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Lower trunk muscle activity in butterfly swimming



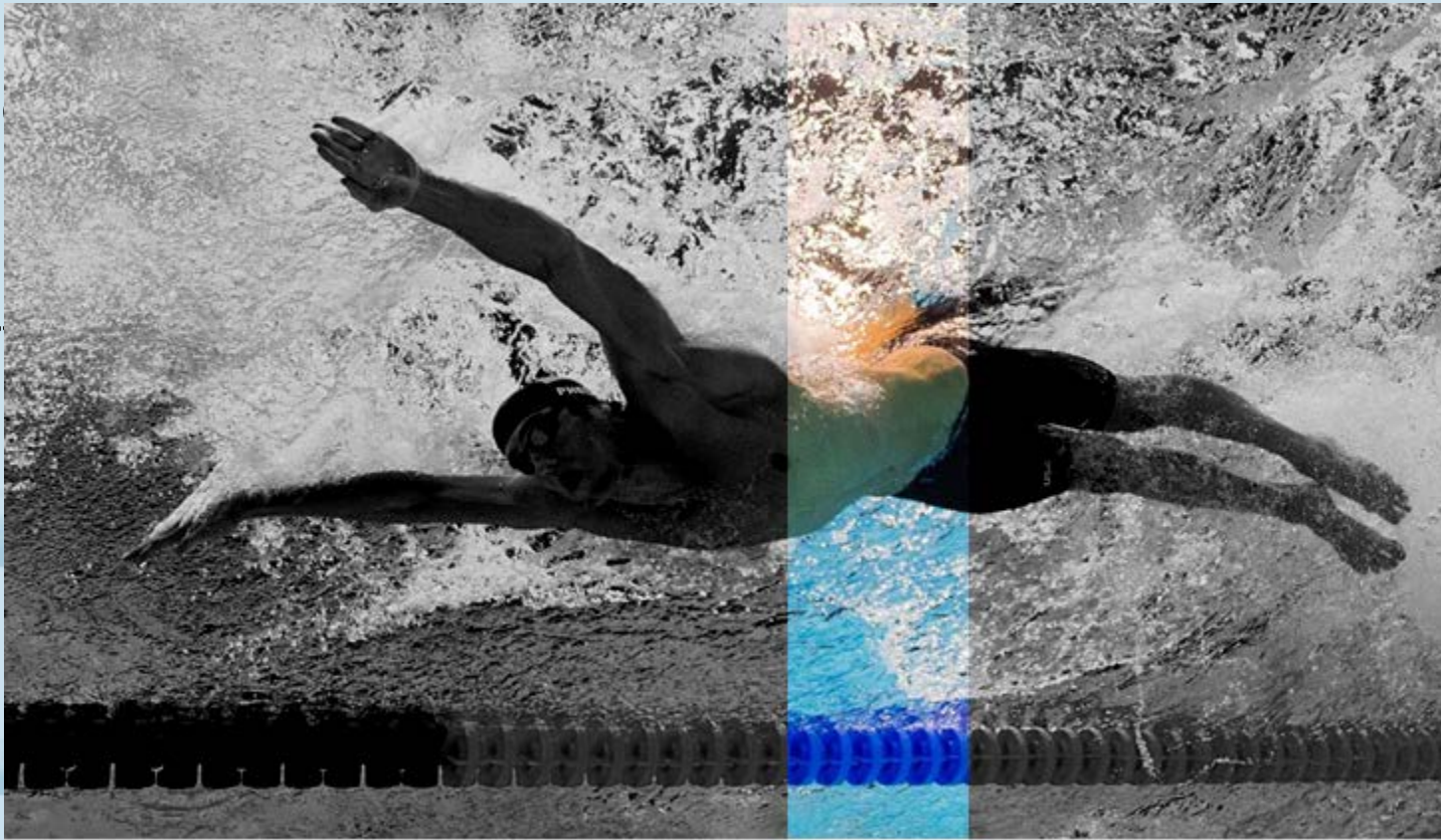
Butterfly swimming involves trunk muscle activity

