

# KINEMATIC ANALYSIS IN CYCLING BIOMECHANICS

## AN EVIDENCE BASED APPROACH

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# A PROPERLY ADJUSTED BICYCLE IS ESSENTIAL FOR:

- ▶ Comfort
- ▶ Injury prevention
- ▶ Peak performance
- ▶ Safety

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# REQUIRES UNDERSTANDING OF:

- ▶ The bicycle configuration
- ▶ Cyclists' goals
- ▶ Type of training and racing

“It has been suggested that cyclists would benefit from training under the same conditions that they would race in, maximizing the use of muscle coordination patterns seen during competition”

As fatigue occurs, cyclists may change their muscle activation patterns to maintain performance

# CHANGES IN MUSCLE RECRUITMENT PATTERNS WITH FATIGUE

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- ▶ Alteration in co-ordination patterns of the cycling movement with the development of fatigue
- ▶ Adapted to ensure the efficient transfer of power to the pedal

# CHANGES IN KINEMATICS WITH FATIGUE

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- ▶ Shift towards a greater trunk lean angle
- ▶ Increase into ankle dorsiflexion

It is not clear whether the riders change in position was due to fatigue, maximal effort or to the rider trying to find his own comfortable position



## 17 MALE CYCLISTS

AGE:  $31 \pm 9$

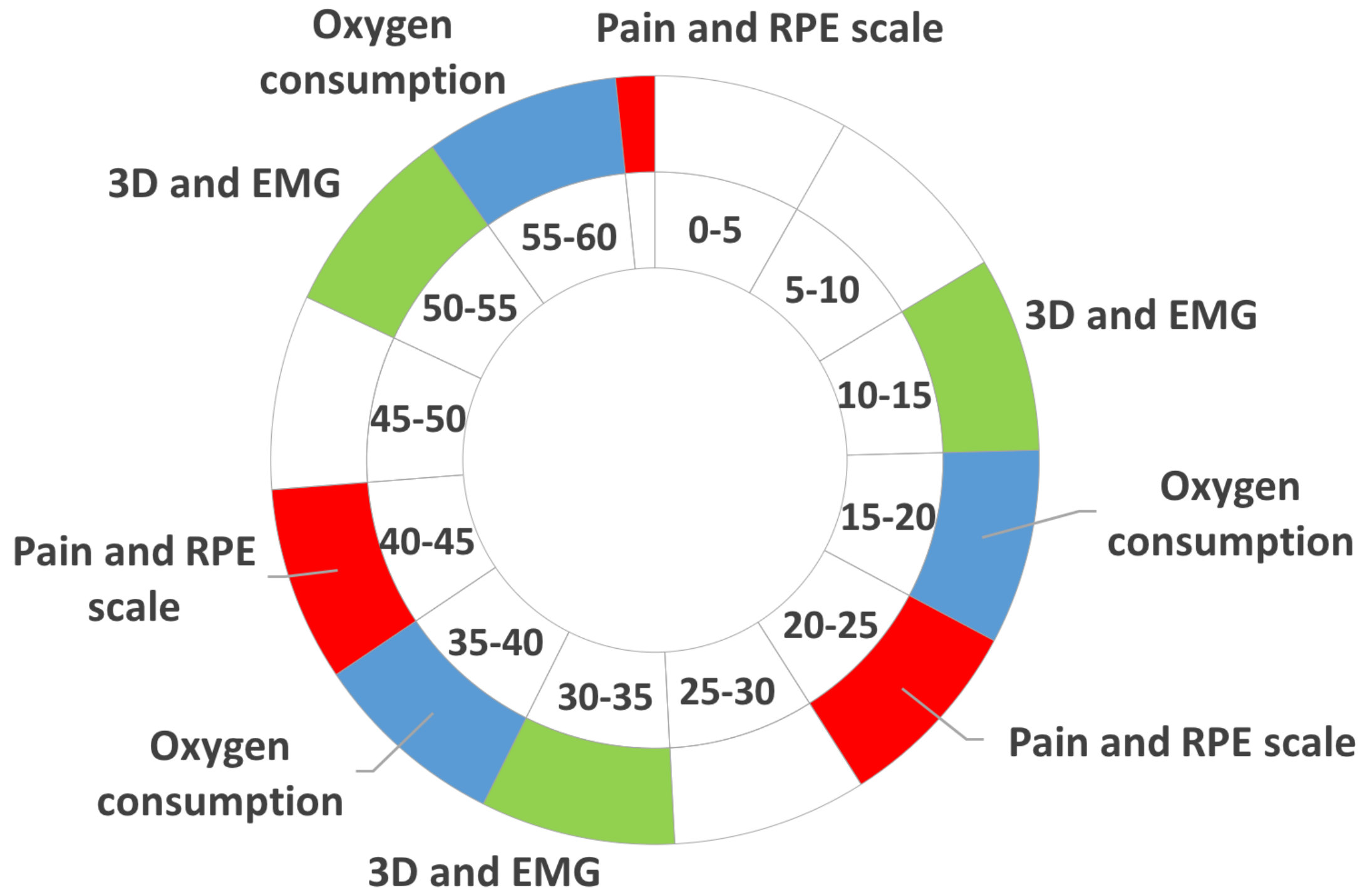
BODY MASS:  $75.5 \pm 7.5$  Kg

STATURE:  $178.4 \pm 4.4$  cm

BODY FAT %:  $8.4 \pm 2.8$

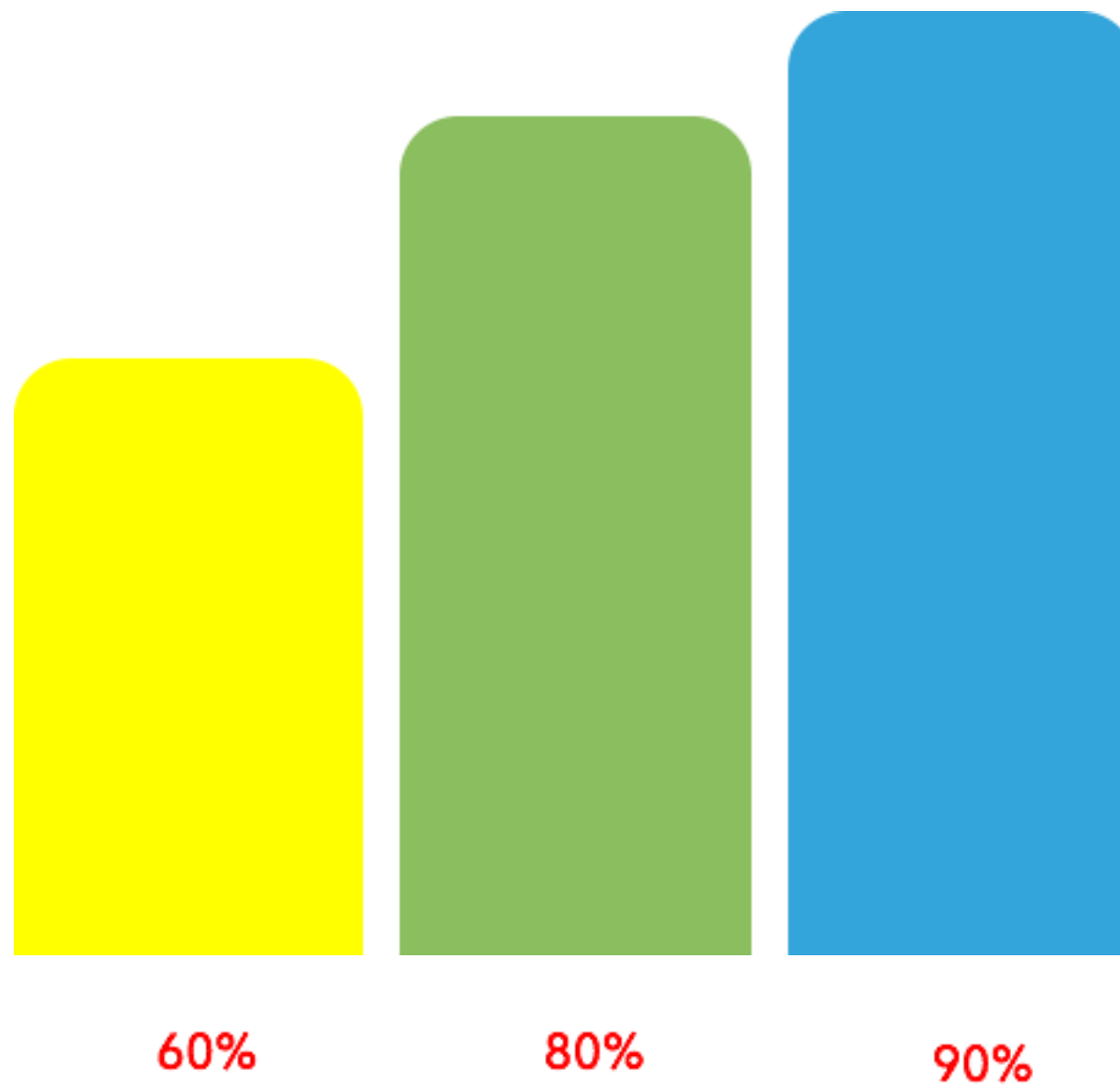
RELATIVE  $VO^2$  MAX:  $55.2 \pm 6.4$

# HOUR LONG STEADY STATE CYCLE



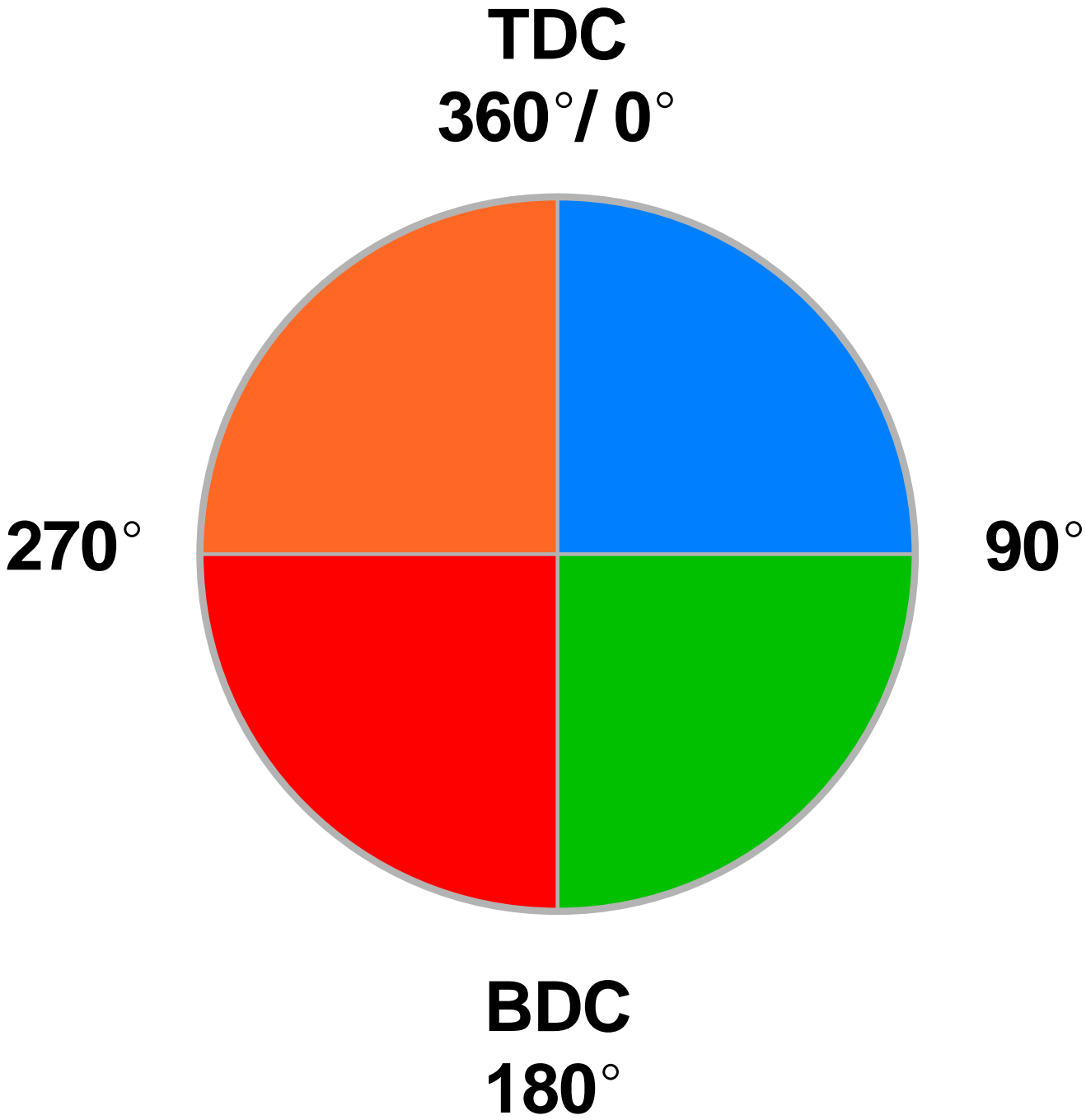
# INCREASED INTENSITY

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# EMG RESULTS

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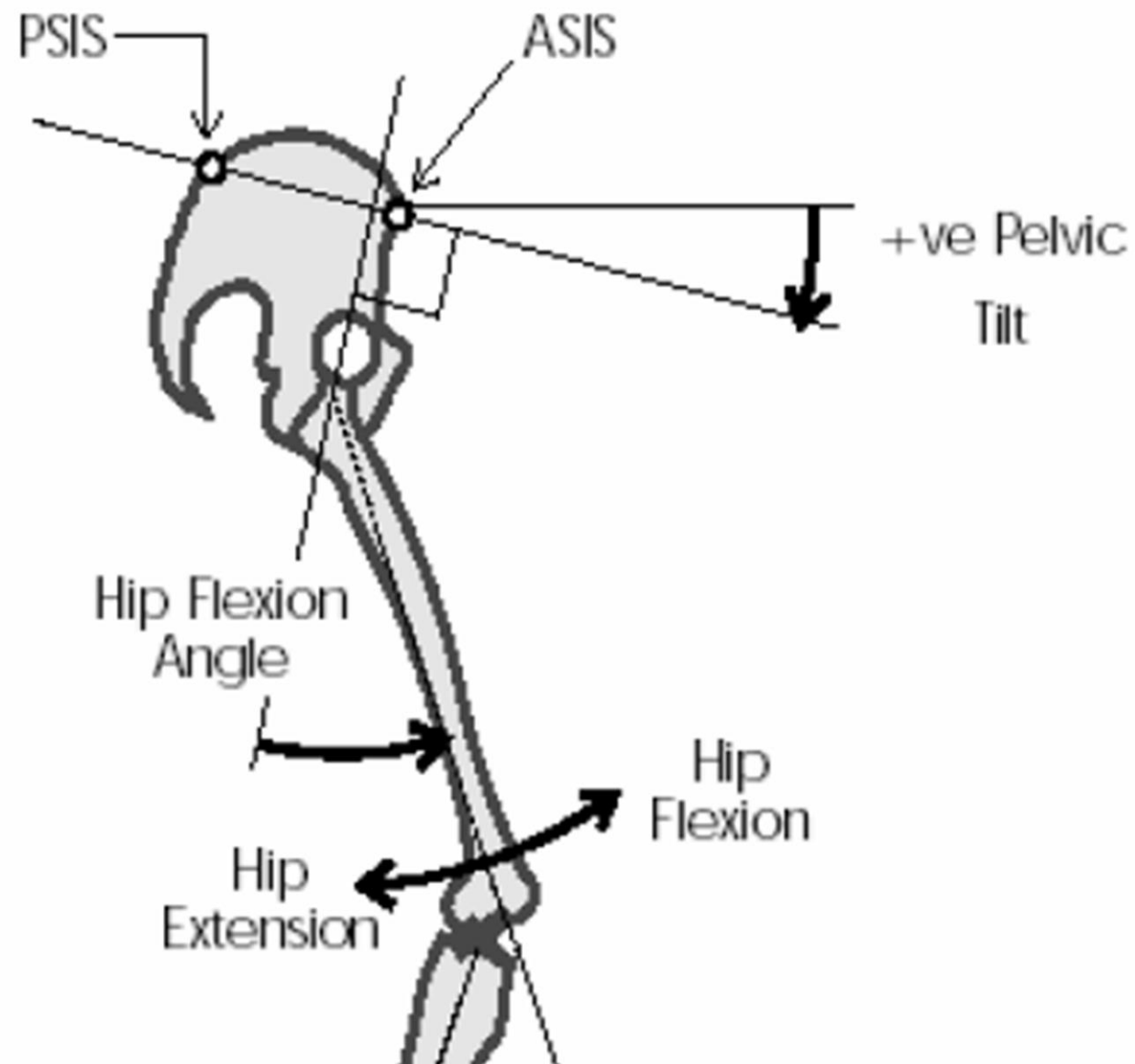


