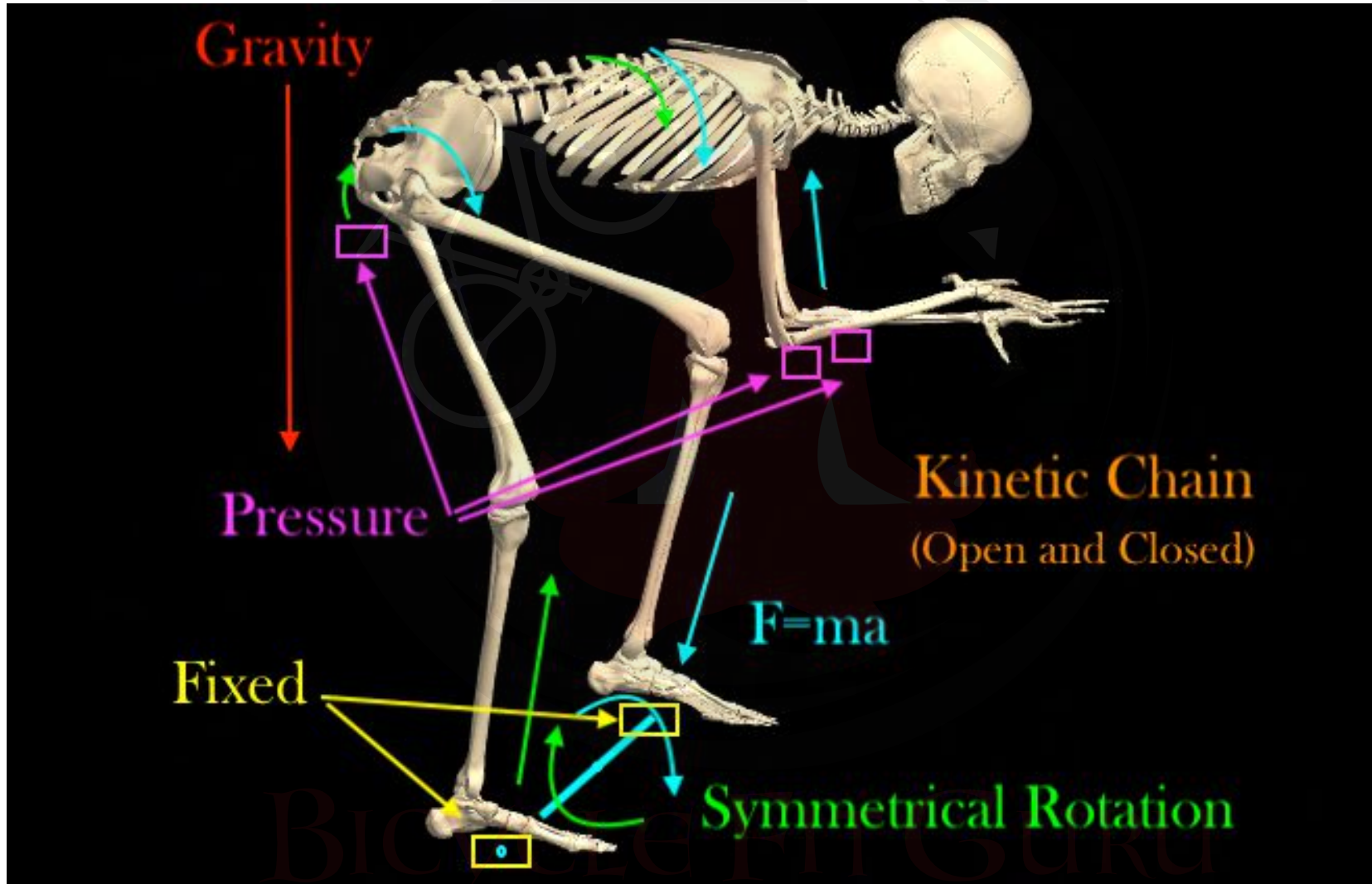


Cycling Biomechanics -- Triathlon