Ikai et al., 1964; Barthels & Adrian, 1971



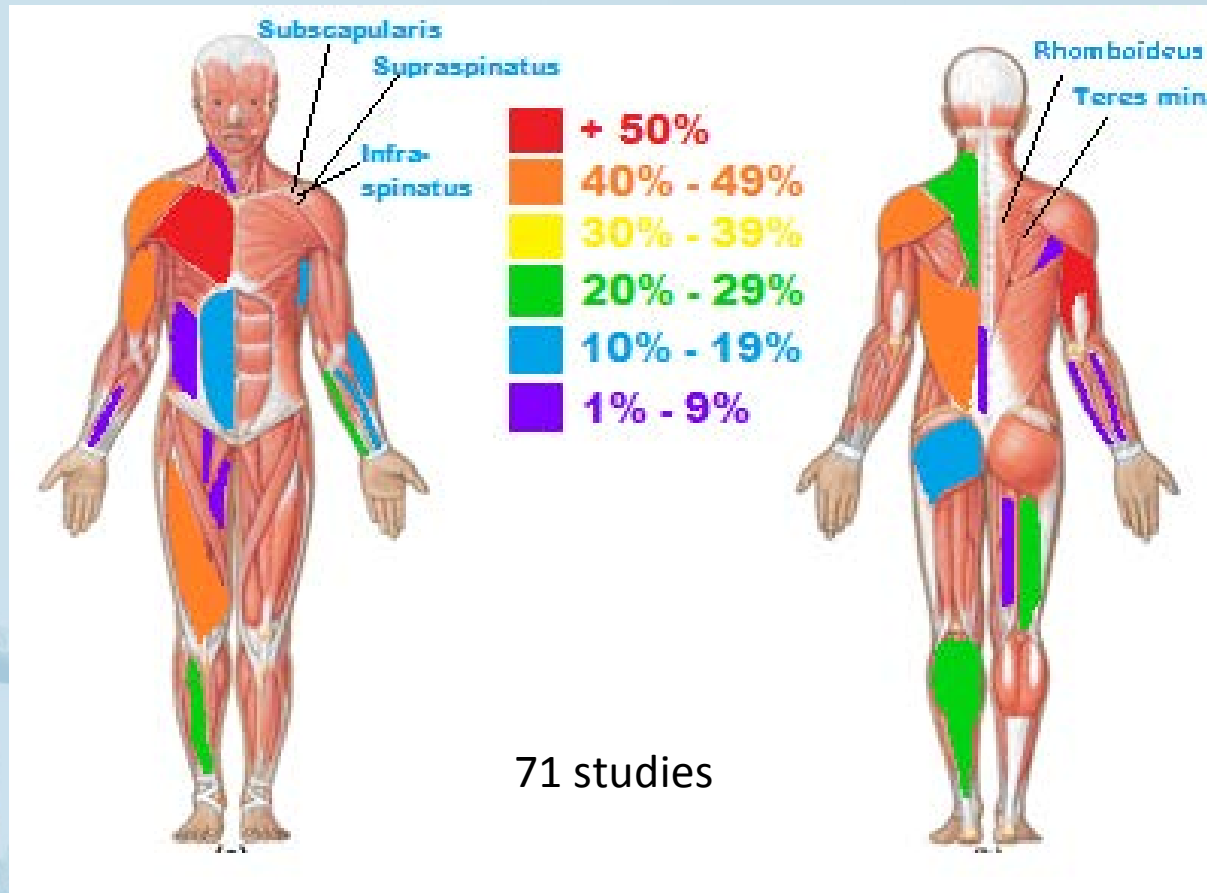
Only 2 studies on lower trunk muscle activity in butterfly using electromyography

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No clear analysis of the timing of activity relative to arm and leg coordination

Abdominal and lower back muscles are amongst the least studied muscles in all swimming strokes



More focus on muscles responsible for propulsion

Importance of lower trunk muscle activity becomes more recognized

Trunk muscles + injuries

- *"Whereas the functional manifestation may present as shoulder pain or injury, the underlying cause may be core weakness."*

Heinlein, 2010

Trunk muscles + swimming technique

- *"... we noticed a significant difference in work intensity in trunk muscles between different swimming levels. All these observations stress the importance of correct use and specific training of trunk muscles to improve performance in swimming **the front crawl**"*

Clarys, 1986; Clarys, 2011

...and what about butterfly ?