# 3D MOTION CAPTURE

## Lower Limb (Right)

RTHI – Right  
RKNE – Right  
RTIB – Right

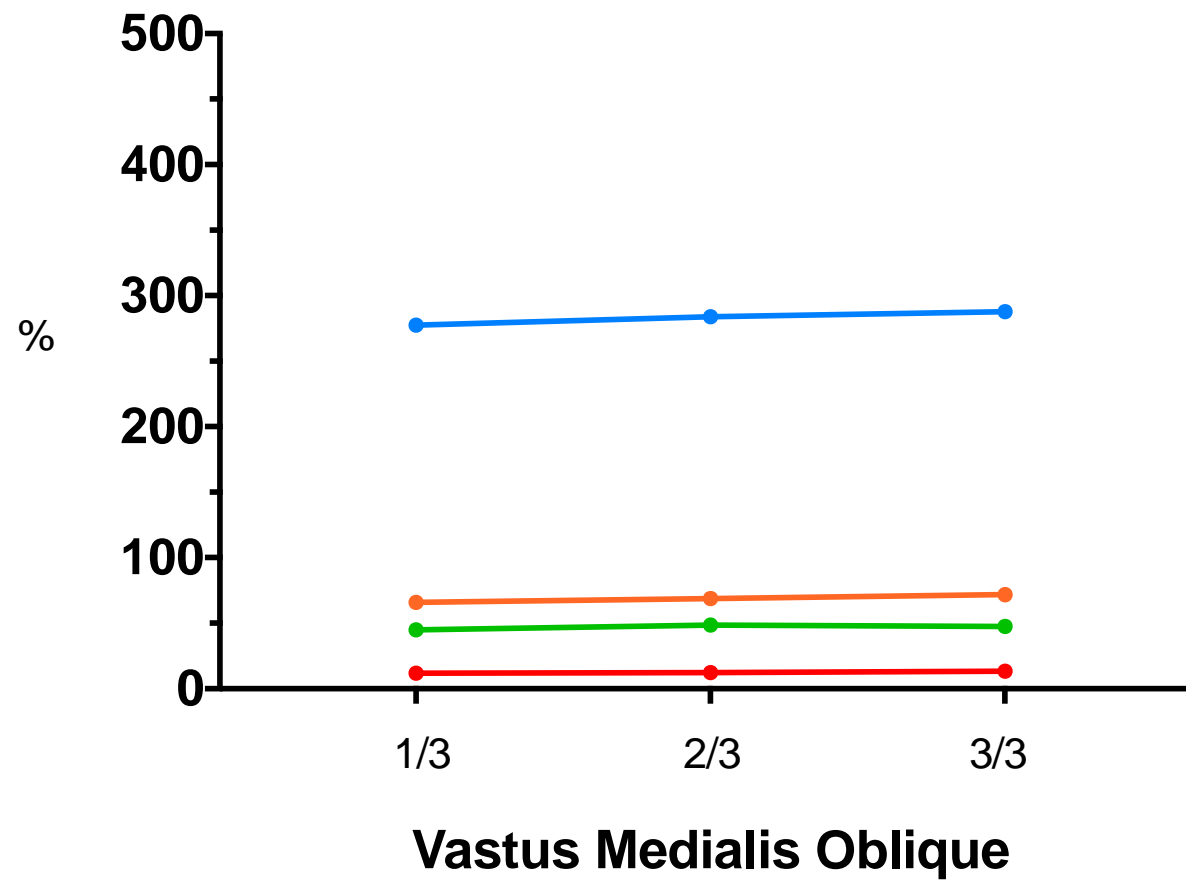
RTOE – Right  
RANK – Right  
RHEE – Right



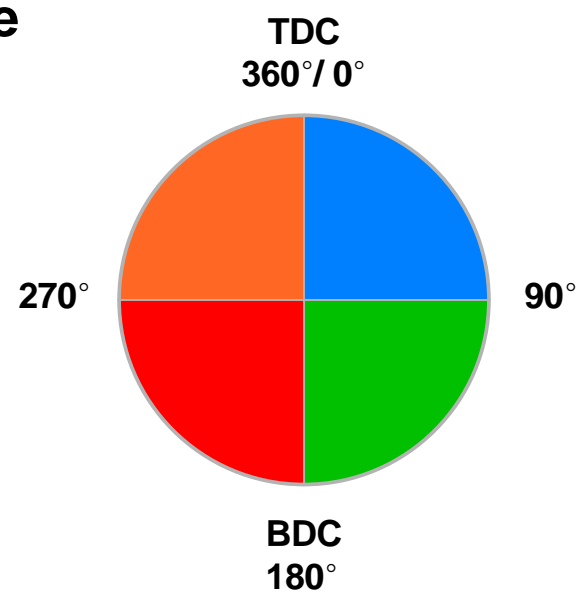
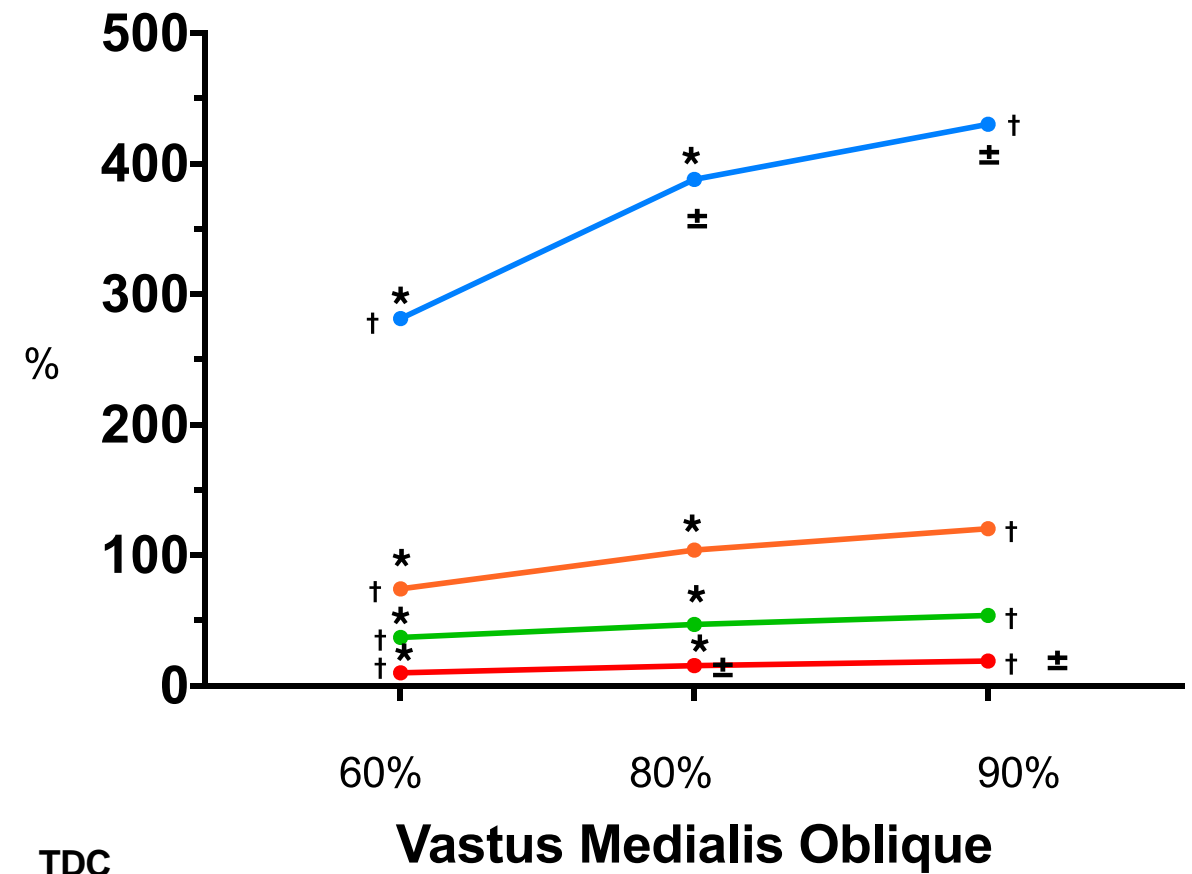
Left Anterior  
Superior Iliac  
Right Anterior  
Superior Iliac

