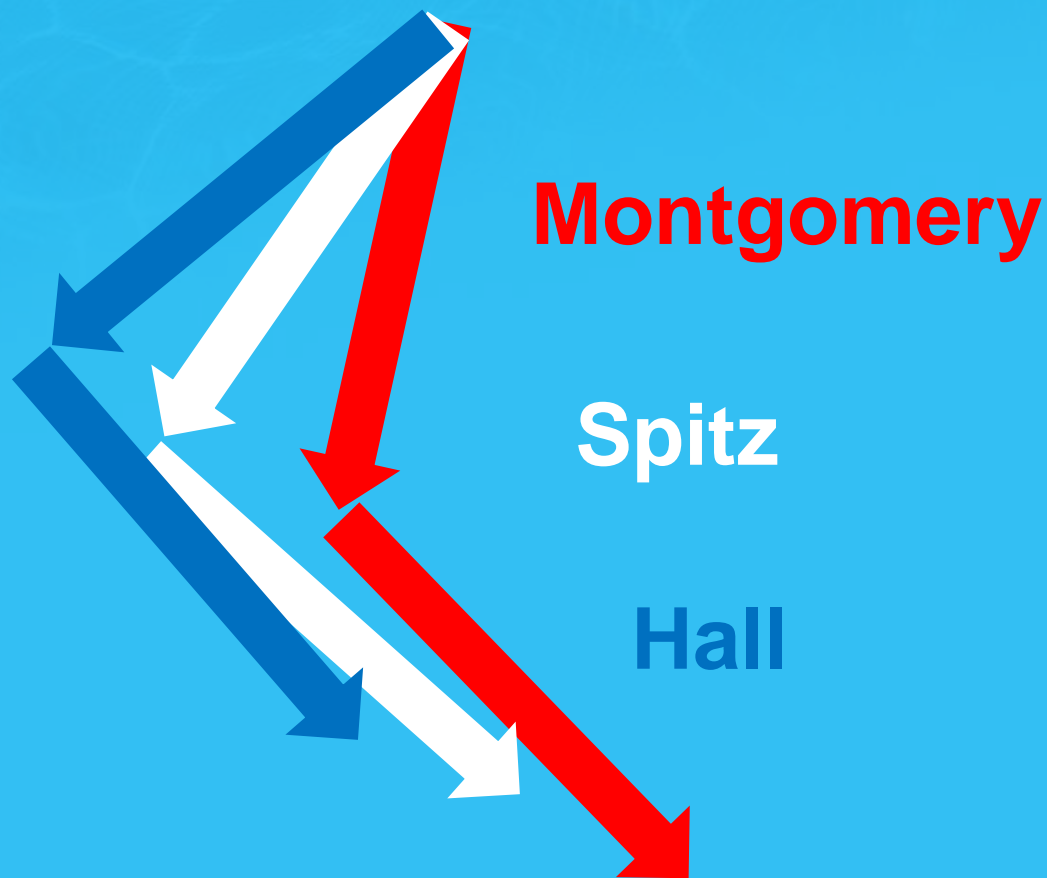
Practice Effect



Havriluk, 2003, 2006, 2014

- ▶ **Model with Science**
- ▶ **Quantify Technique**
- ▶ **Practice *Deliberately***

Who is the Olympian?



Schleihau, 1979

swimmingtechnology.com

Thank you.

Questions?