Aim

Analyze lower trunk muscle activation in butterfly swimming in relation to arm and leg coordination



Methods

1. Subjects

- 2 male swimmers
- between 20 and 22 years old,
- Personal besttime 100m butterfly : 56,8sec and 59,9sec



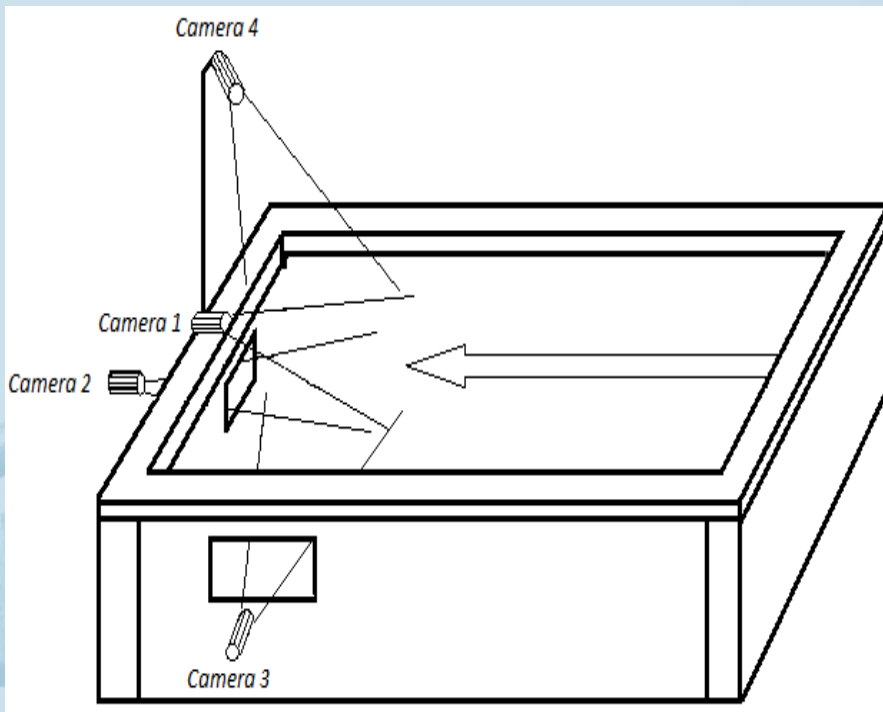
Methods

1. Subjects
2. Equipment
 - 4 wireless surface EMG units with internal memory
 - Waterproof taping
 - 4 digital 50Hz video camera's



Methods

1. Subjects
2. Equipment
3. Experimental protocol



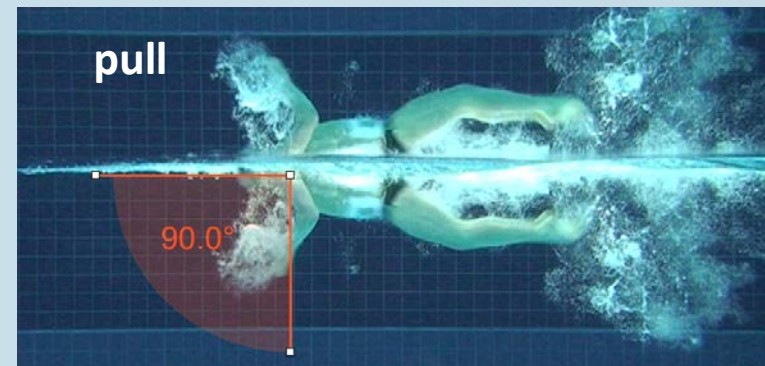
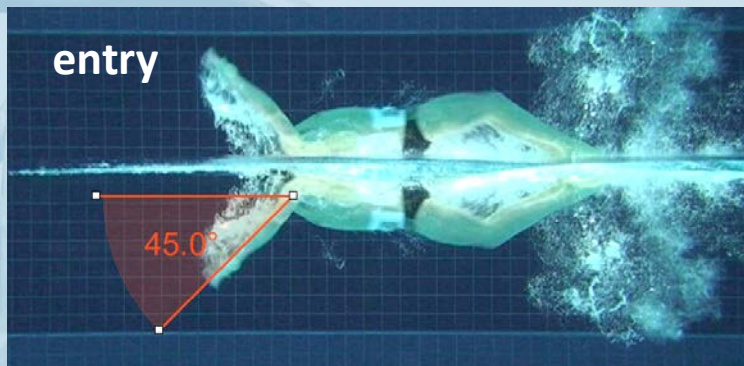
12,5m max. speed without breathing

- full butterfly stroke
- no leg kick (pullbuoy)
- leg kick only (undulation)

