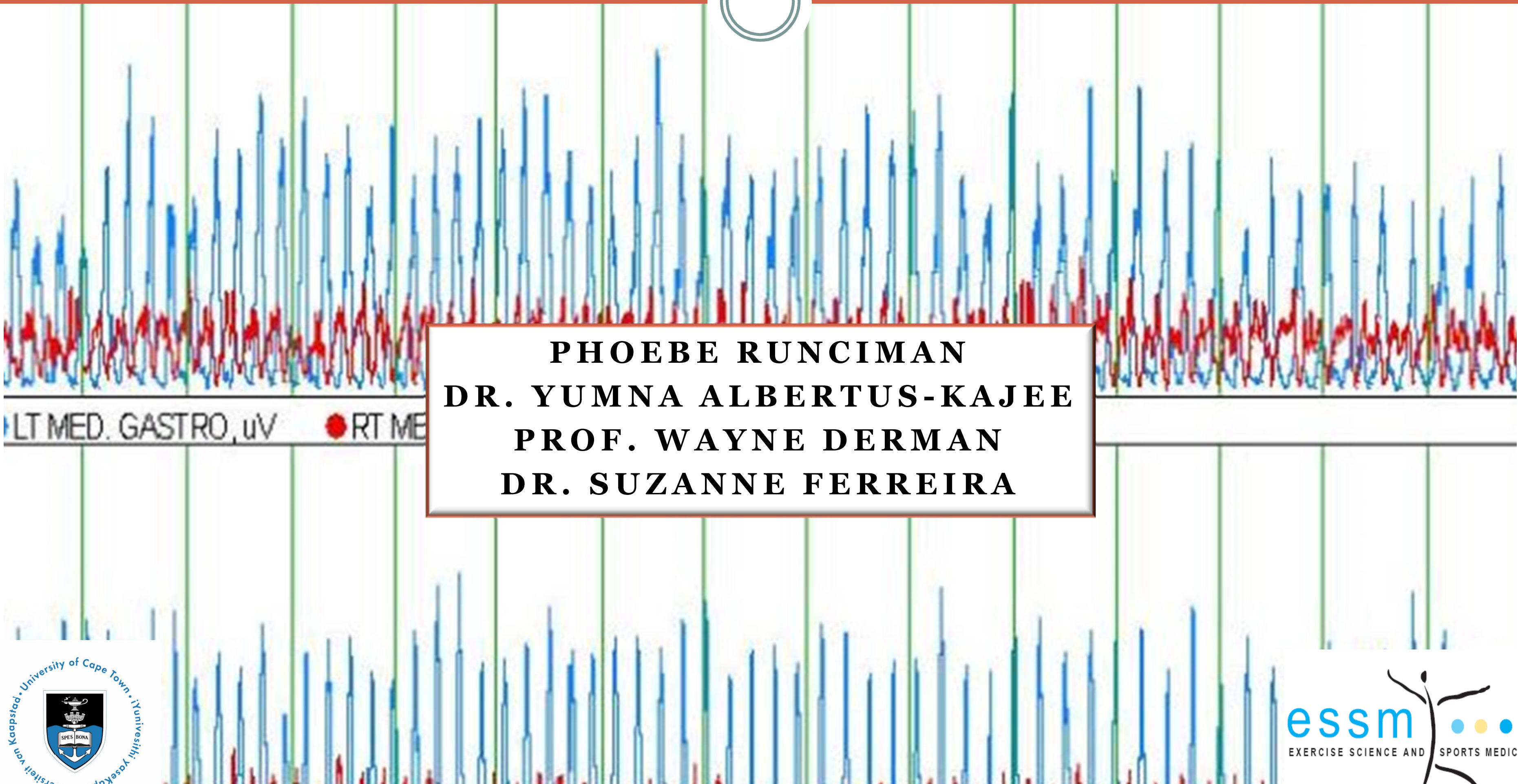
NOVEL USES OF ELECTROMYOGRAPHY IN EVALUATION OF SKELETAL MUSCLE RECRUITMENT DURING EXERCISE IN ATHLETES WITH DISABILITIES: A KEY TO INJURY PREVENTION AND FUTURE CLASSIFICATION?



PHOEBE RUNCIMAN
DR. YUMNA ALBERTUS-KAJEE
PROF. WAYNE DERMAN
DR. SUZANNE FERREIRA

essm EXERCISE SCIENCE AND SPORTS MEDICINE

Electromyography (EMG)

The study of muscle activation by examination of the electrical signals that emanate from skeletal muscle

Neuromuscular conditions:

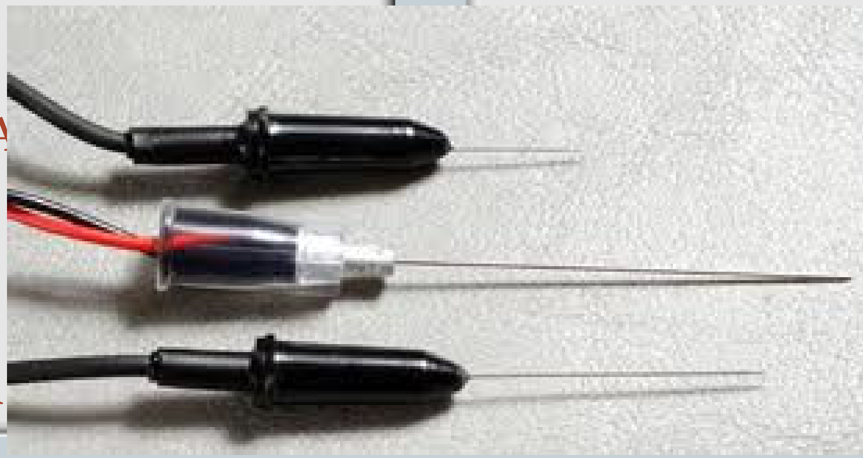
Amyotrophic
(A

Cerebral

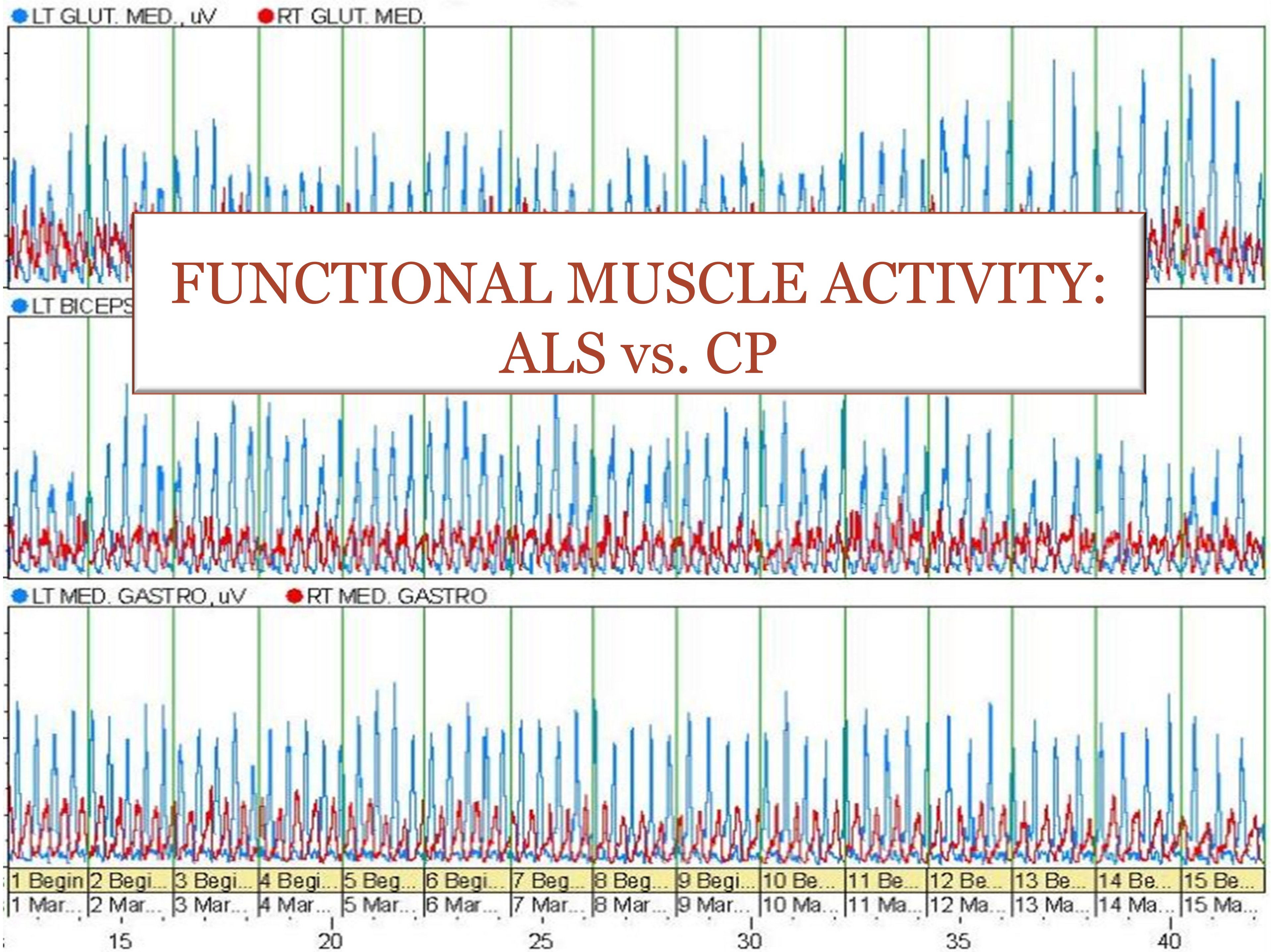
Musculoskeletal injury:

al strains

ring strains



FUNCTIONAL MUSCLE ACTIVITY: ALS vs. CP



Background: Athletes

ALS

- Lower motor neuron form of ALS
- Age: 43 yrs
- Time since diagnosis: 4 yrs
- Prognosis: 18 - 24 months
- 2 yrs participation
- Classification- S9
- Side most affected: Left
- Swimming event: freestyle