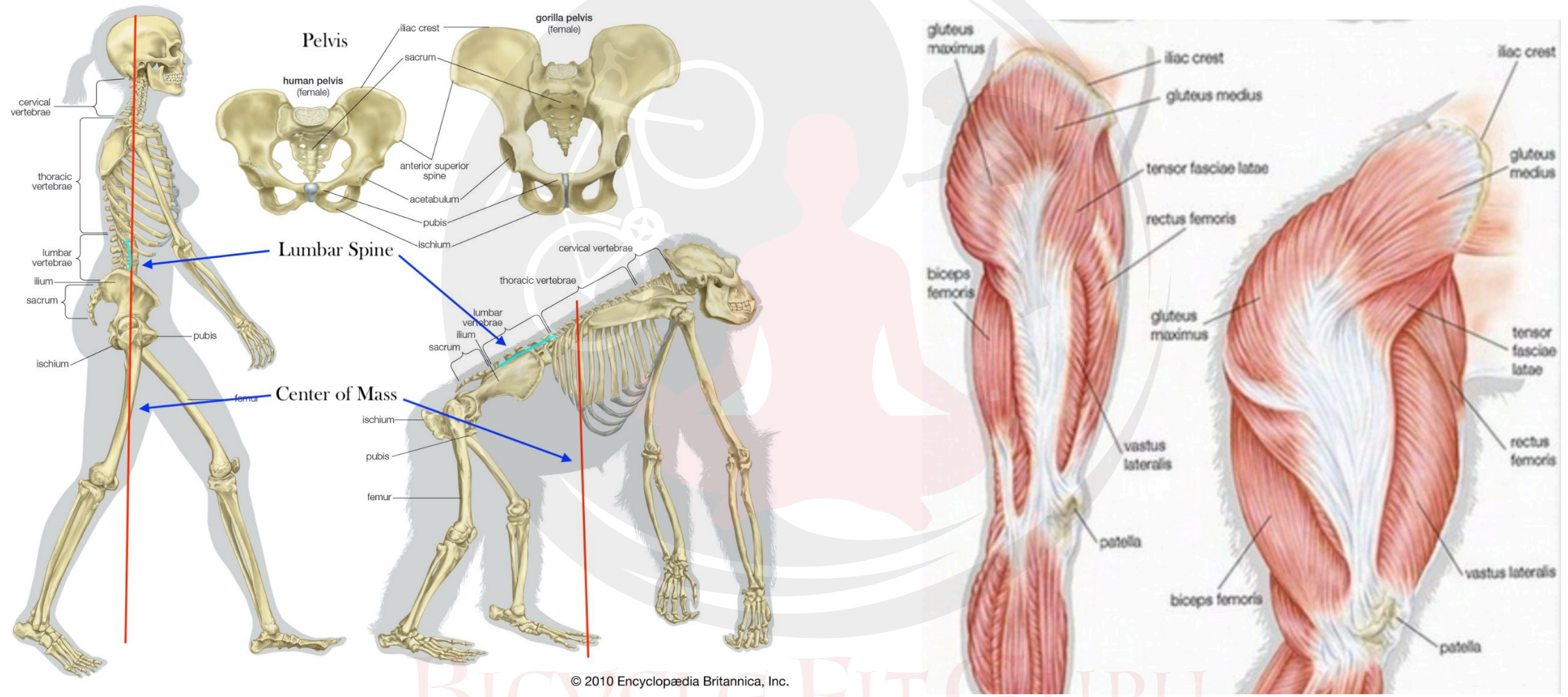


BICYCLE FIT GURU

Cycling-Specific