Bilateral EMG of **erector spinae** and **obliquus externus**

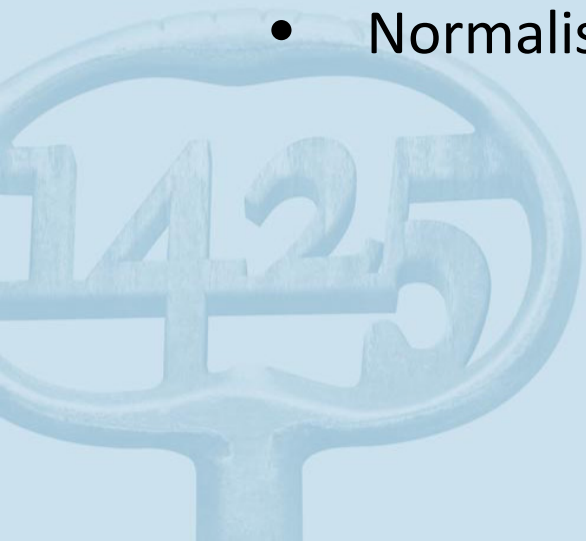
Methods

1. Subjects
2. Equipment
3. Experimental protocol
4. Data processing
 - Dartfish Prosuite[®] software for kinematic data
 - hand in – 45° : entry
 - 45° - 90° : pull
 - 90° - 135° : push
 - 135° - hand out : exit
 - hand out – hand in : recovery