CP

- Spastic hemiplegic CP
- Age: 25 yrs
- 8 yrs participation
- Classification- T37
- Side affected: Right
- Track events: 100m, 200m

Testing protocol

Muscles:

Primary power muscles:
- Anterior deltoid, Posterior deltoid
- Pectoralis major
- Serratus anterior
- Latissimus dorsi

Secondary support muscles:
- Upper trapezius, Lower trapezius
- External oblique

Normalised to 10s max trial

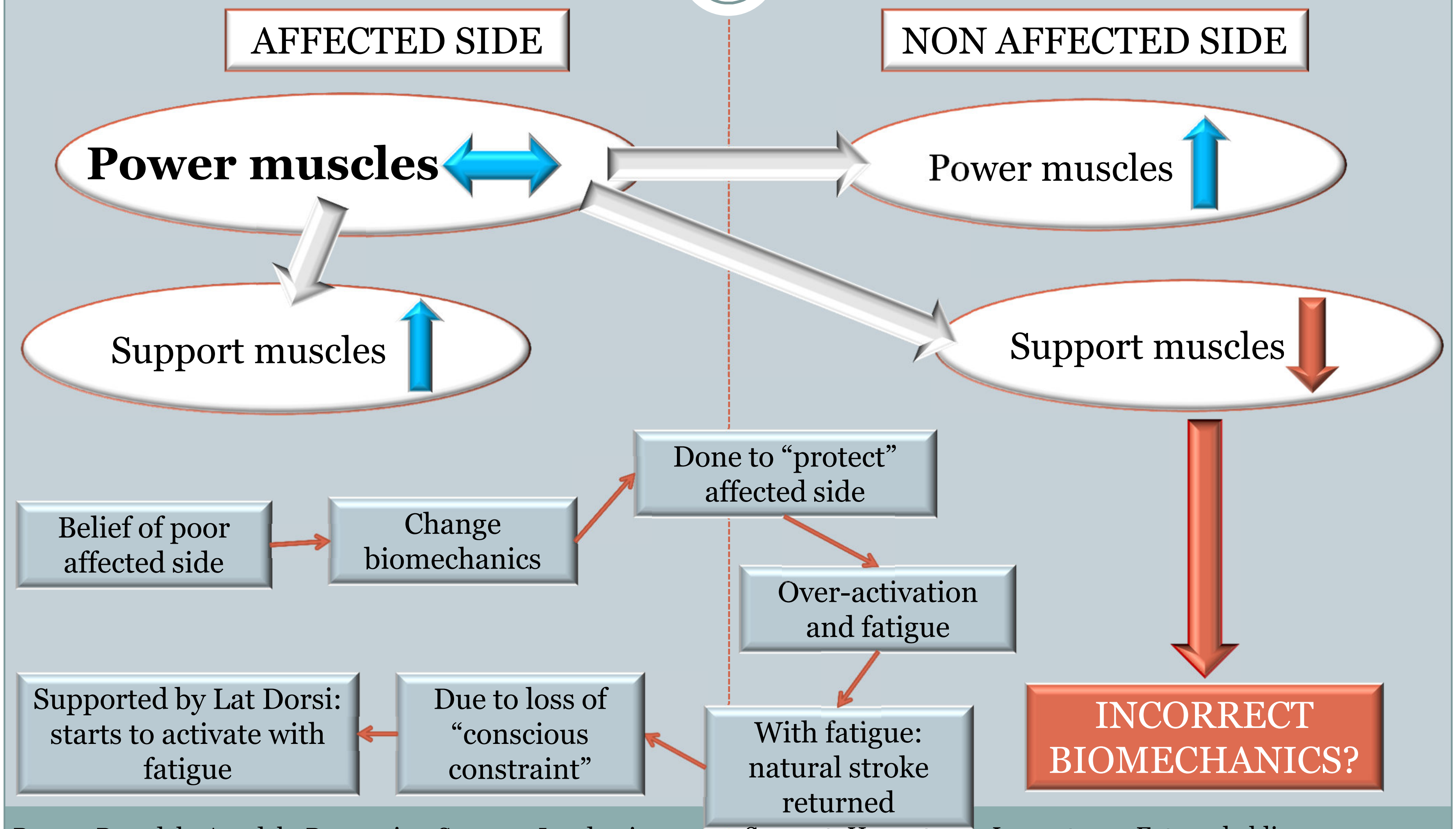
Muscles:
- Erector spinae
- Gluteus medius
- Biceps femoris
- Vastus lateralis
- Gastrocnemius medialis

Normalised to 10s sprint

Results: ALS

Muscle	Left	Right	Same
Pectoralis Major			4.5 %
Posterior Deltoid	16.8 %		
Anterior Deltoid		20 %	
Serratus Anterior			0 %
Latissimus Dorsi	21 %		
Upper Trap			1.2 %
Lower trap	18.8 %		
External Obliques		11.6 %	