Biomechanics



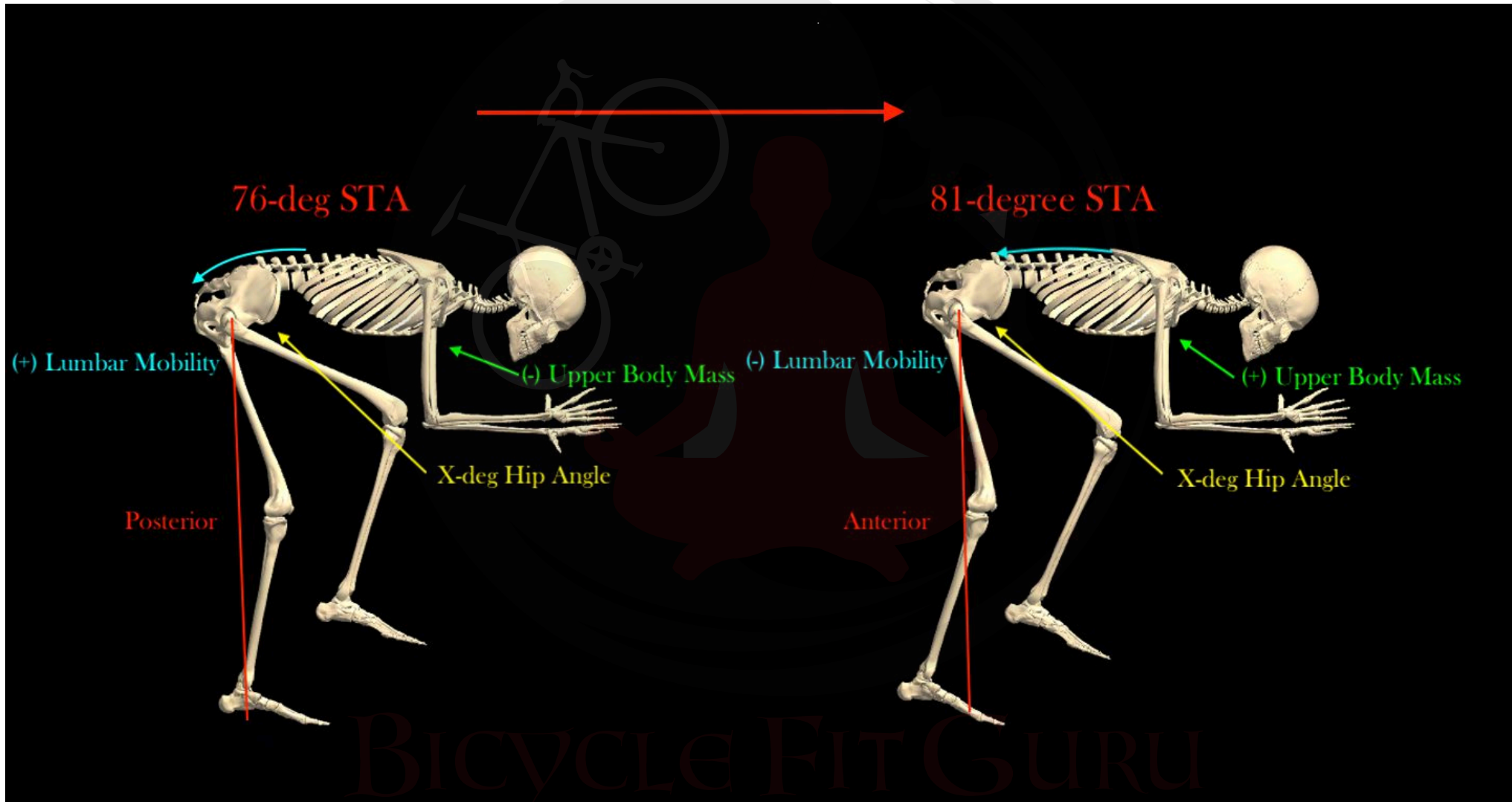
Who does it better?