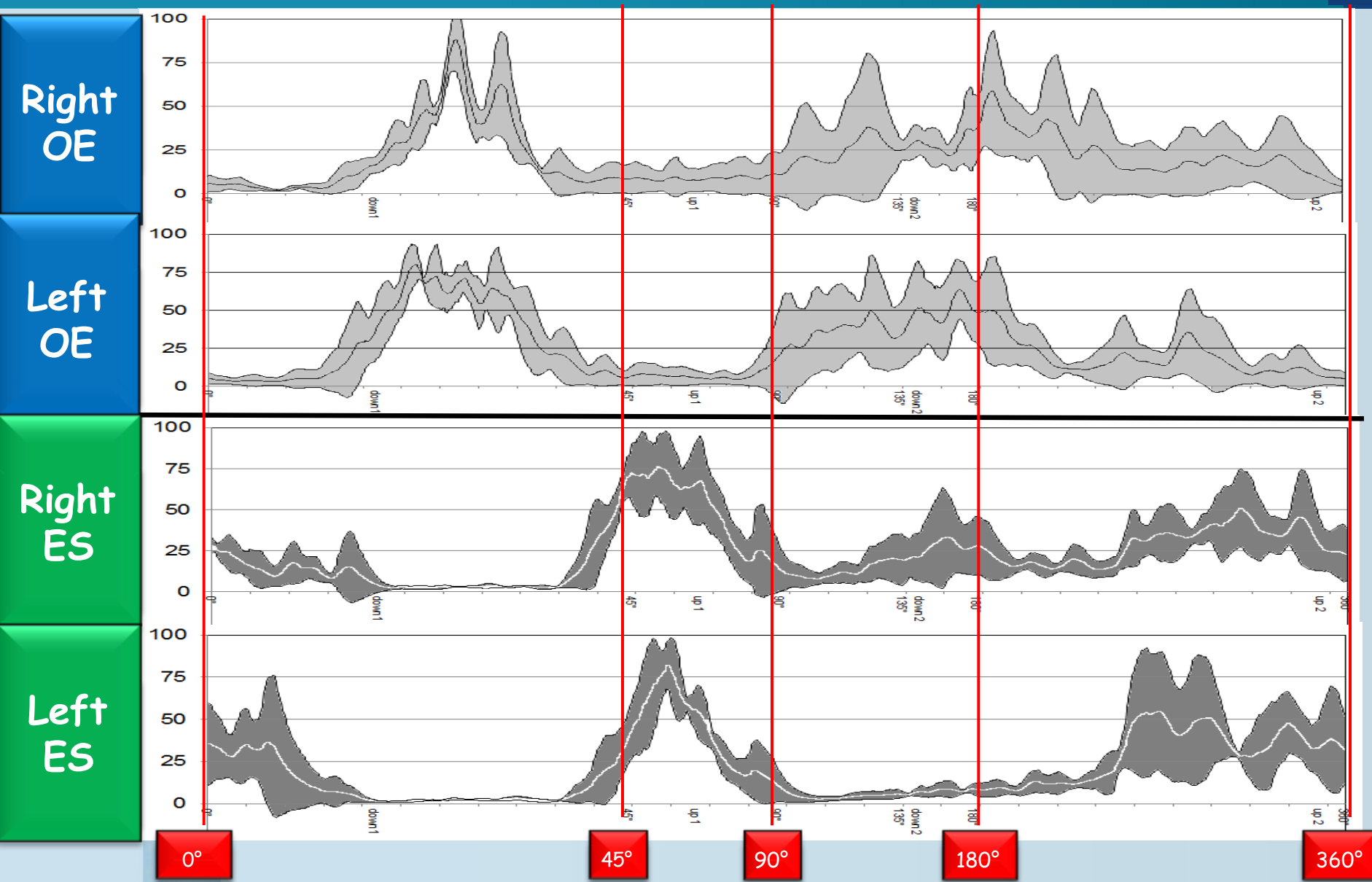


Methods

1. Subjects
2. Equipment
3. Experimental protocol
4. Data processing
 - Dartfish Prosuite[®] software for kinematic data
 - KINE software for EMG analysis
 - Integrated
 - Running average 40ms
 - Normalised to dynamic maximum



Symmetrical and reciprocal activity of abdominal and lower back muscles in full butterfly stroke