Results: ALS fatigue and symmetry



Power: Post delt, Ant delt, Pect major, Serr ant, Lat dorsi

Support: Upper traps, Lower traps, External obliques

Results: CP: Pre-fatigue symmetry

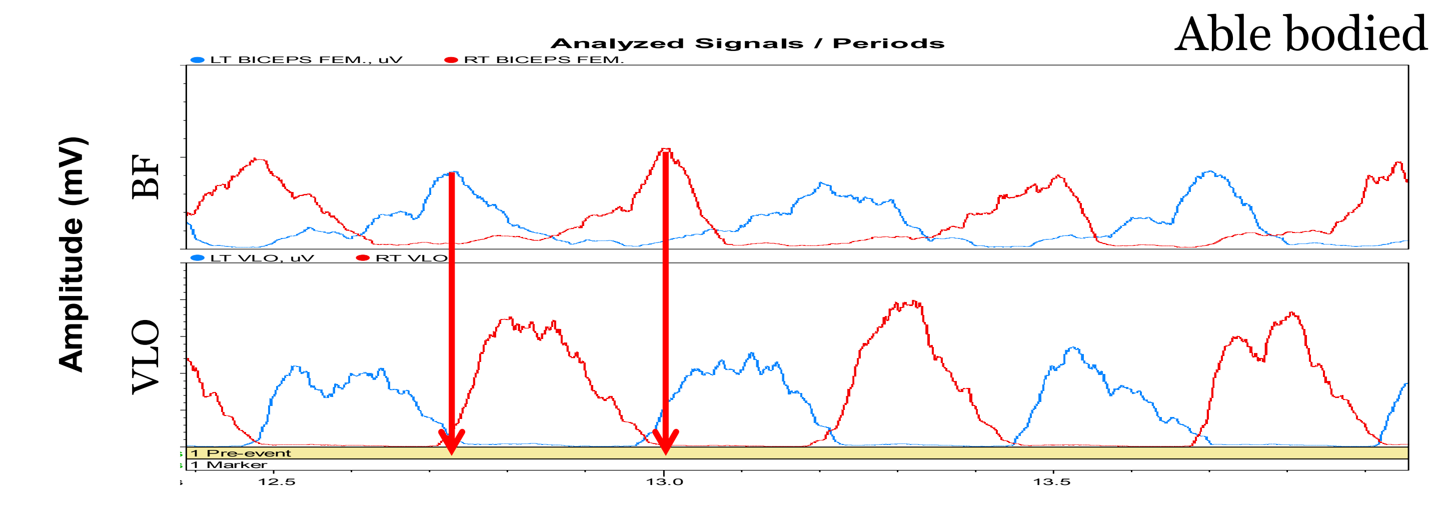
Muscle	Non affected side	Affected side	Similar
Erector spinae		23 %	
Gluteus medius			4 %
Biceps femoris	13 %		
Vastus lateralis	25 %		
Gastrocnemius			1 %

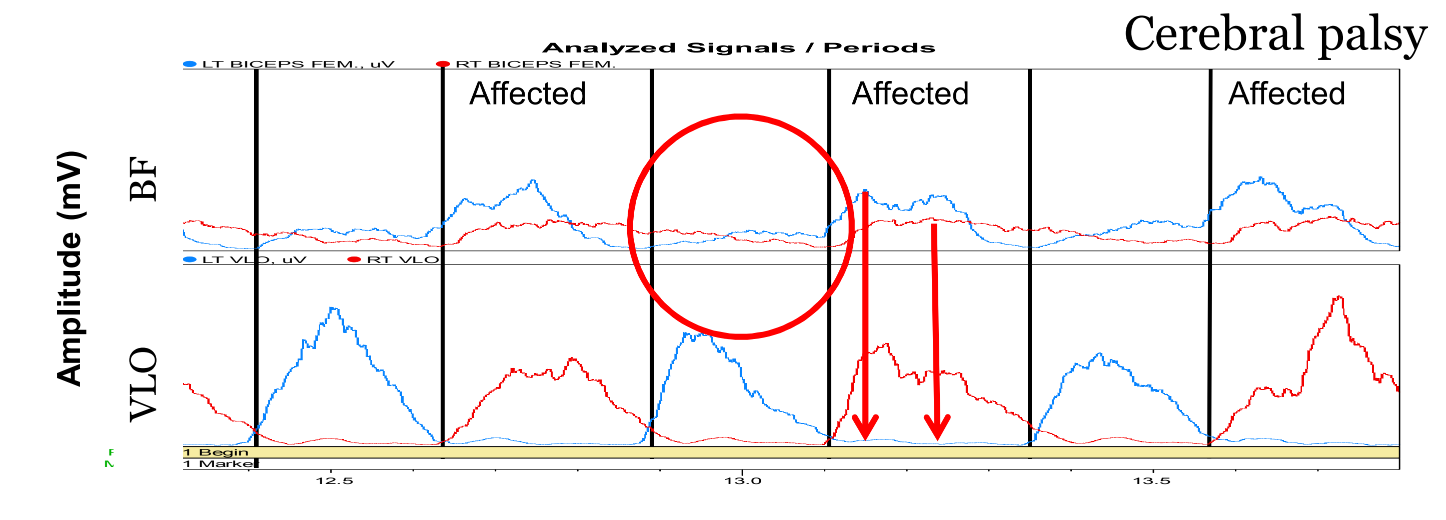
Results: CP: Post-fatigue symmetry

Muscle	Non affected side	Affected side	Similar
Erector spinae		27 %	
Gluteus medius			
Biceps femoris			9 %
Vastus lateralis	25 %		
Gastrocnemius			6 %