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BICYCLE FIT GURU

Tri-Specific Biomechanics



Lumbar Morphology

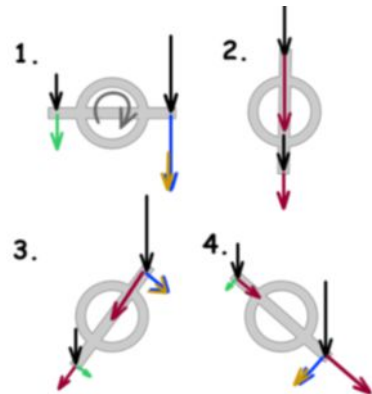
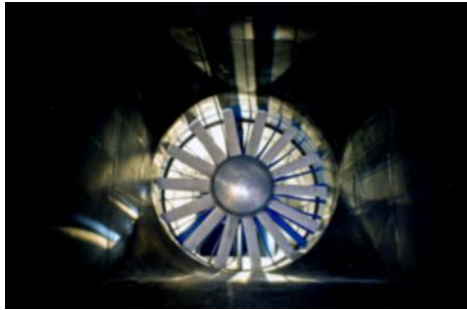


TRI = Three



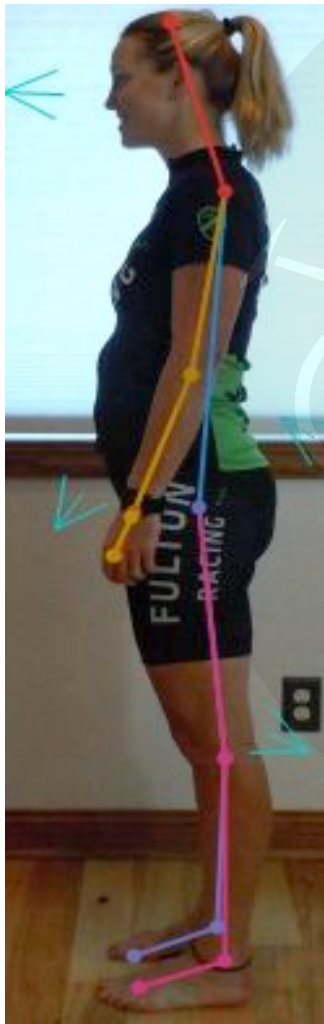
BICYCLE FIT GURU

What is Optimal?

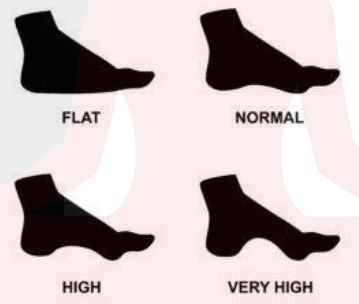


Bicycle Fit Guide

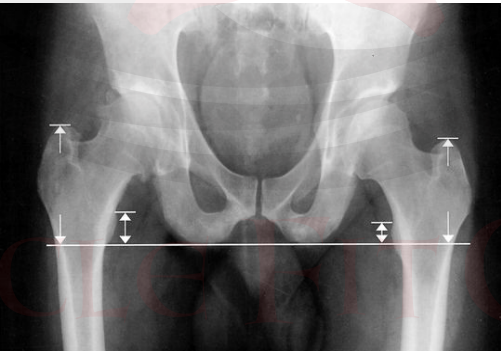
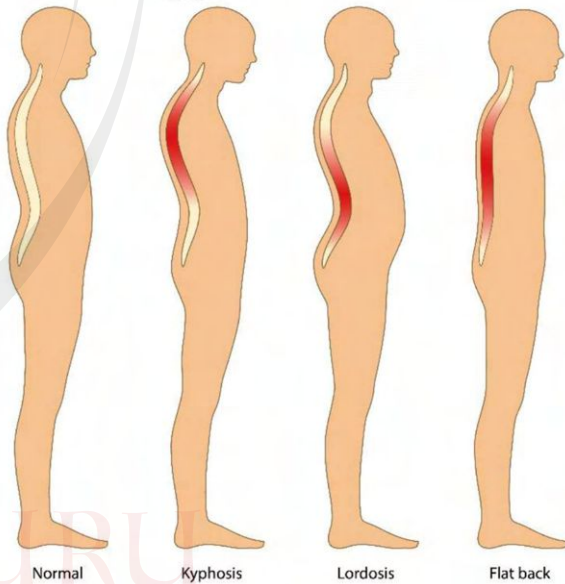
The Human Condition