First peak : support arm action + trunk flexion

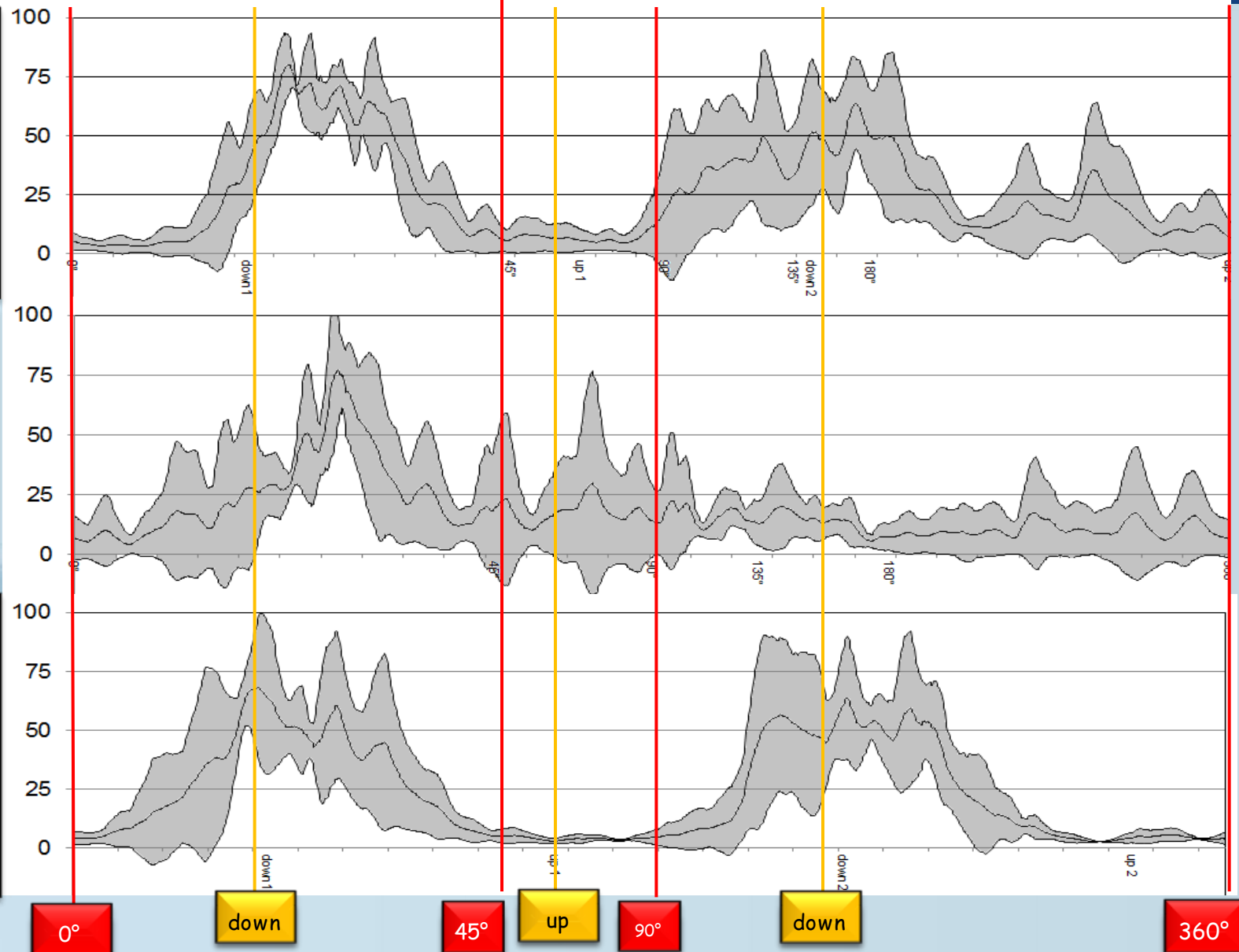
Second peak : mainly trunk flexion

Left abdominals

Full butterfly stroke

No leg kick

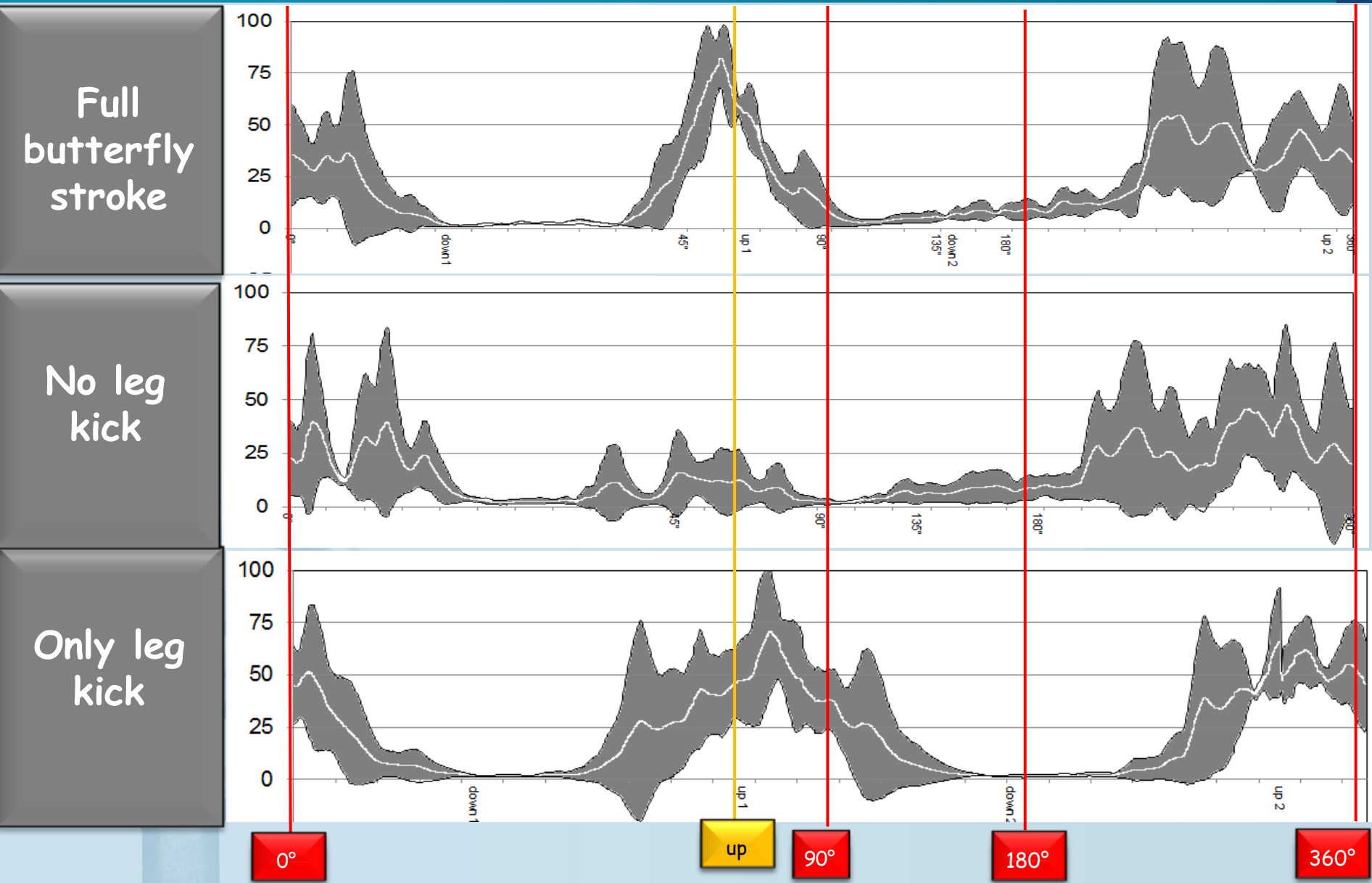
Only leg kick



First peak : trunk extension

Left lower back

Second peak : trunk extension + support arm recovery



Summary

- Symmetrical activity of abdominal and lower back muscles in full butterfly stroke
- Lower back muscles work antagonistic to abdominals
- 1st peak of activation in abdominals caused by undulation AND arm action