Possible compensation for lack of BF over-activation on affected side

CP: A closer look shows a muscle irregularity



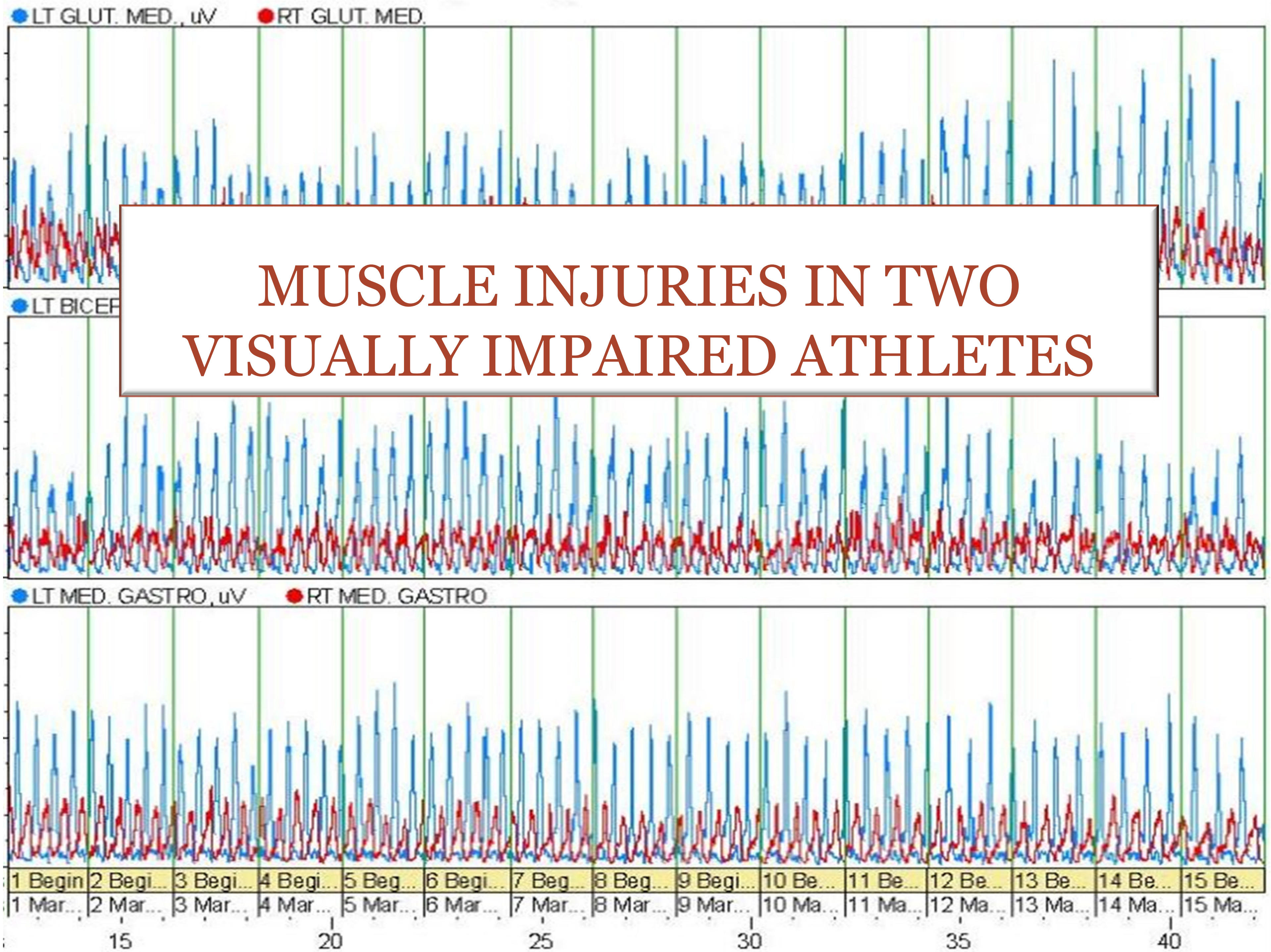


Summary: ALS & CP

- ALS:
- The results suggest that by protecting the side that he believed to be “severely affected”, he was compromising his whole stroke
- This is supported by the correction of his stroke post-fatigue
- With knowledge of muscle activation:
  - Know that the rehabilitation is working (keep doing what he is doing)
  - Correct stroke (and performance) by changing flawed ideas

- CP:
- Compensation for the BF may indicate reliance on the non-affected side for power output in this cycling task
- May also be a result of co-activation of the affected BF
- The identification of this co-activation is of clinical significance

MUSCLE INJURIES IN TWO VISUALLY IMPAIRED ATHLETES



Athletes: Injury history

Case 1:

- *T/F 13*
- *100m, 200m, LJ*

- No precipitating trauma
- Prior right foot strain
- Prior achilles injury

- **Chronic gluteus medius pain/ strains (bilateral)**

Case 2:

- *T 12*
- *200m, 400m*

- No precipitating trauma
- Prior right foot fracture
- Right proximal hamstring strain at 2011 IPC WC

- **Chronic left hamstrings strains**

Previous literature in athletes with visual impairment?