# EMG RESULTS

## STEADY STATE CYCLE

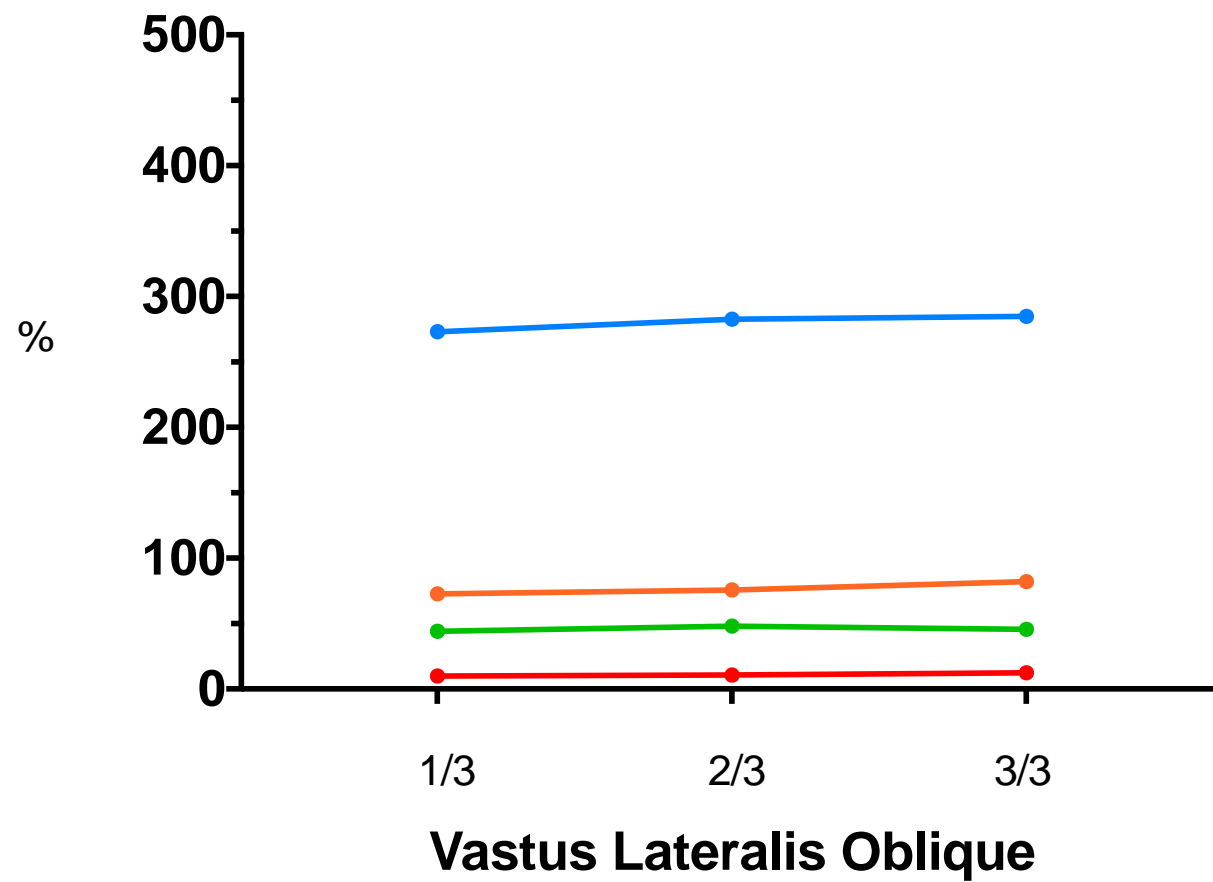


## INCREASED INTENSITY

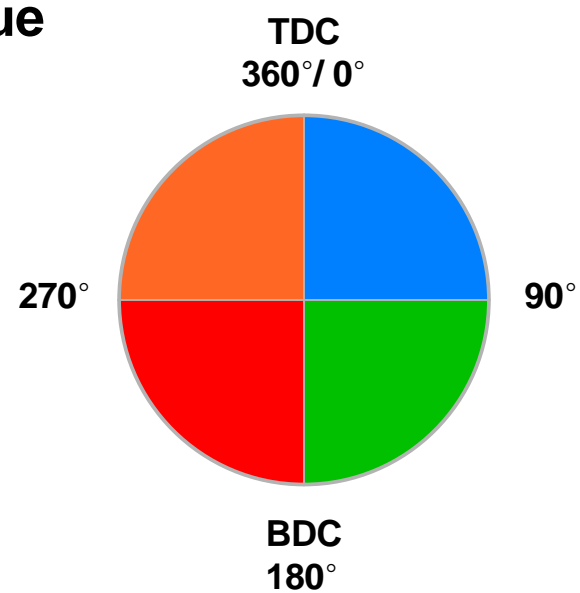
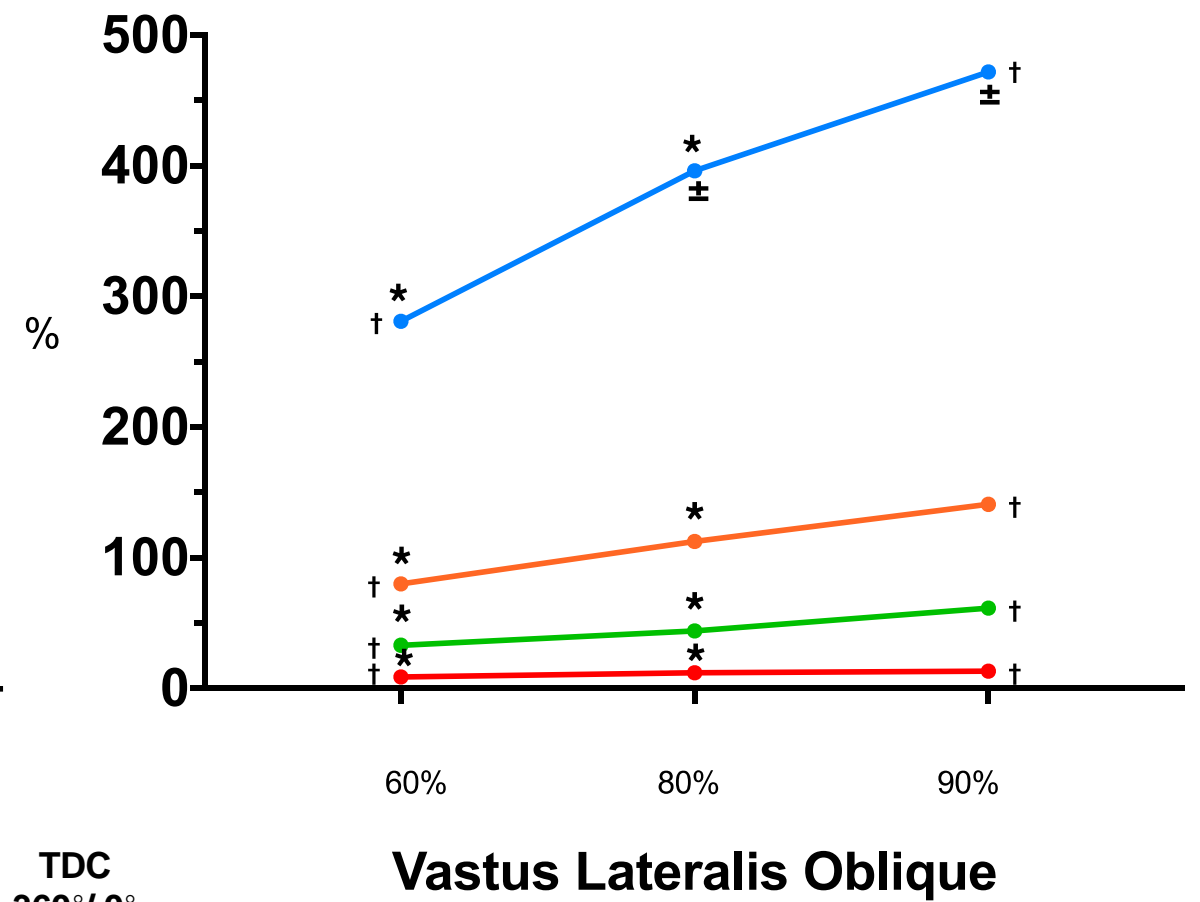


\* significant change from 60% to 80%    † significant change from 60% to 90%    ± significant change from 80% to 90%

## STEADY STATE CYCLE



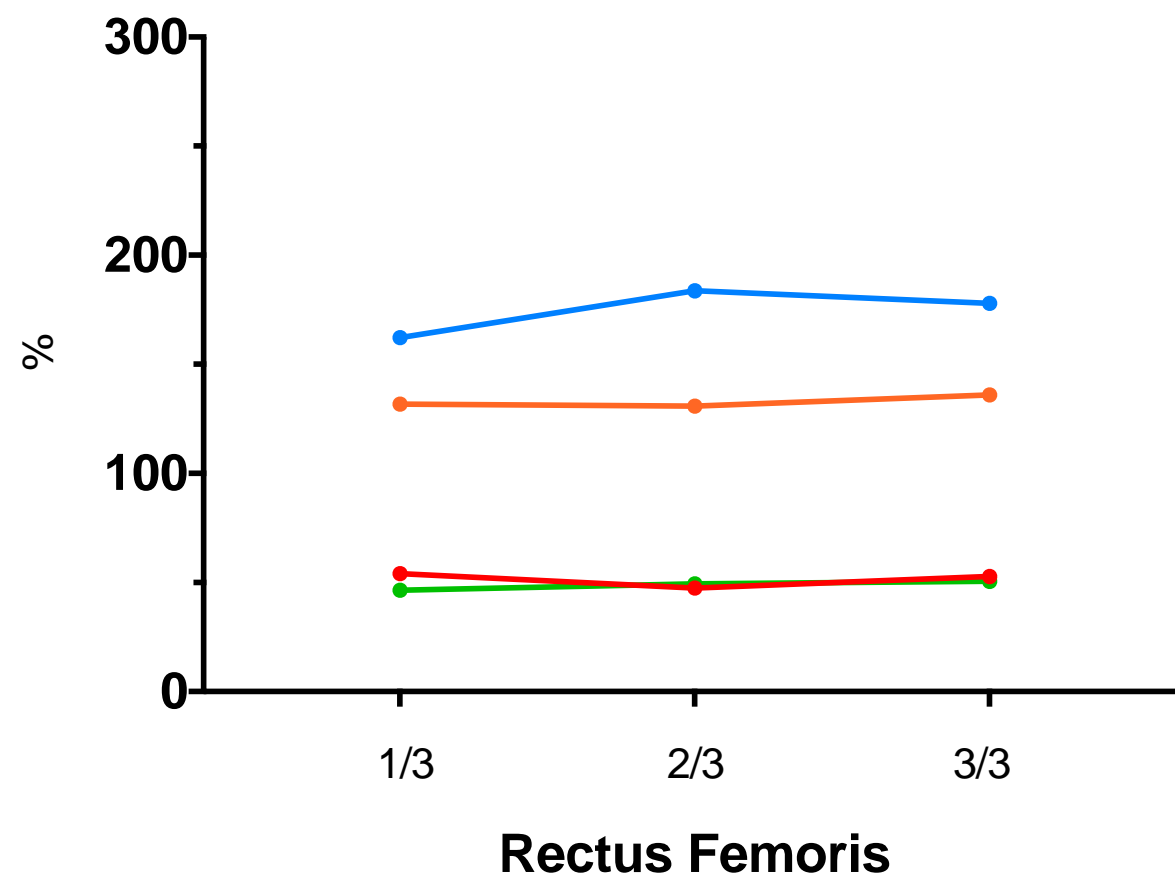
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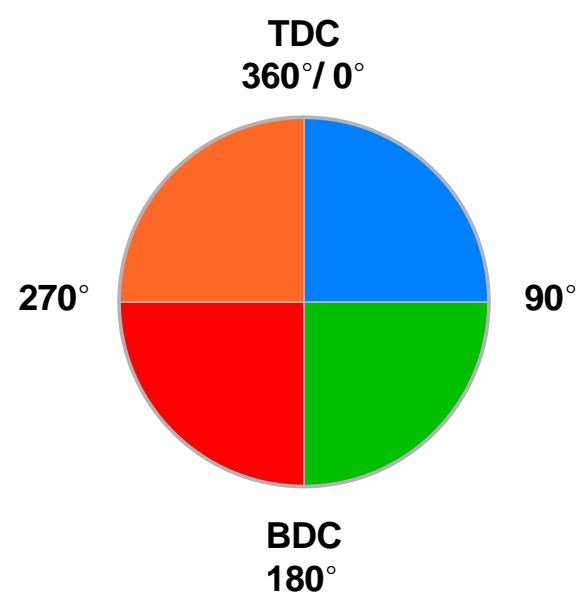
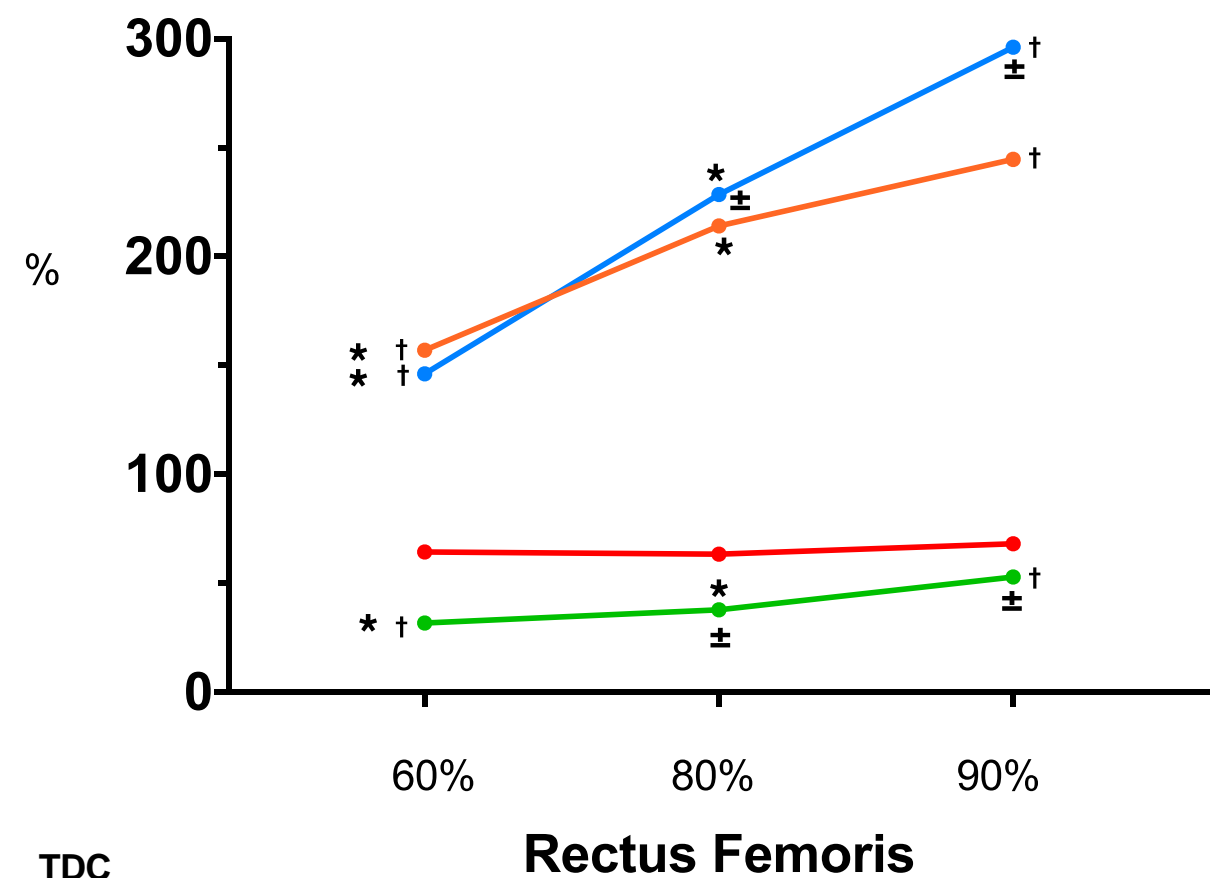
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## STEADY STATE CYCLE