FOOT ARCH TYPES

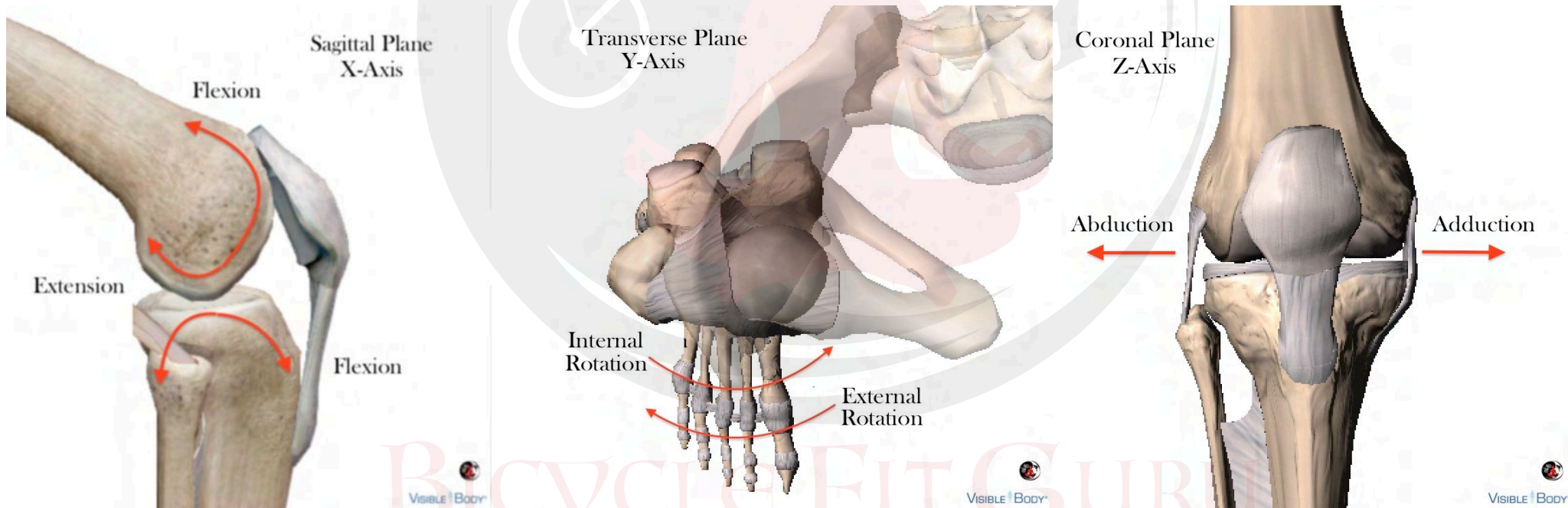


Sagittal Plane Deformity



Perspective

 Cardinal Planes & Axes of Movement		
Plane	Axis	Description
Sagittal	Coronal (X)	Lateral Perspective - Medial/Lateral Sections
Transverse	Vertical (Y)	Axial Perspective - Superior/Inferior Sections
Coronal	Sagittal (Z)	Frontal Perspective - Anterior/Posterior Sections



Biomechanics

- Kinematics: study of movement without cause. (Math)
- Kinetics: study of the forces systems behind movement. (Physics)