Methodology: Testing protocol

Case 1:

- 3 starts
- 2 max sprints
- Fatigue (1km at 400m pace)
- 1 max sprint

Muscles:

- Erector spinae
- Gluteus medius
- Gluteus maximus
- Biceps femoris
- Gastrocnemius lateralis

Normalised to 20m max sprint

Case 2:

- 3 block starts
- 5 40m @ 400m pace
- 1 block start

Muscles:

- Tibialis anterior
- Gluteus maximus
- Vastus lateralis
- Biceps femoris
- Gastrocnemius lateralis

Normalised to 20m max sprint

Bilateral gluteus medius pain

Results: Case 1

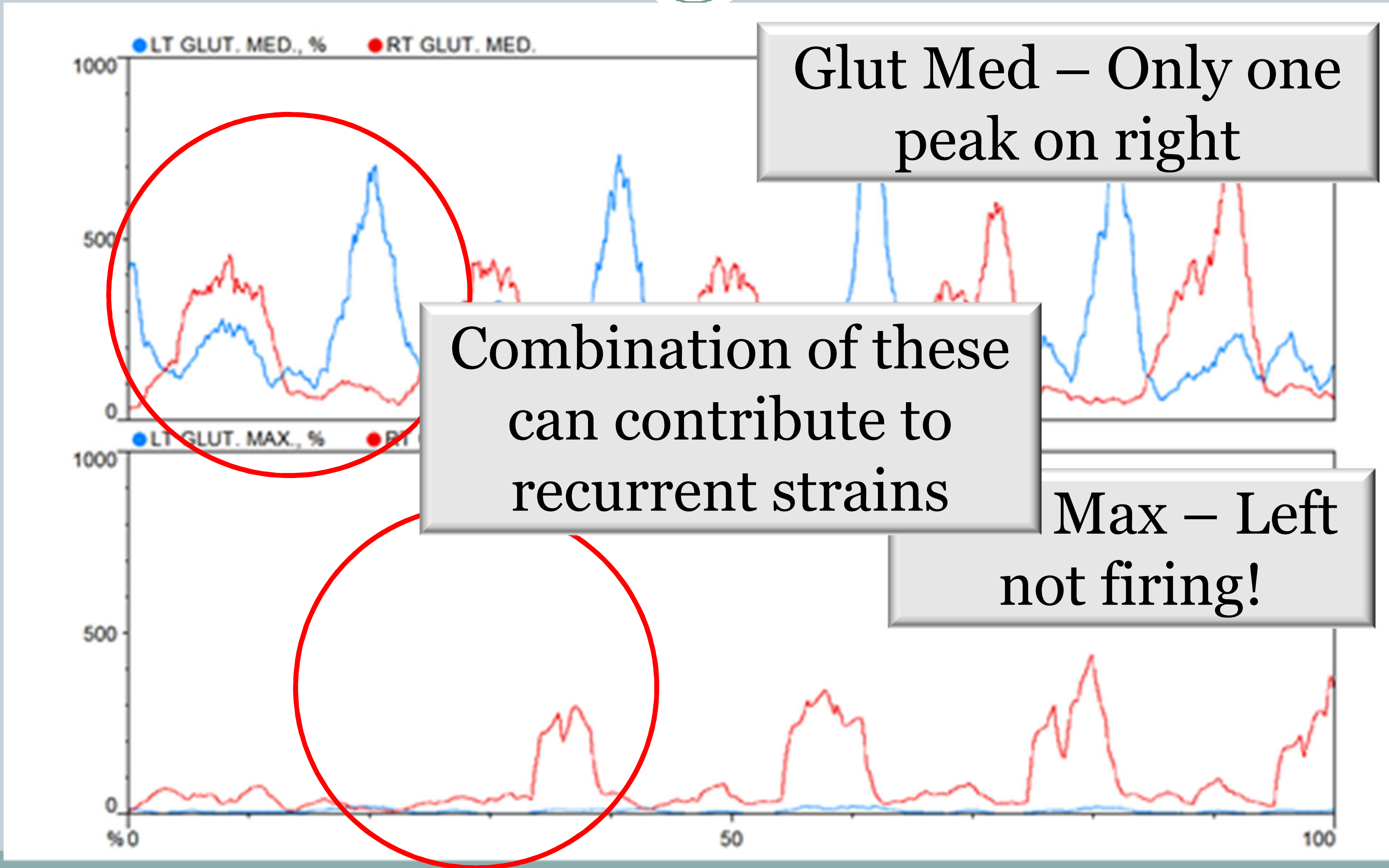
2nd max sprint

Muscle	Left	Right
Erector spinae	33.8 %	
Gluteus medius		
Gluteus maximus		91.1 %
Biceps femoris	71 %	
Lateral gastrocnemius	24.3 %	