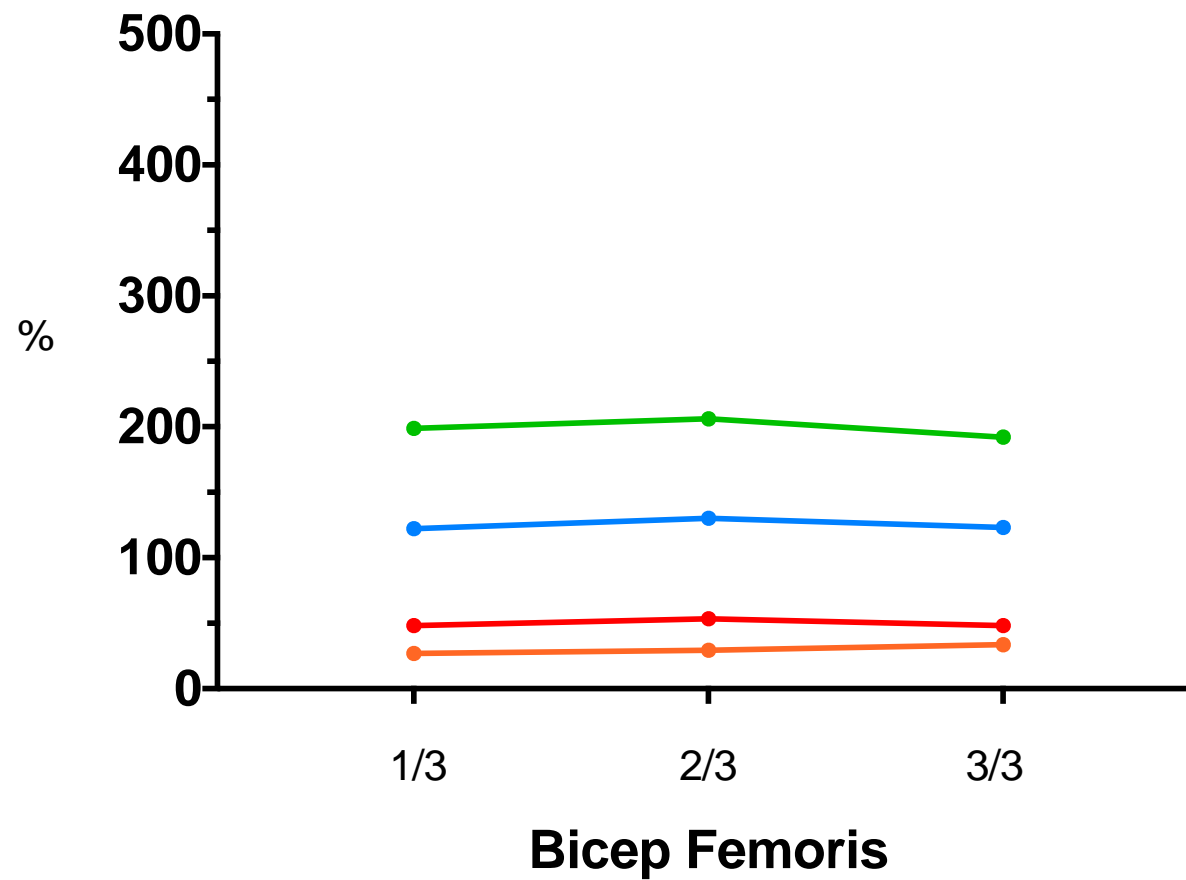


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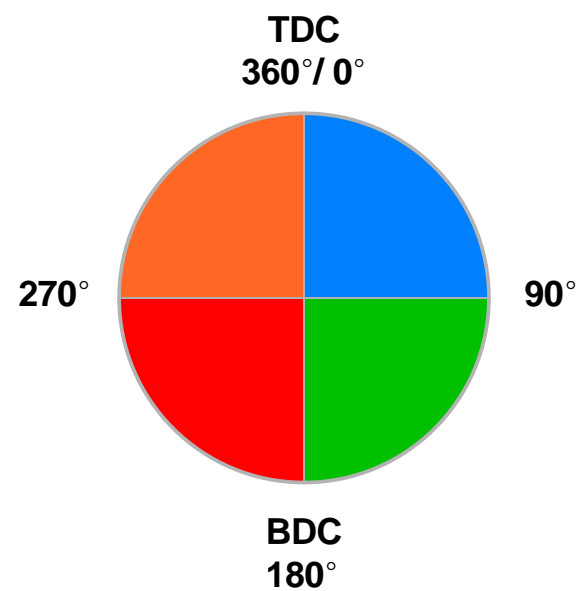
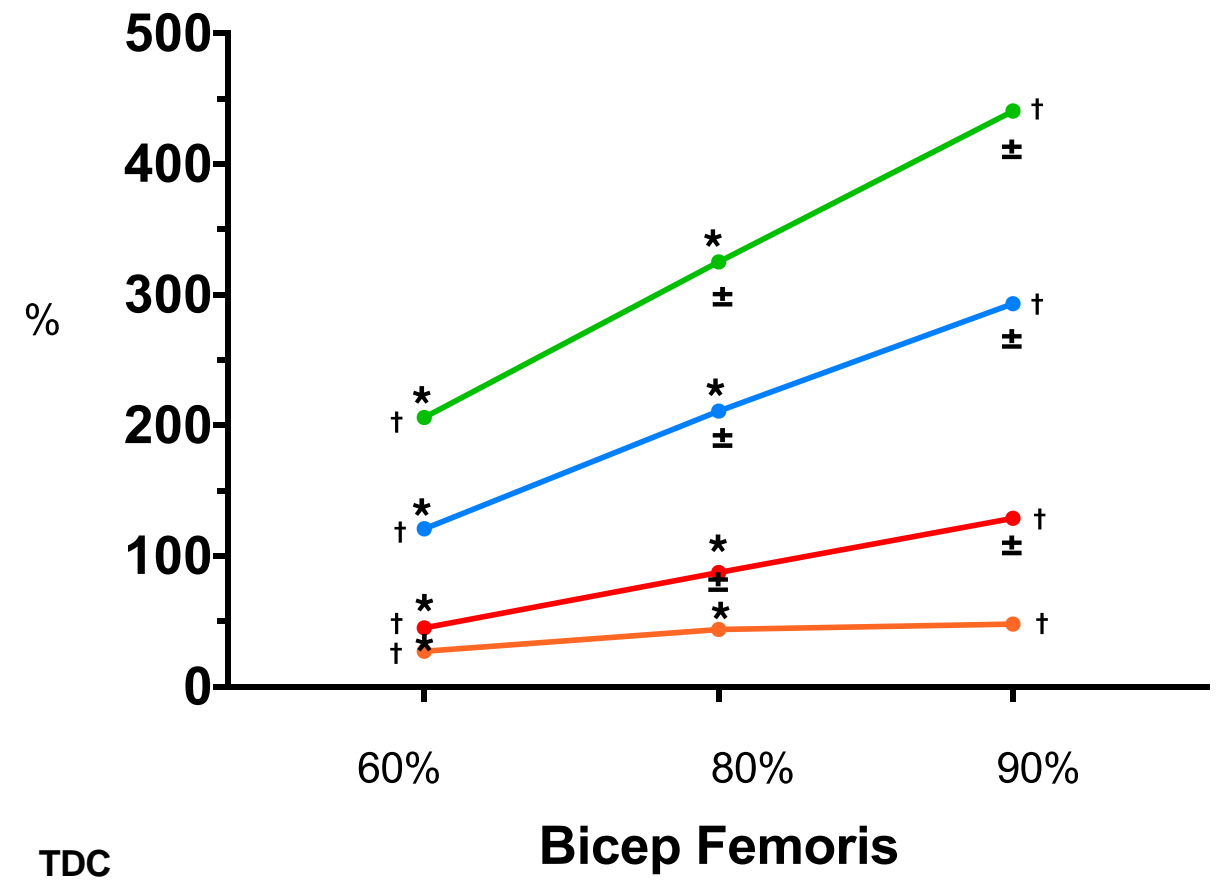


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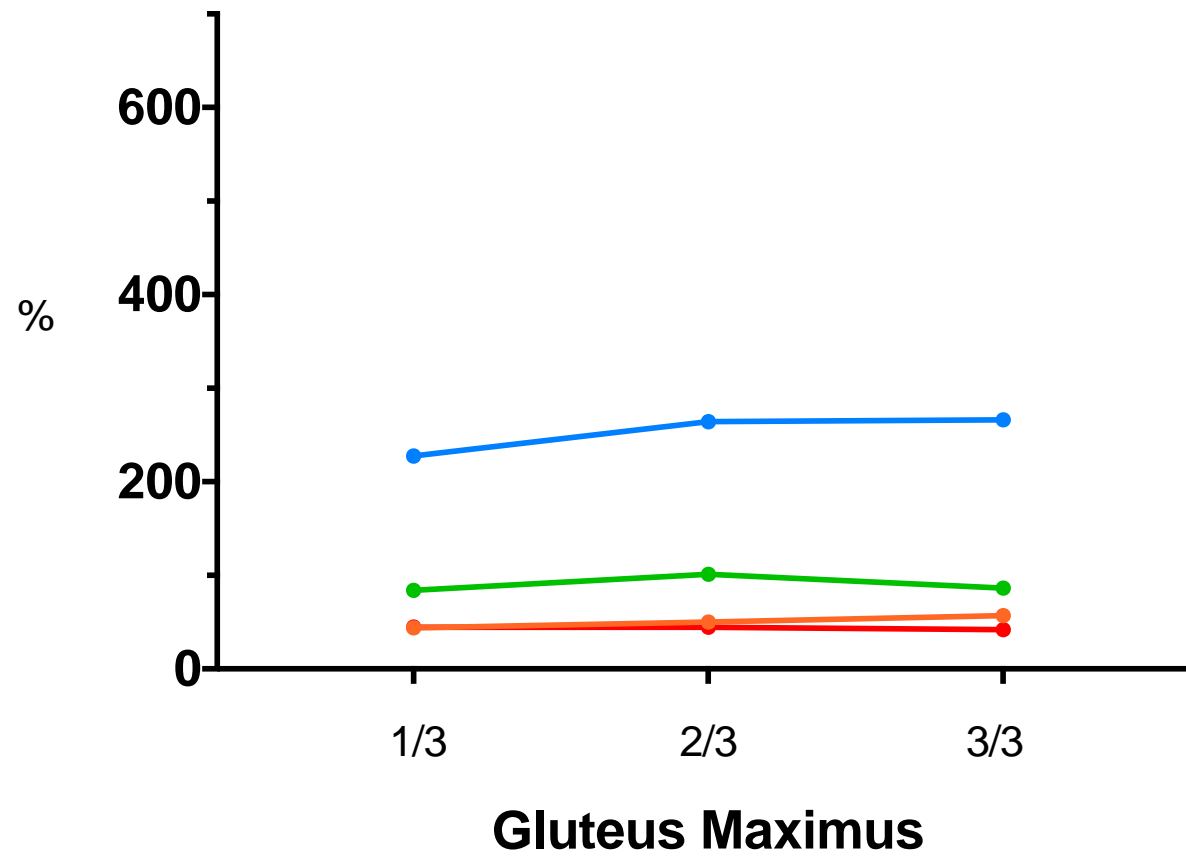


## INCREASED INTENSITY

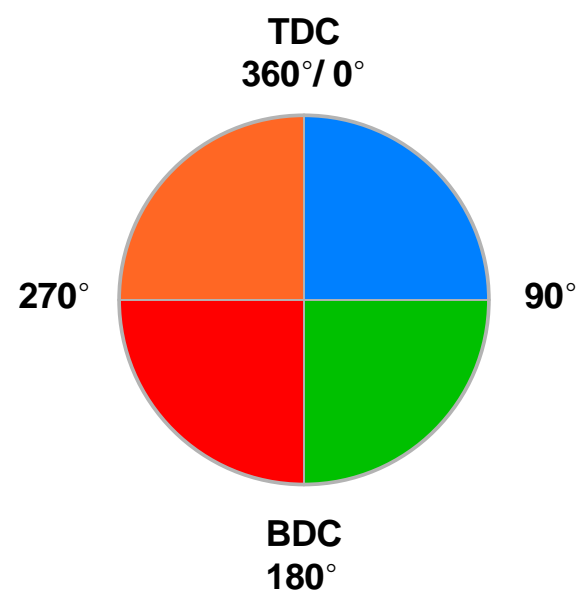
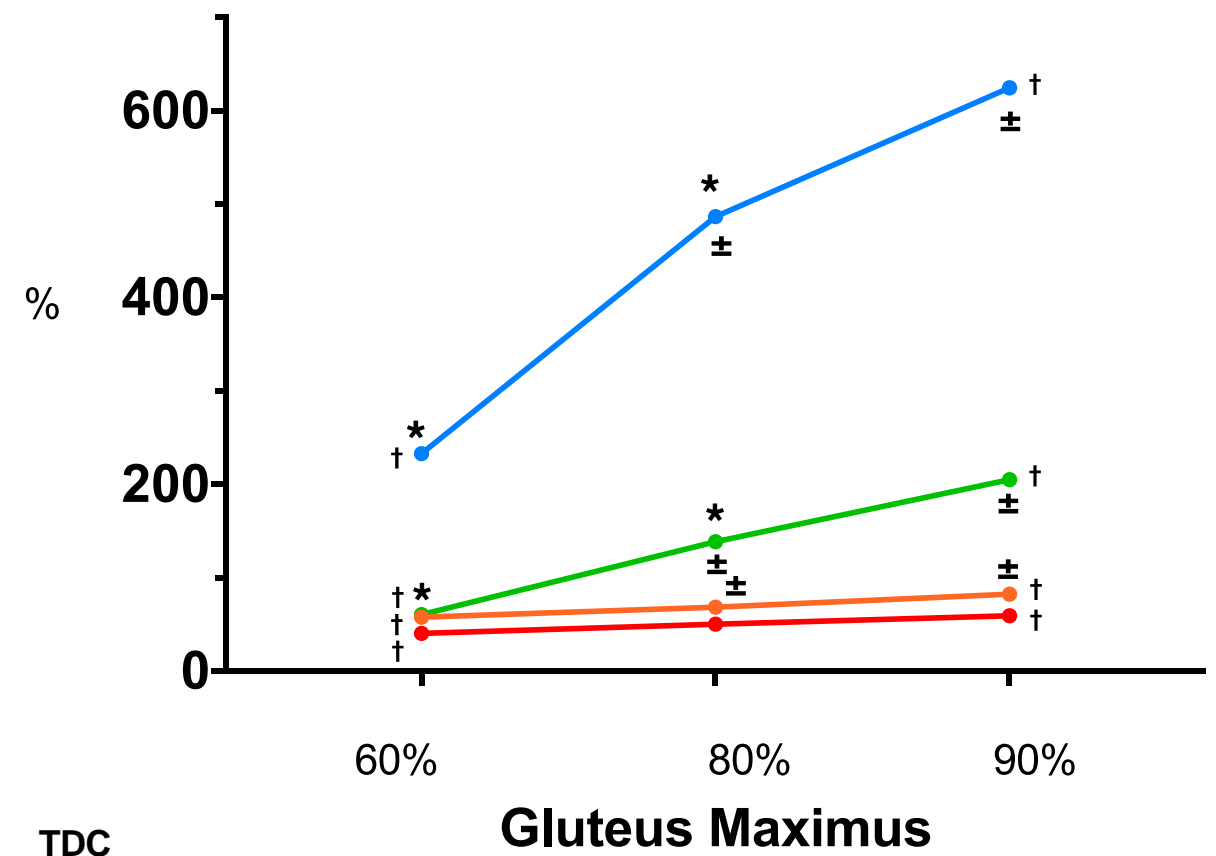


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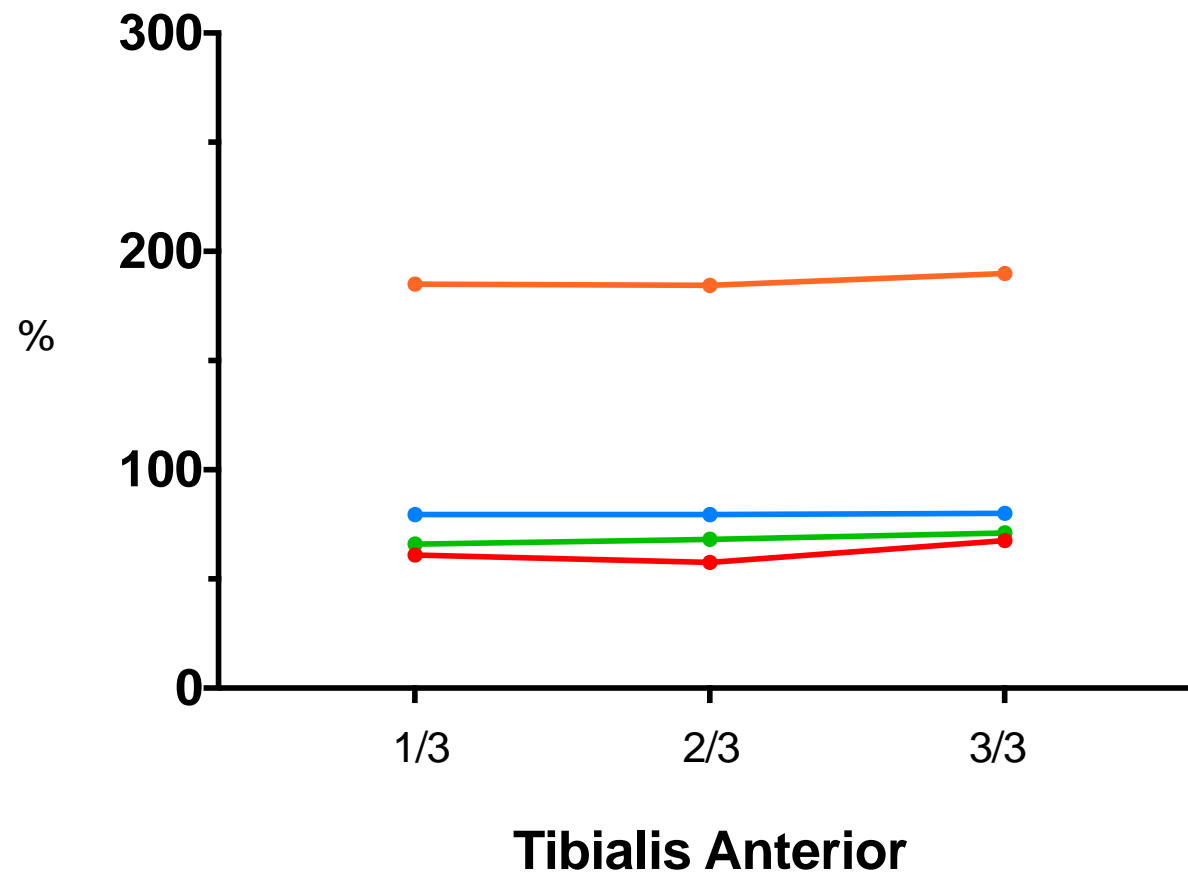