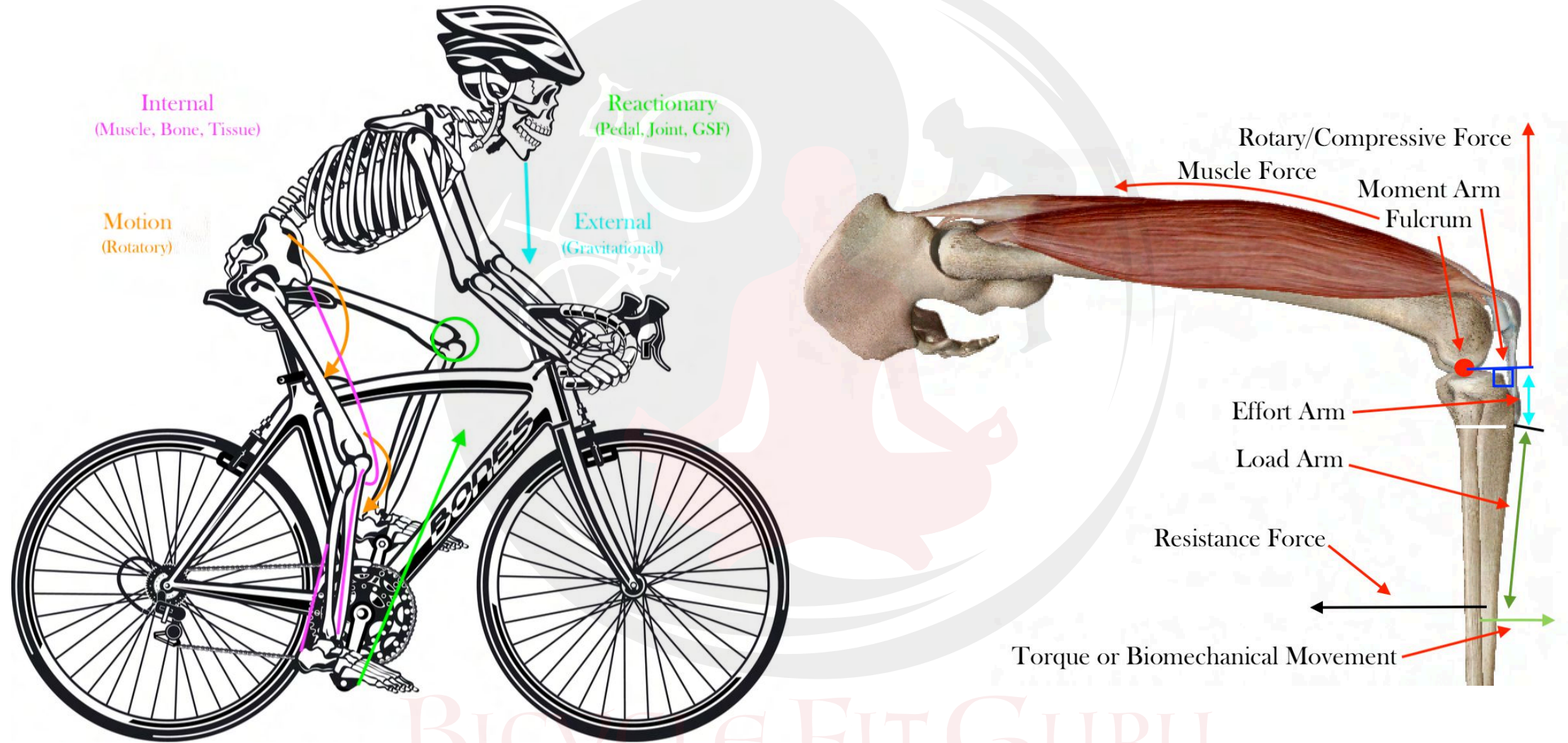
BICYCLE FIT GURU

Biomechanics

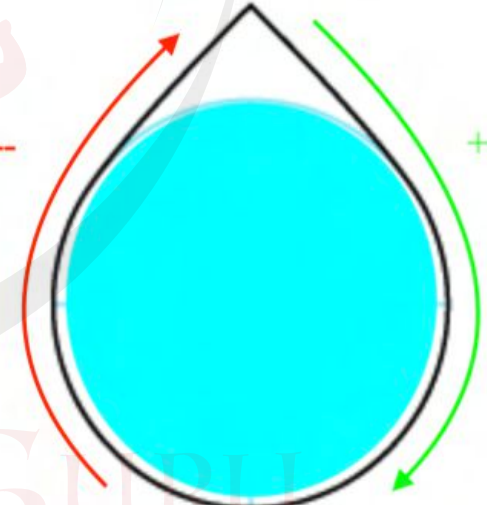
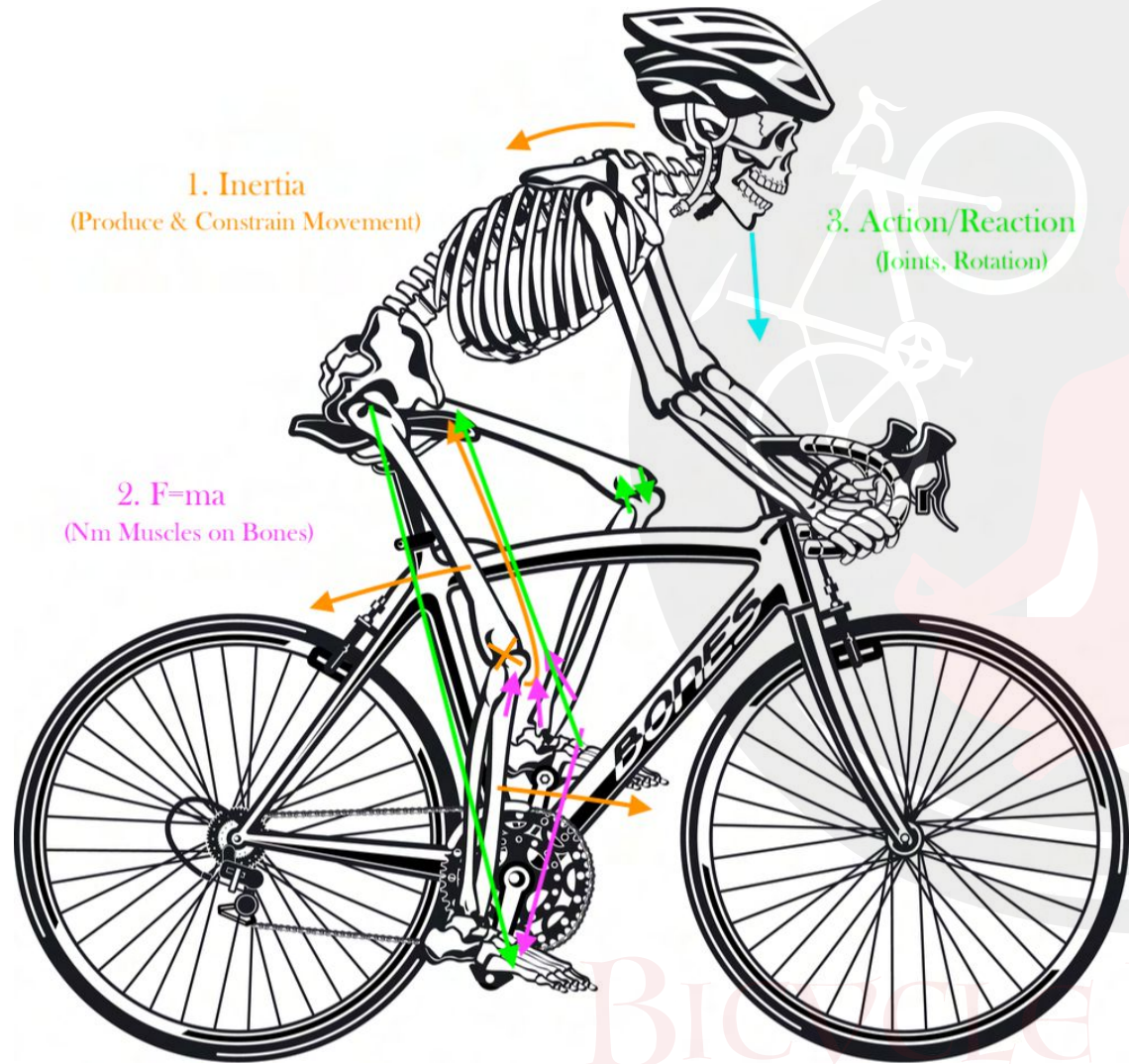
- **Force:** Vector = Application, Magnitude, Direction
- **Newtonian Laws:** Inertia, $F=ma$, Action/Reaction
- **Levers:** Axis, Resistance, Force
- **Torque:** Force applied to levers that cause rotation
- **Gravity:** Force – Vertical (COG/COM)
- **Pressure:** Force/Area