Left leg muscles compensating for low Glut Max activation

Bilateral gluteus medius pain

Results: Case 1



Glut Med – Only one peak on right

Combination of these can contribute to recurrent strains

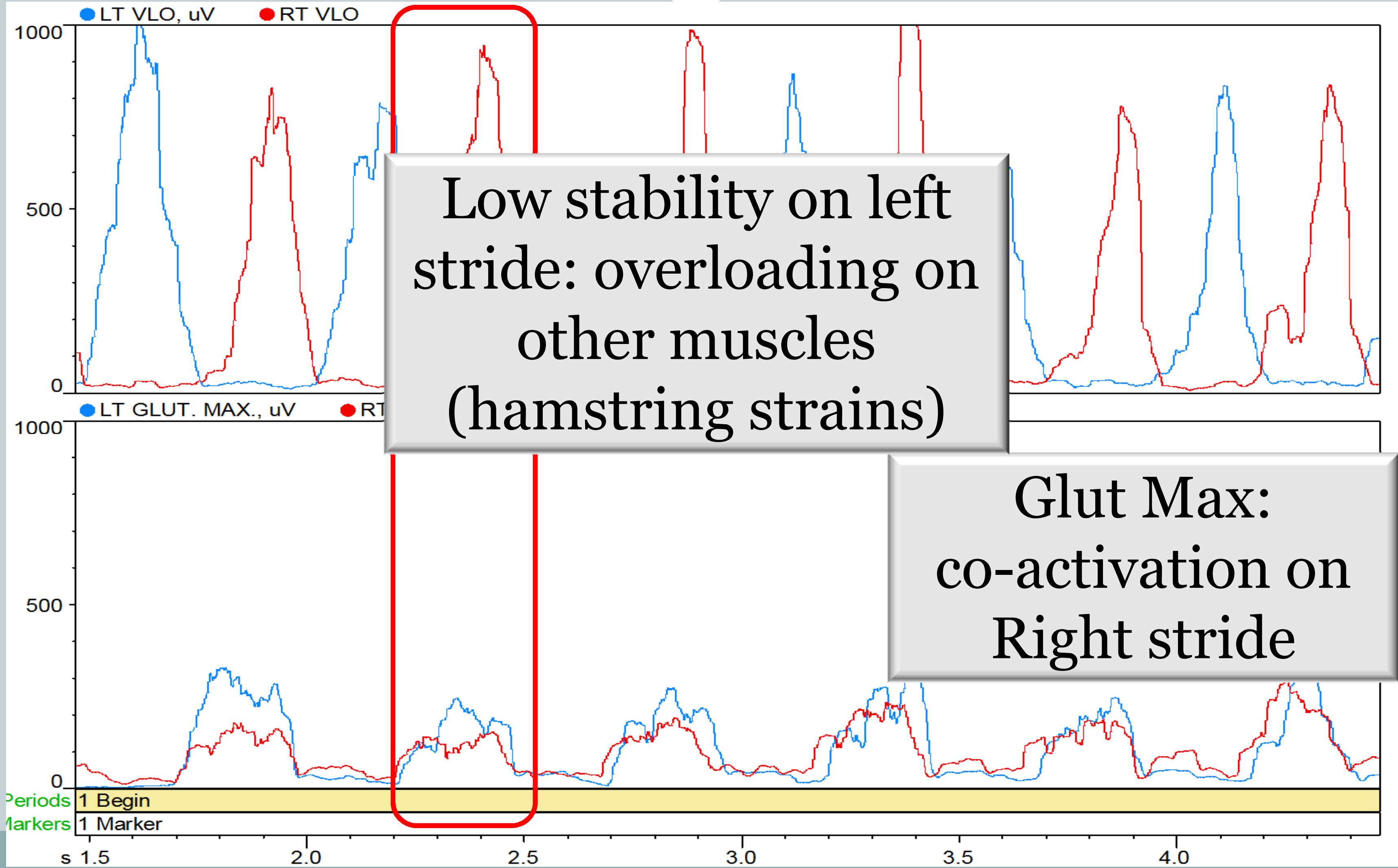
Max – Left not firing!

Gazendam et al, 2007

Left hamstring strains

Results: Case 2

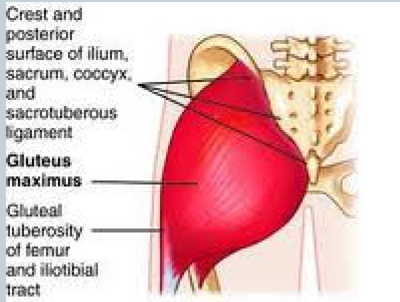
400m pace run



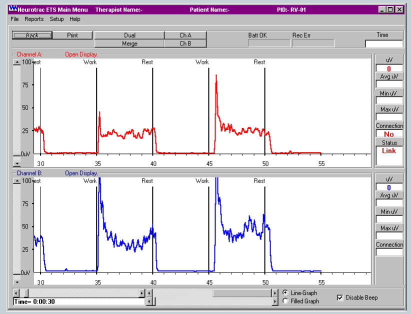
Left hamstring strains

Case 2: Rehabilitation

- Glut max rehabilitation
  - As opposed to glut med rehabilitation



- Biofeedback
  - EMG



- Shockwave therapy
  - Sports Medicine Clinic

Summary: EMG for injury

- Case 1:
- We identified a possibly large compensation for extremely high gluteus maximus activation during maximal sprinting
- Identification of reciprocal EMG irregularities in the gluteus muscles exposed possible contributing factors for chronic gluteal strains and pain