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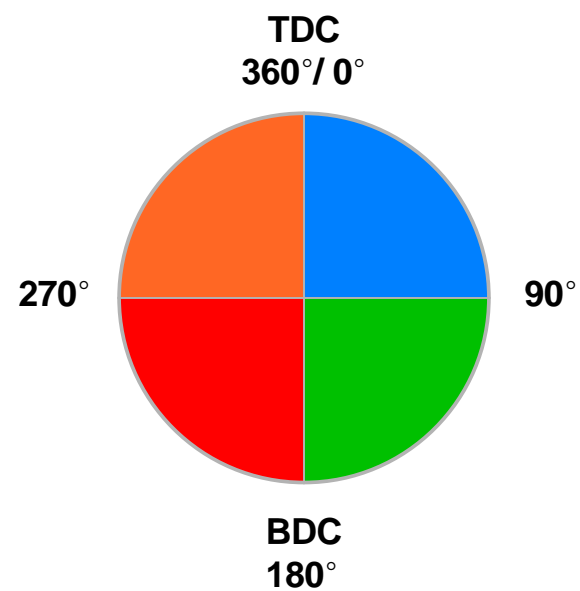
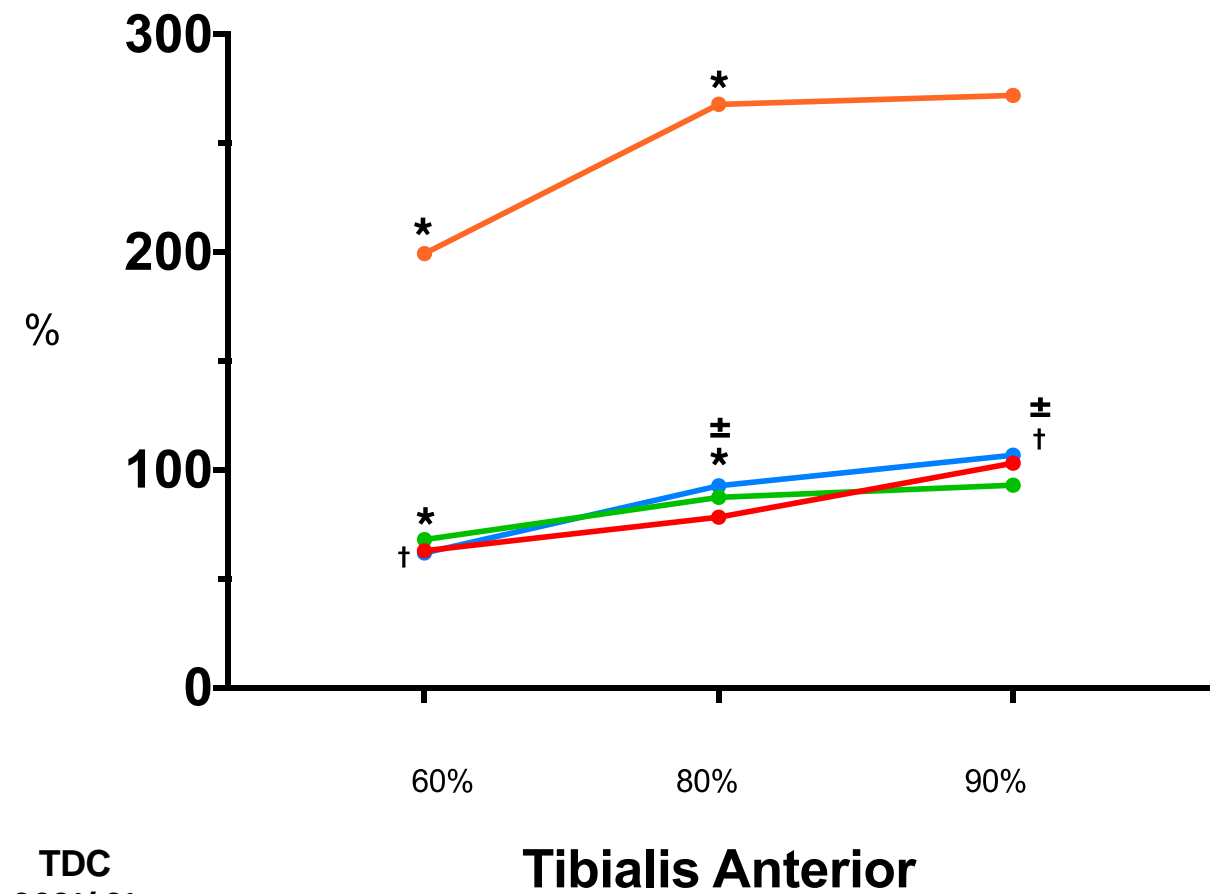


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## STEADY STATE CYCLE

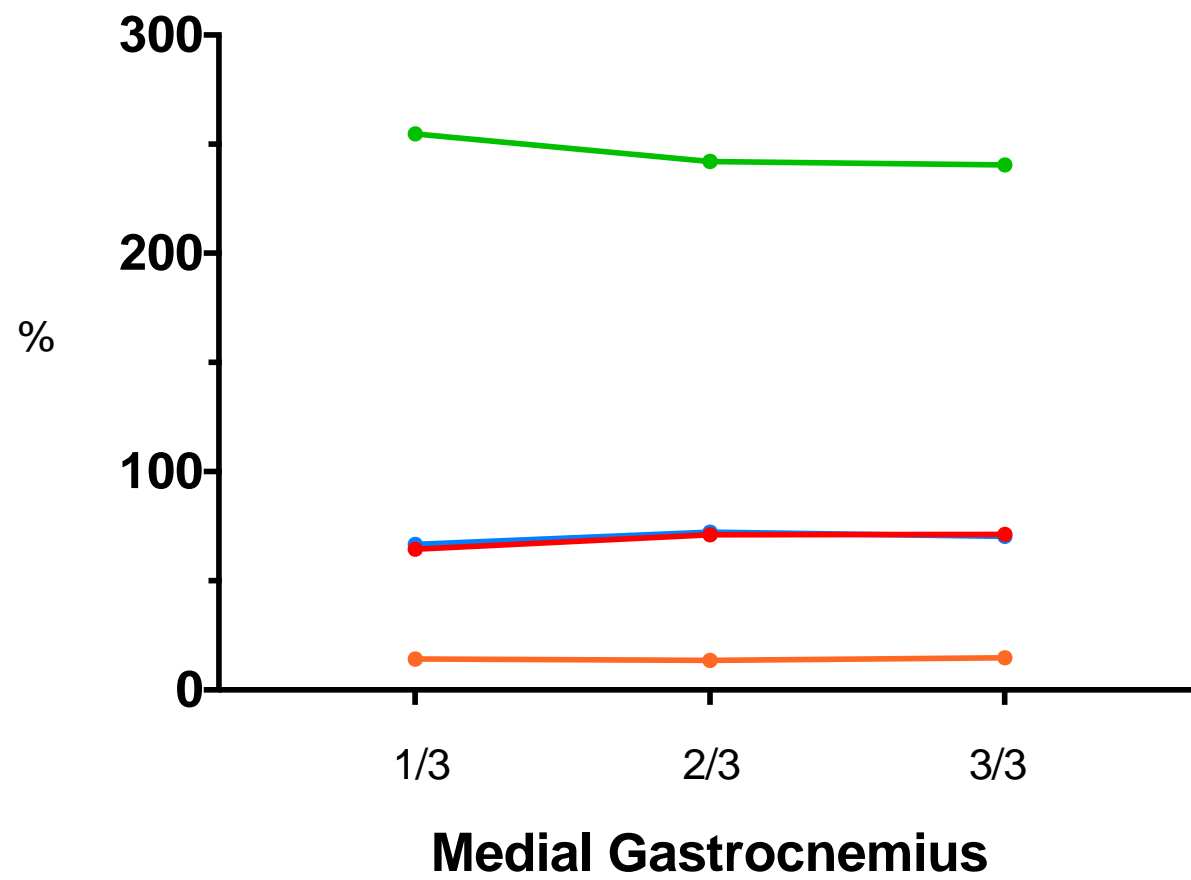


## INCREASED INTENSITY

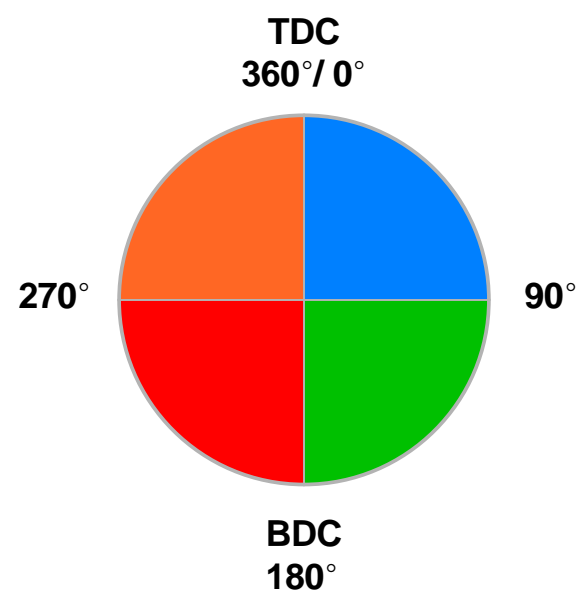
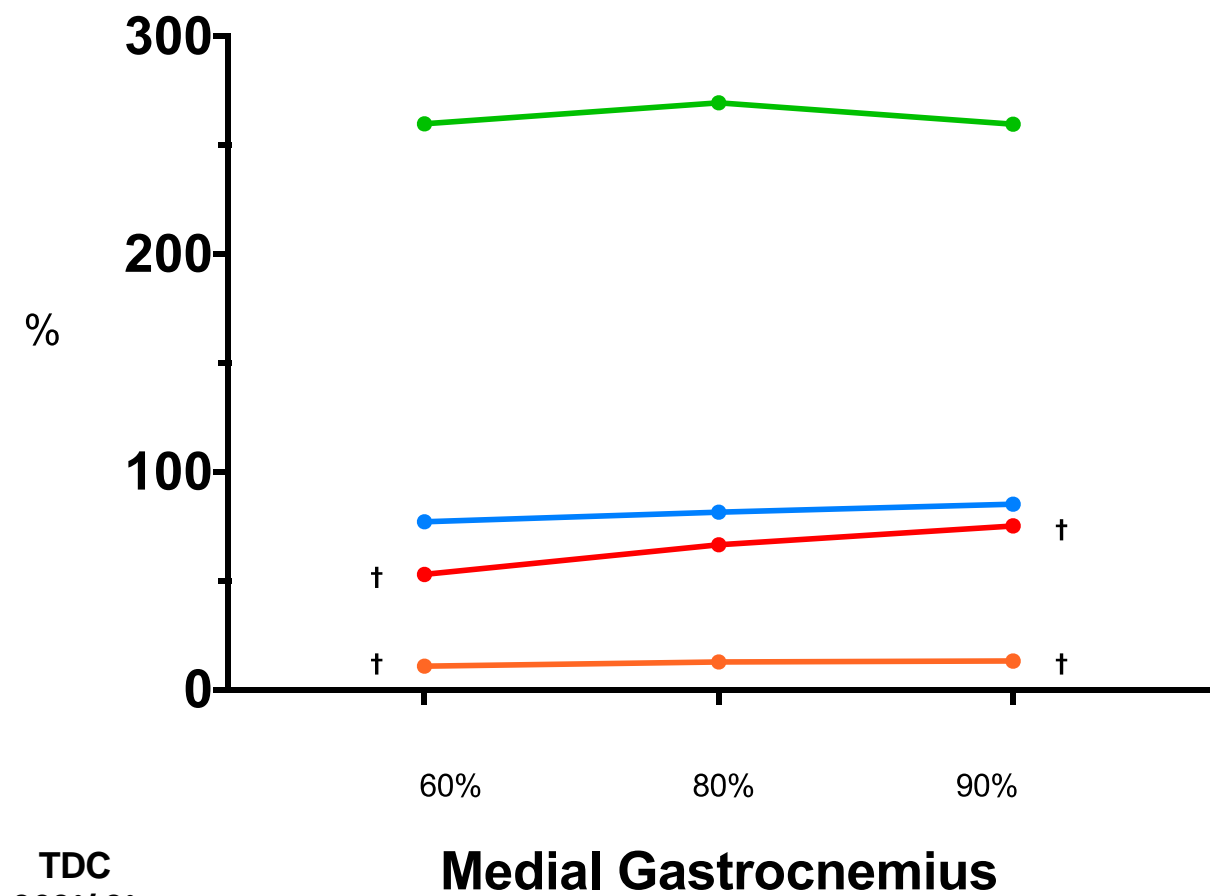