body prepares to stabilize trunk for the forces generated by the arms when lever is largest

- 2nd peak caused by undulation
- 1st peak of activation in lower back muscles caused by undulation
- 2nd peak caused by undulation and recovery of arms



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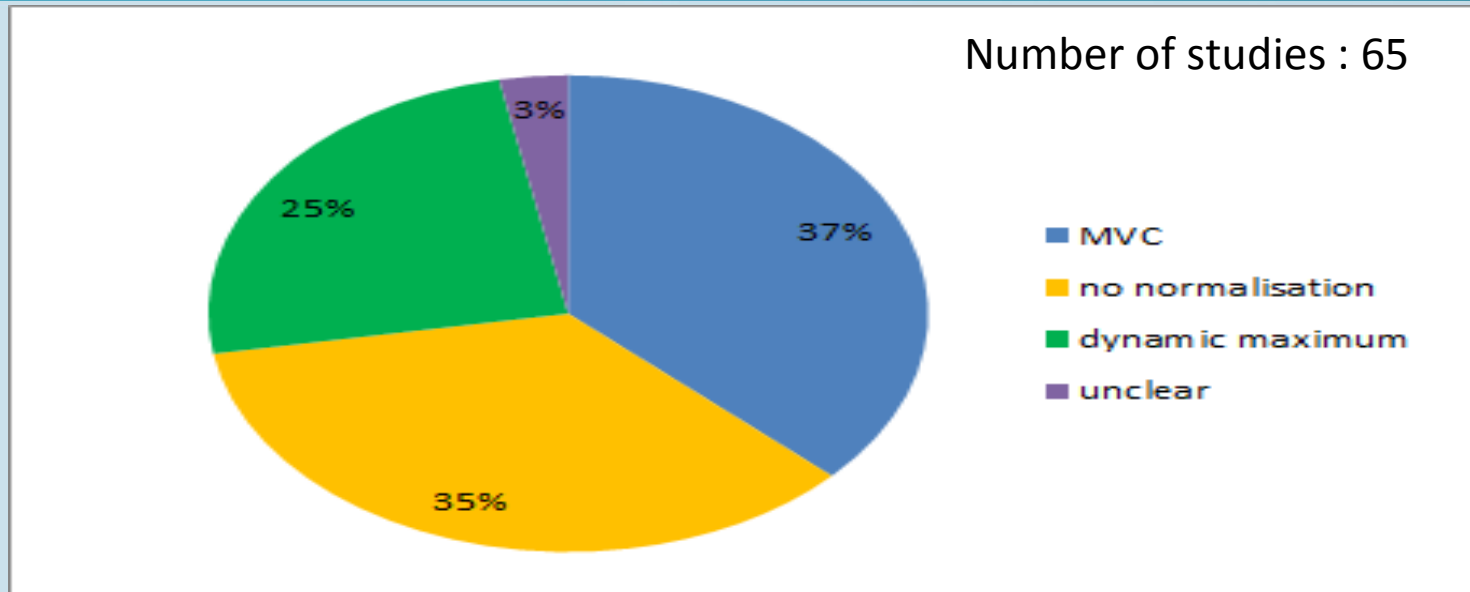
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To MVC or not to MVC



- MVC : subject does maximal voluntary contraction of all muscles studied
 - iEMG of MVC is reference value (100%)
 - + perfect in all static (e.g. isometric) applications (Clarys 2011)
 - for dynamic activities (e.g. swimming) debatable (Clarys 2000, 2002)
 - dynamic percentages in swimming up to 160% of MVC (Lewillie 1973, Clarys 1983)
 - difference in MVC on dry land and in water (Masumoto 2008)
- Dynamic maximum : normalization to highest peak activity in dynamic conditions
 - + counters negatives of MVC
 - less internationally accepted (harder to publish)