- Case 2:
- It is possible that co-activation of gluteus maximus on right stride may lead to low stability on the left stride
- This may lead to overloading on surrounding muscles on the left side, thus leading to injury
- EMG allowed us to pursue correct rehabilitation of the injury

Clinical application of EMG

- EMG is recommended as a tool in clinical management of all athletes ***WITH*** and ***WITHOUT*** disabilities

- EMG allows for ***identification of neuromuscular asymmetry***, which is becoming a vital addition to overall clinical assessment

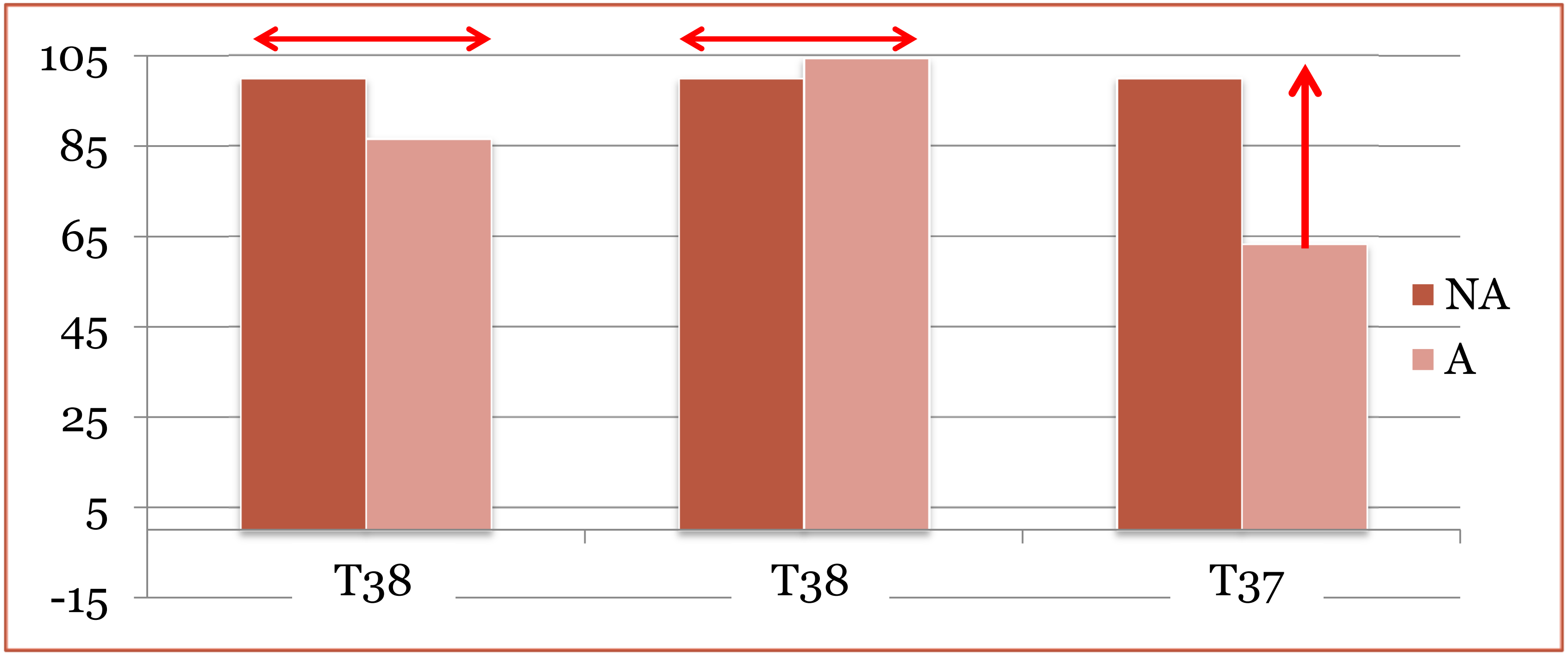
- In depth investigation into muscle pathology
  - **GOES BEYOND** functional testing

Clinical application of EMG cont.

- Abnormal recruitment patterns can persist for ***months or years*** after original injury
- Use information to ***inform clinicians*** on correct rehabilitation
- Easy to administer / User friendly

Possible implications for classification?

- EMG can be used to assess functional muscle activity in athletes with NM conditions:
  - Different activation levels in classes



Thank you!

Acknowledgements

David Karpul, UCT
Wayne Lombard, SSISA HPC

Athletes participation
- *Dr. Suzanne Ferreira*

NRF/DAAD
- *Doctoral Funding*
- *DAAD In-Country Short-Term Research Grant to Germany*

International Paralympic Committee
- *Medical and Scientific Internship*

Contact

Boundary Road, Newlands
Cape Town, South Africa
7700

+2779 074 0097
+4979 3522 450

phoebe.runciman@gmail.com
phoebe.runciman@paralympic.org

Deutscher Akademischer Austausch Dienst
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