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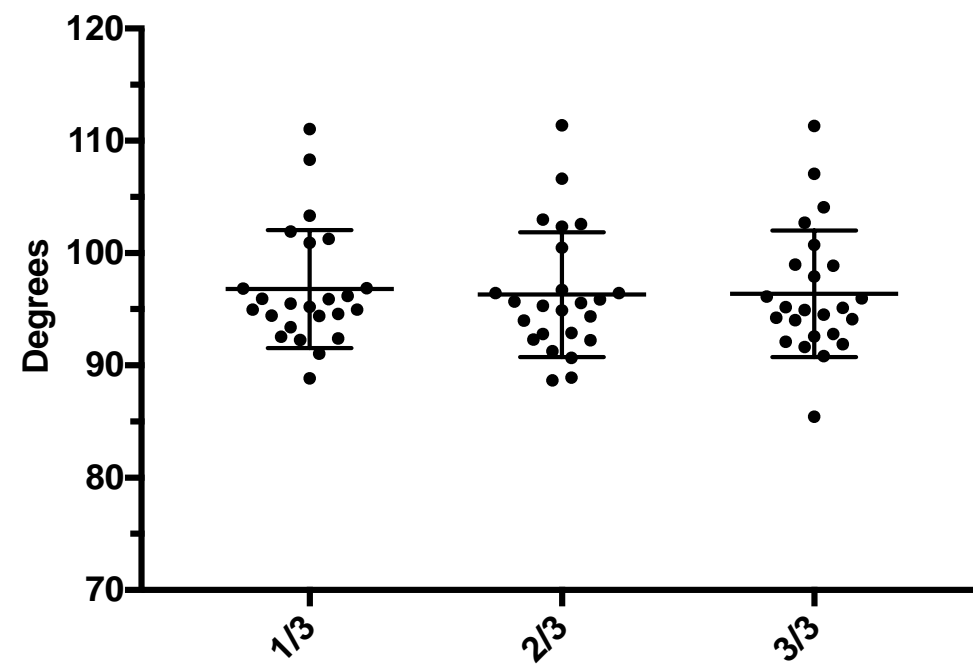
## INCREASED INTENSITY



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# KINEMATICS RESULTS

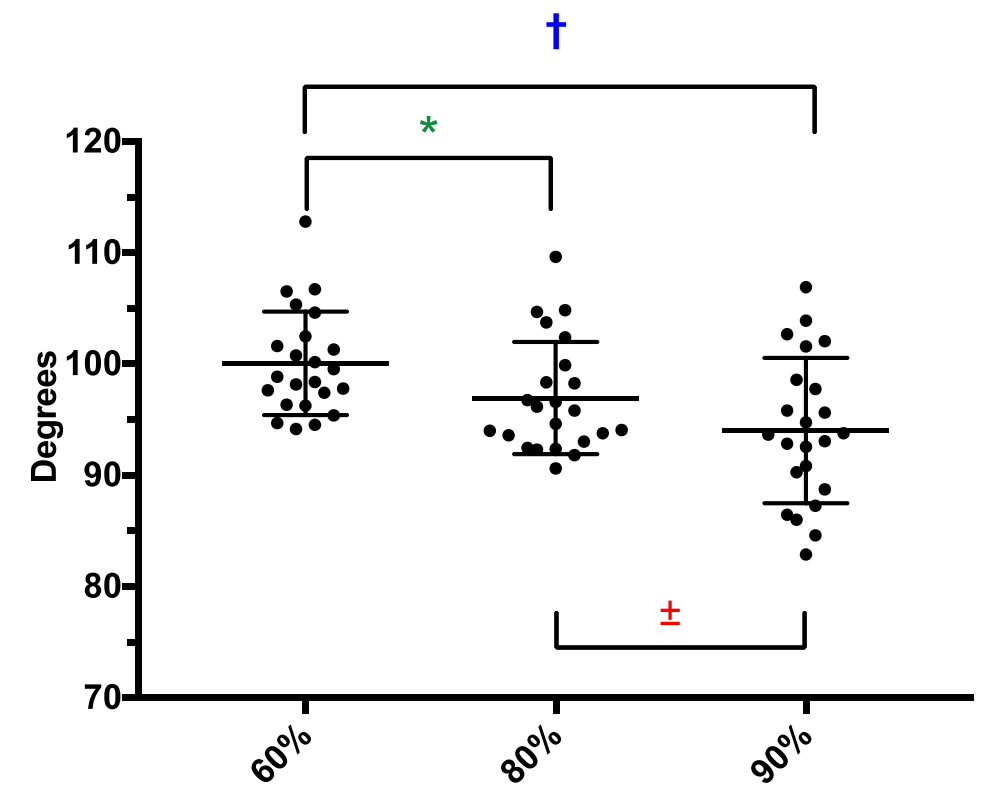
## STEADY STATE CYCLE



p-value = 0.23

**Ankle BDC**

## INCREASED INTENSITY

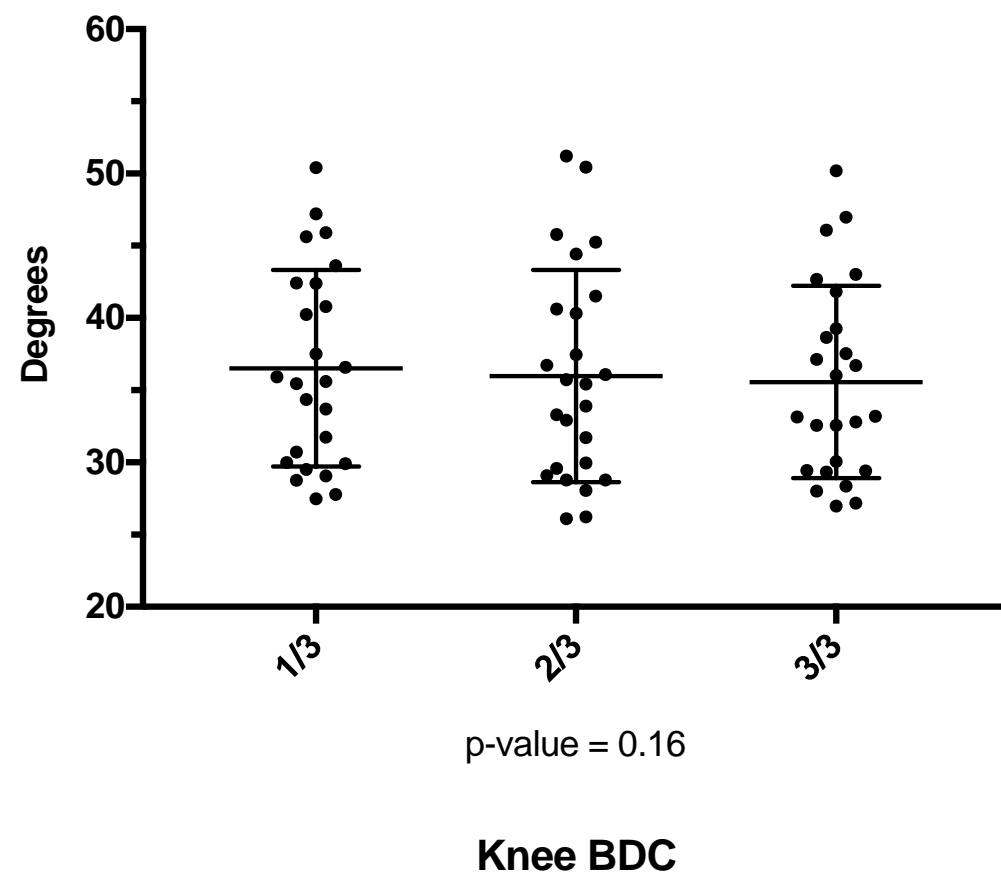


p-value < 0.0001

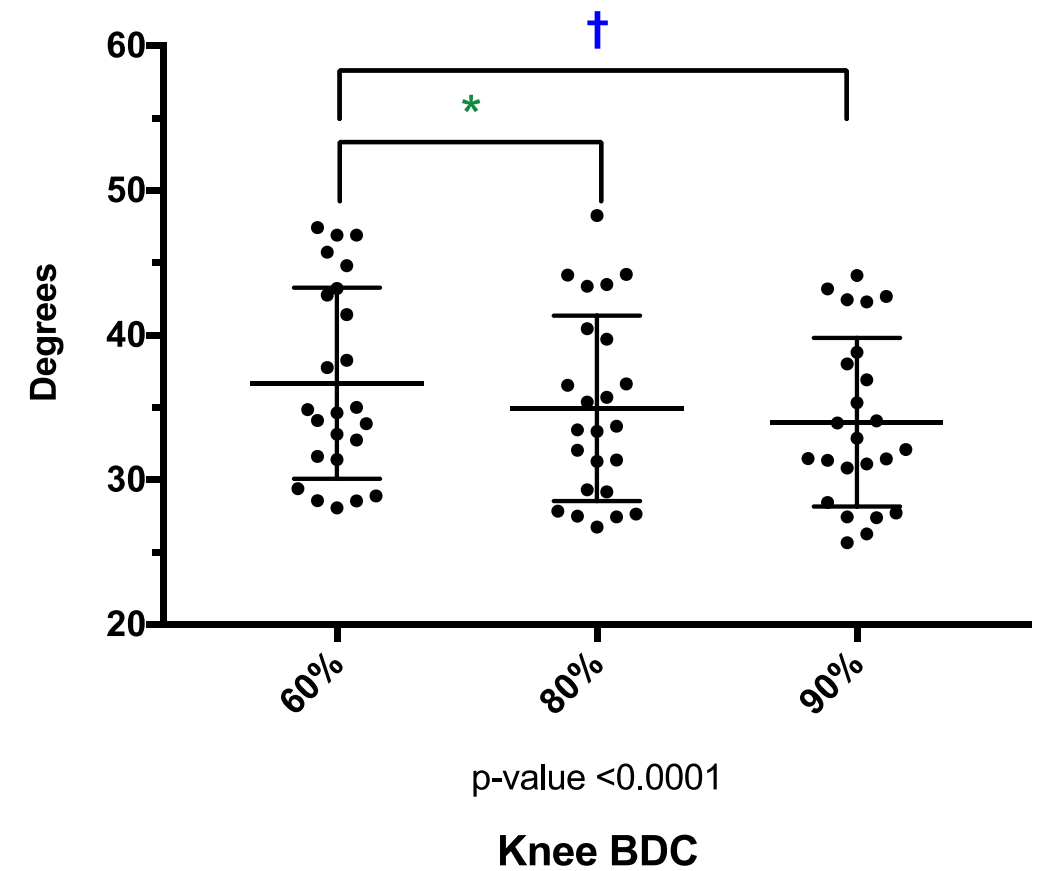
**Ankle BDC**

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## STEADY STATE CYCLE



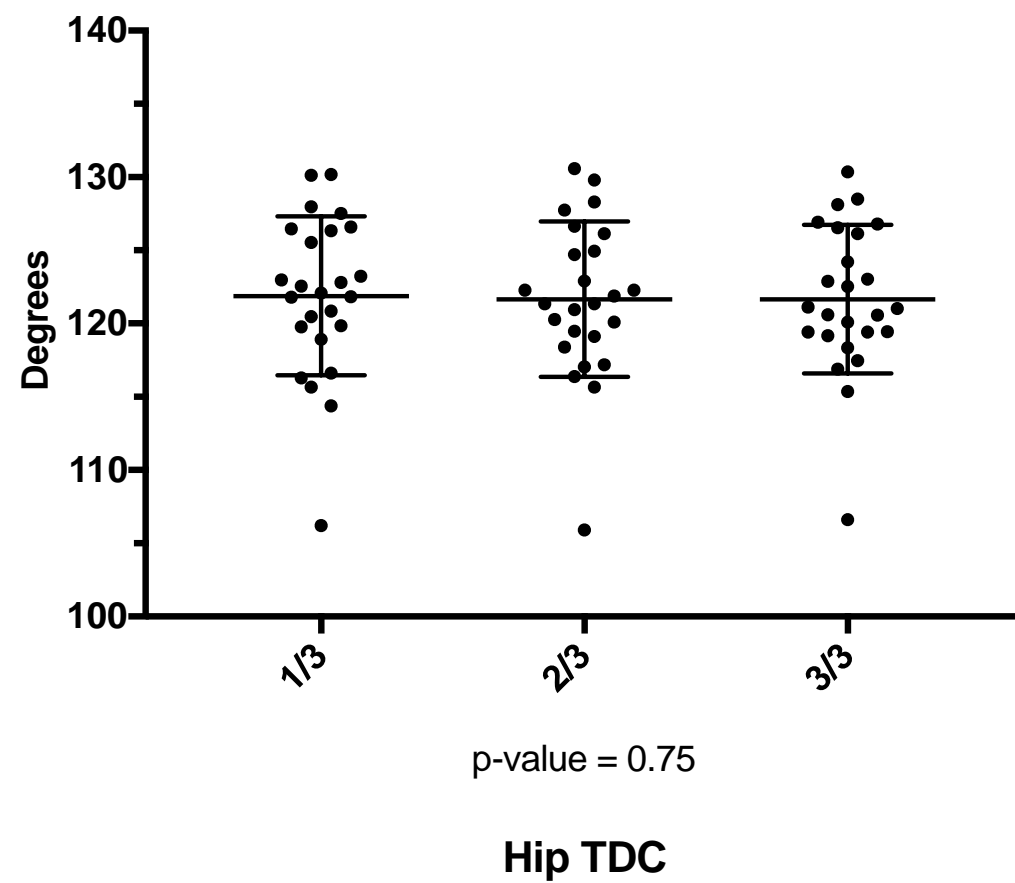
## INCREASED INTENSITY



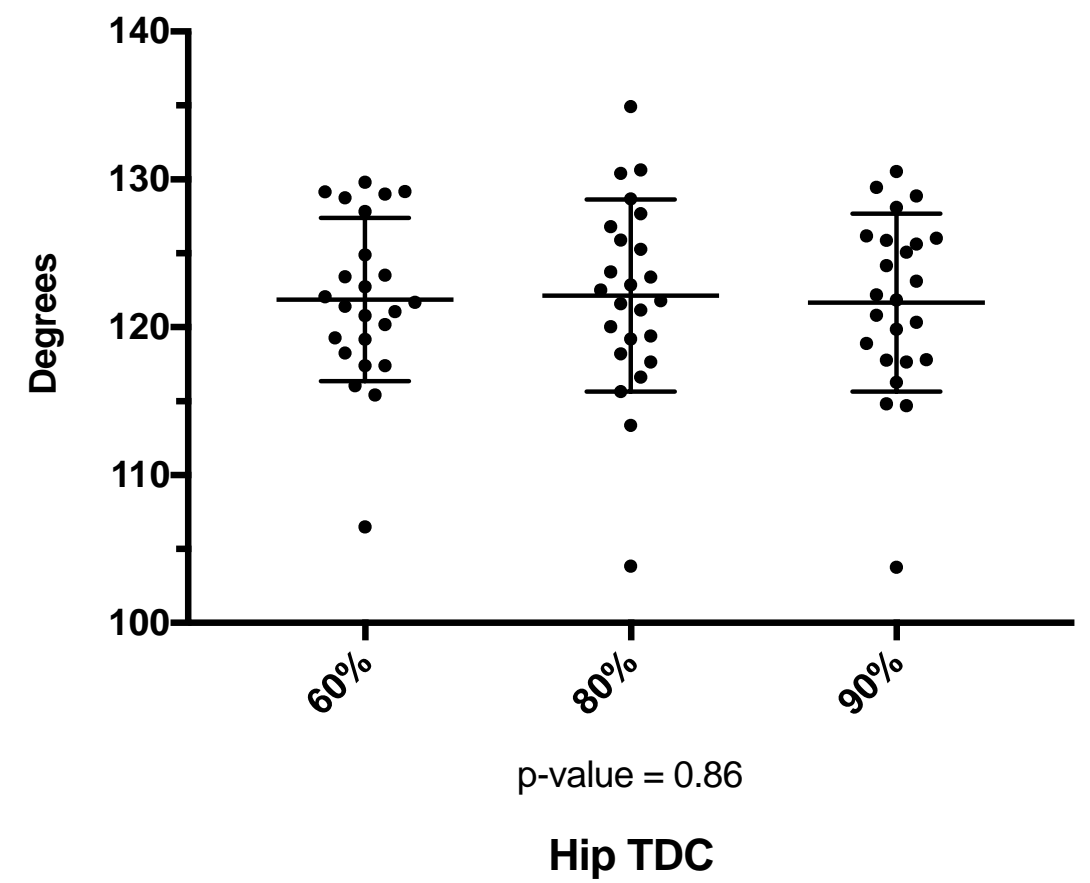
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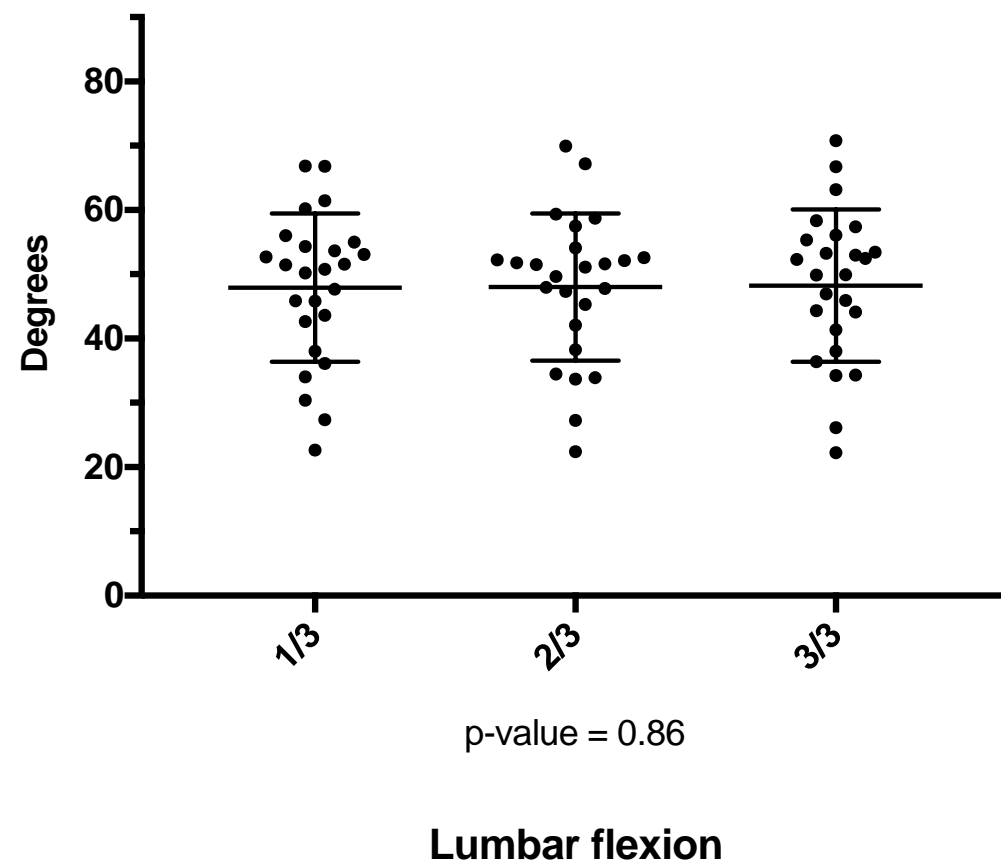
## STEADY STATE CYCLE



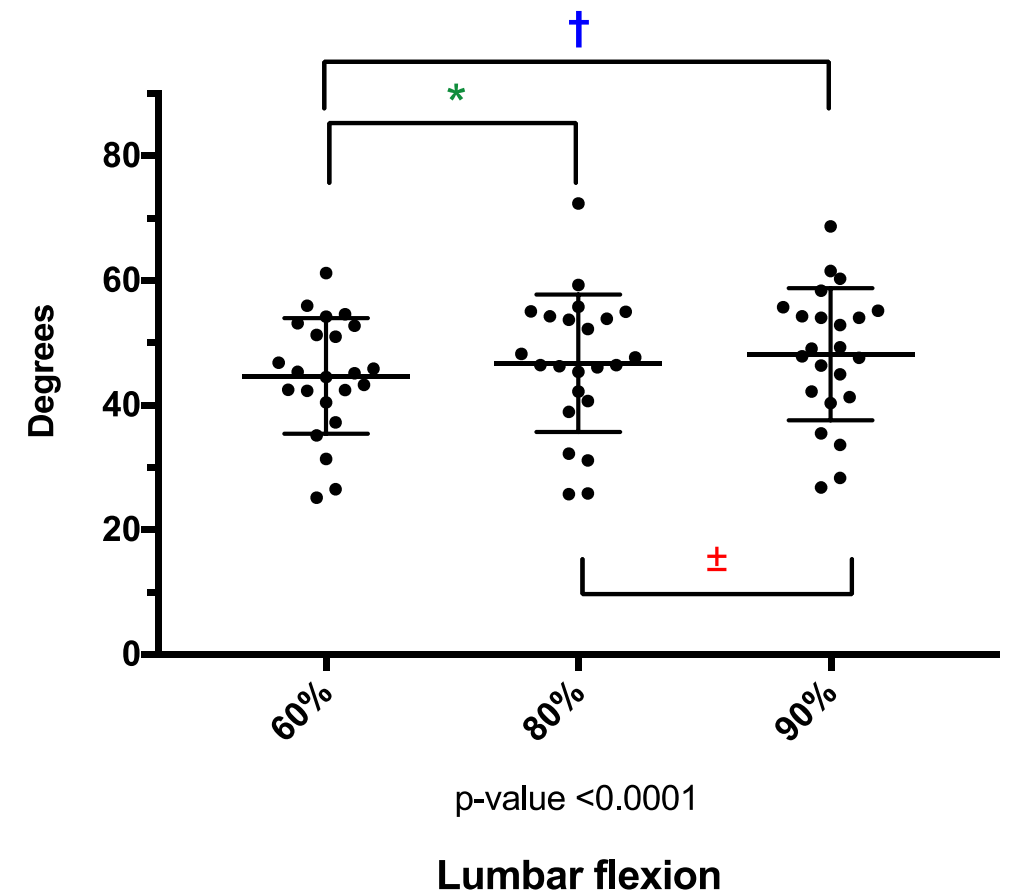
## INCREASED INTENSITY



## STEADY STATE CYCLE



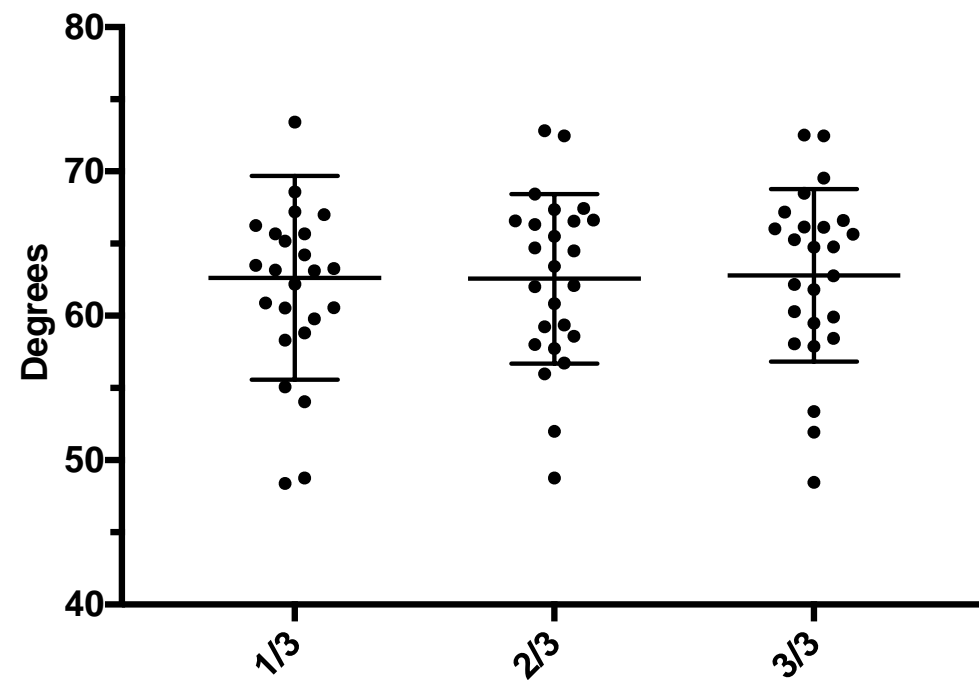
## INCREASED INTENSITY



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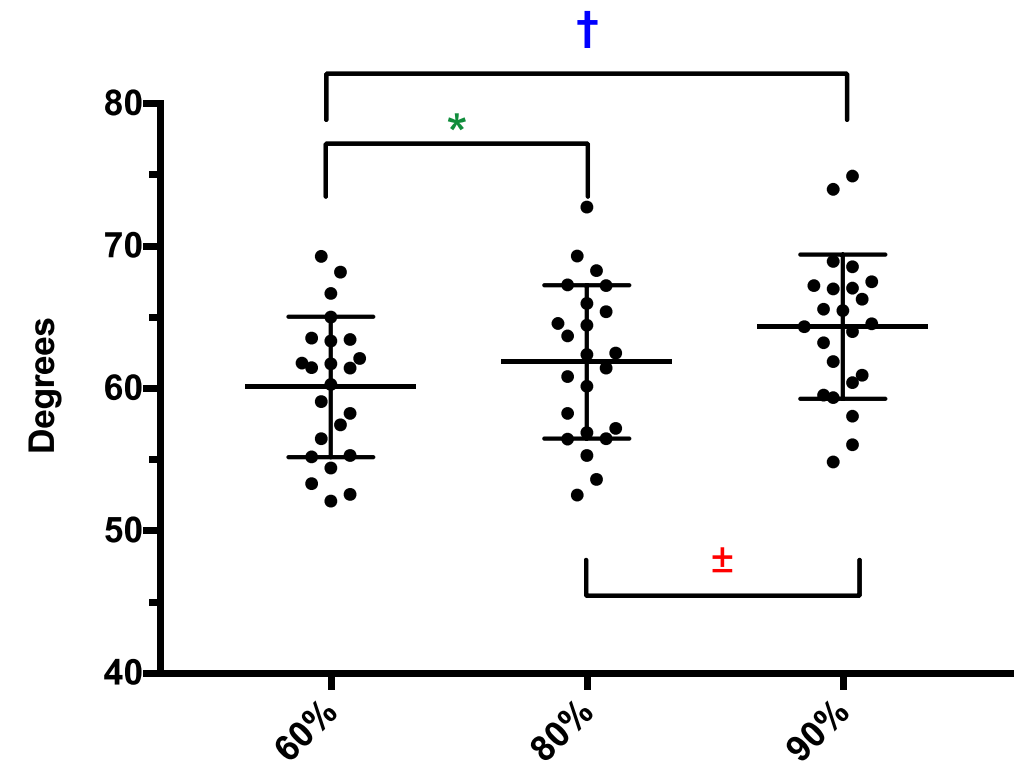
## STEADY STATE CYCLE

## INCREASED INTENSITY



p-value = 0.88

Thoracic lean

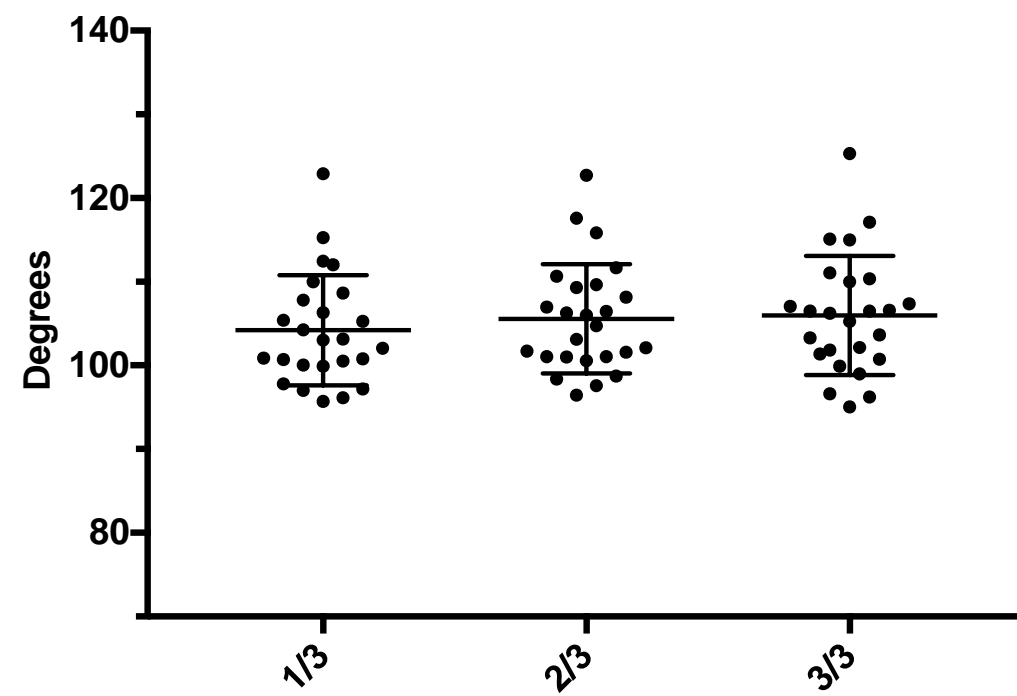


p-value <0.0001

Thoracic lean

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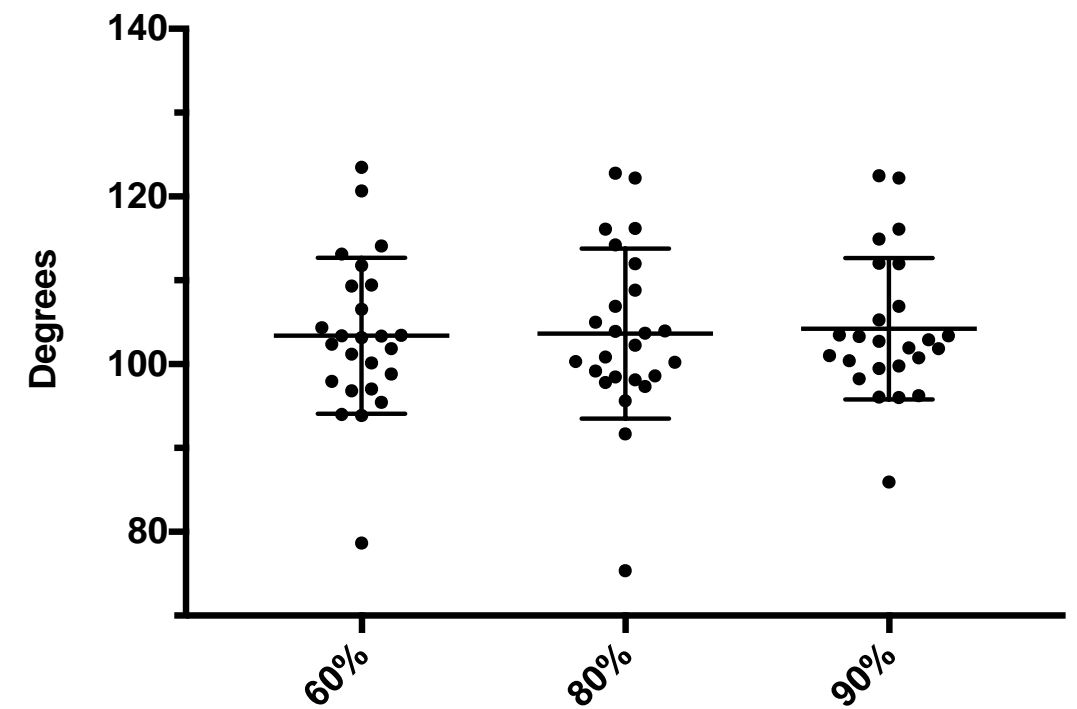
## STEADY STATE CYCLE



p-value = 0.10

**Shoulder**

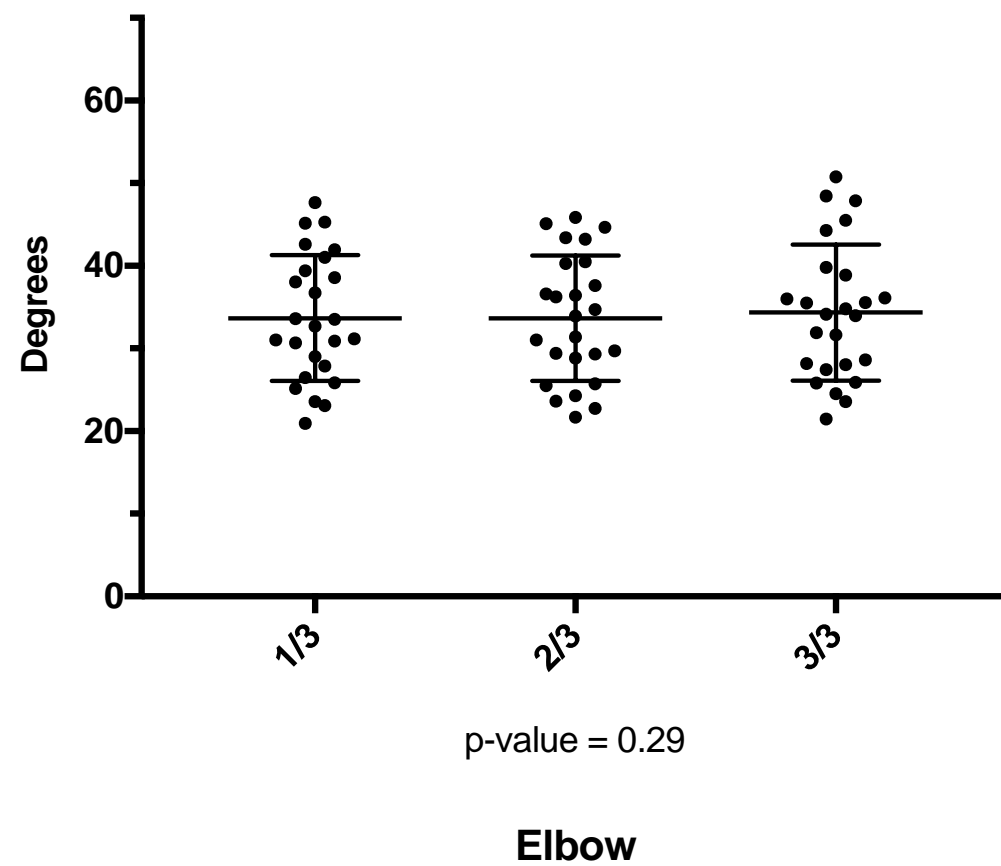
## INCREASED INTENSITY



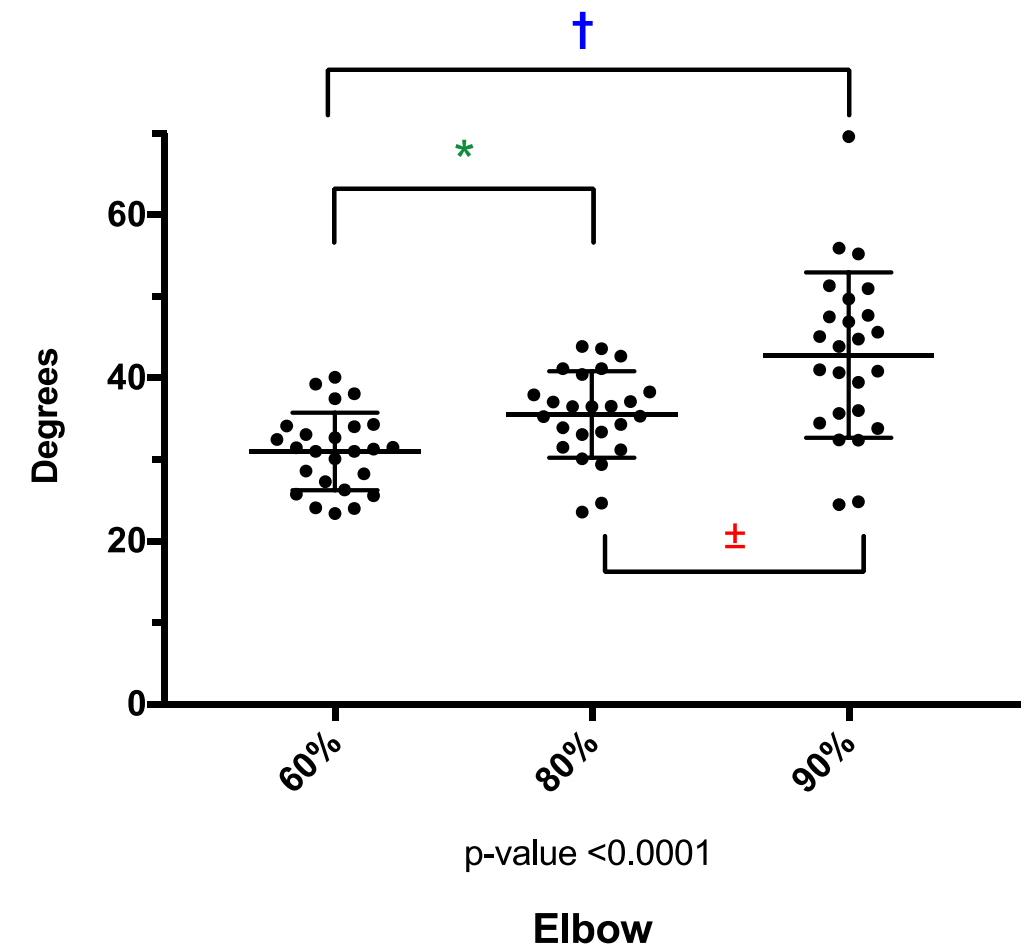
p-value = 0.82

**Shoulder**

## STEADY STATE CYCLE



## INCREASED INTENSITY



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THE PICTURE SAYS IT A



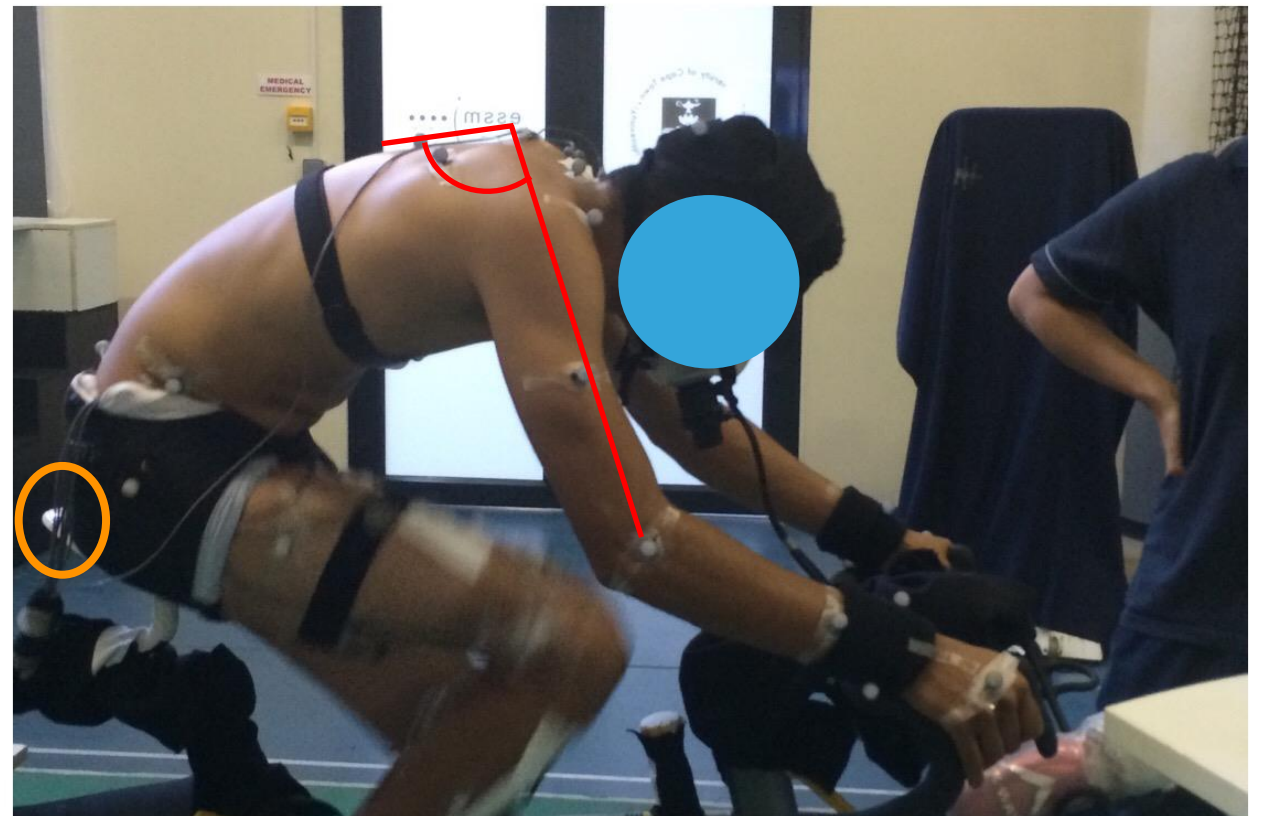
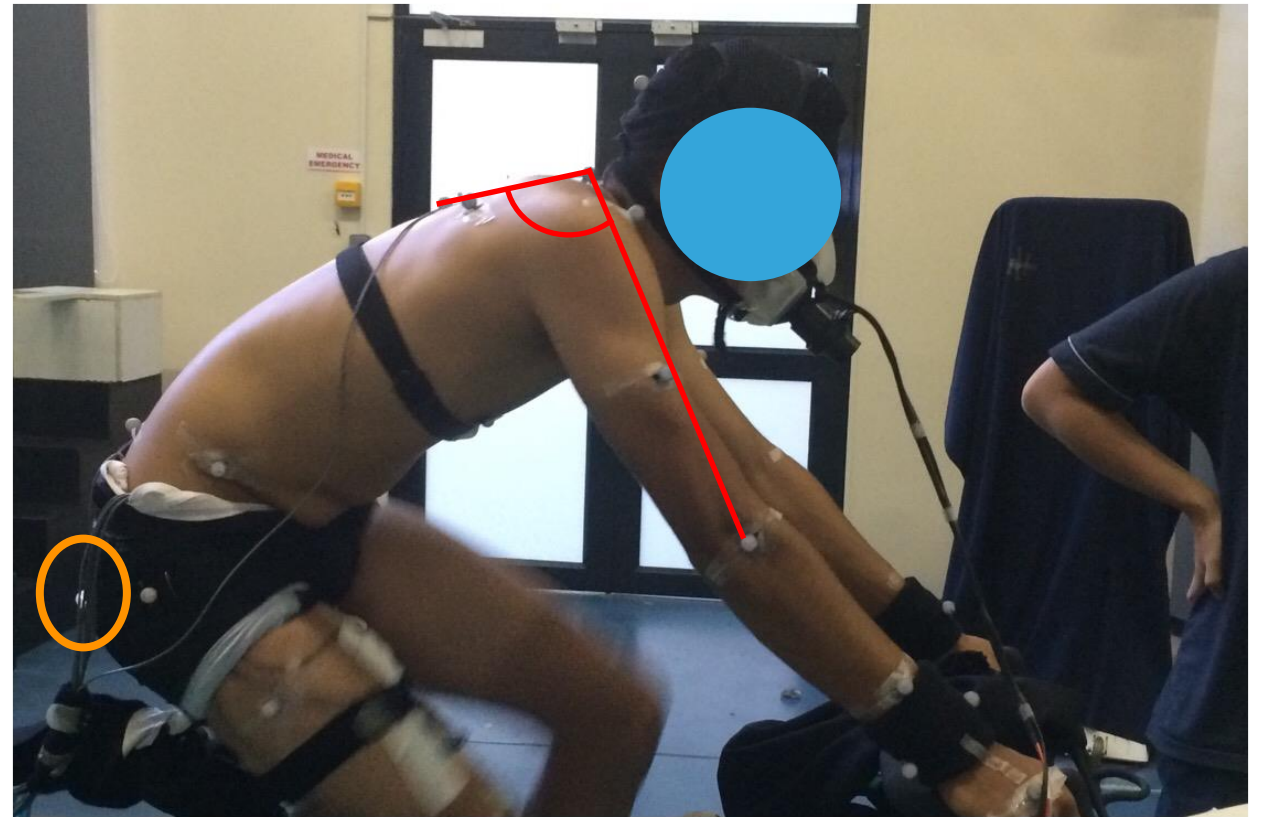
Ankle dorsiflexion

Knee extension

Lumbar flexion

Thoracic lean

Elbow flexion



IN SUMMARY:



When configuring the rider to their bike, it is important to discuss the type of training they will be doing.



dynamic 2D & 3D kinematic d  
ould interpret knee flexio  
relation to the relative inter

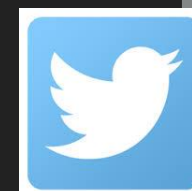
**Guidelines for optimal positioning should take into account the training discipline and the intended riding intensity of the cyclist.**



# THANK YOU!



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