BICYCLE FIT GURU

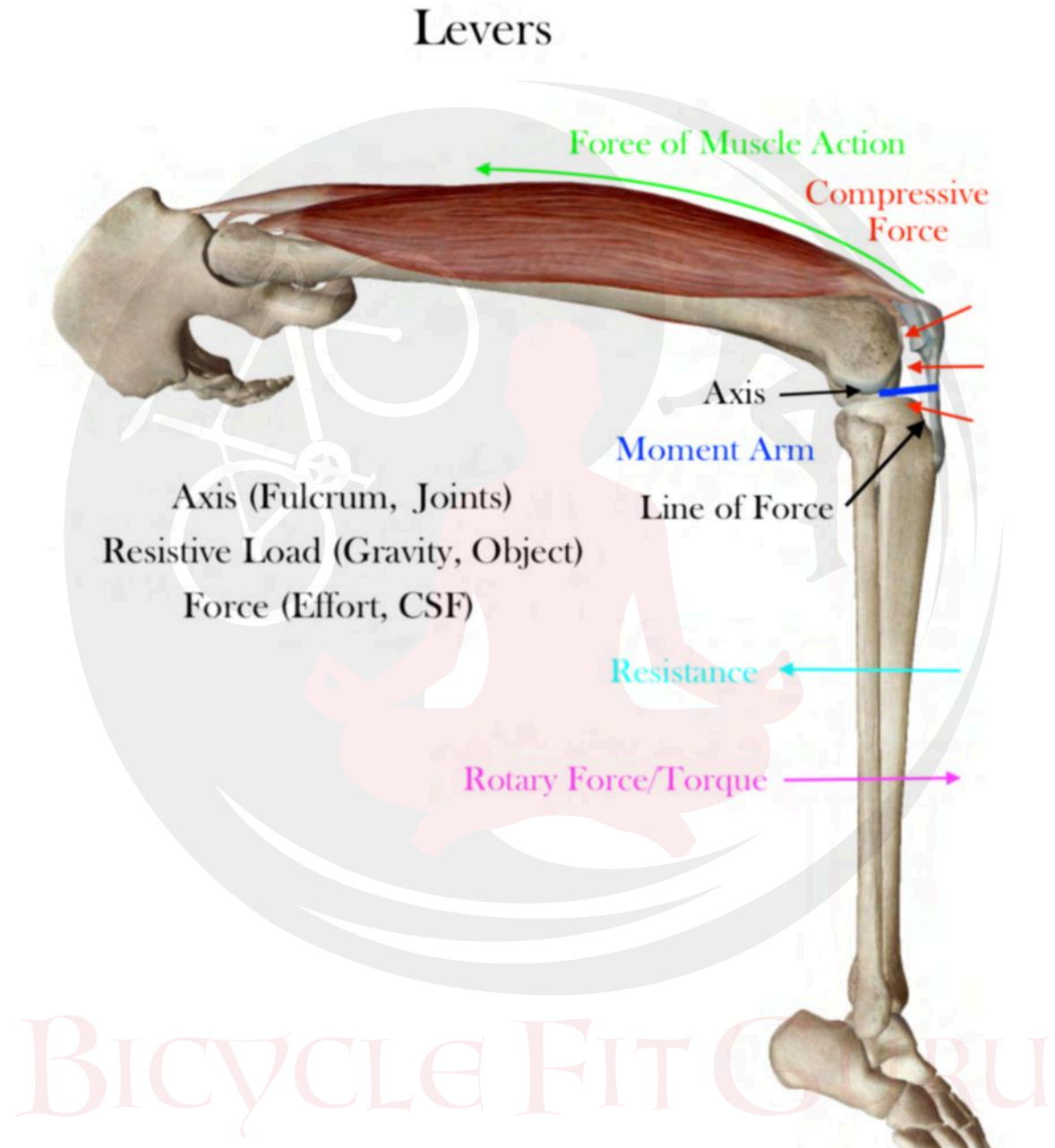
Force



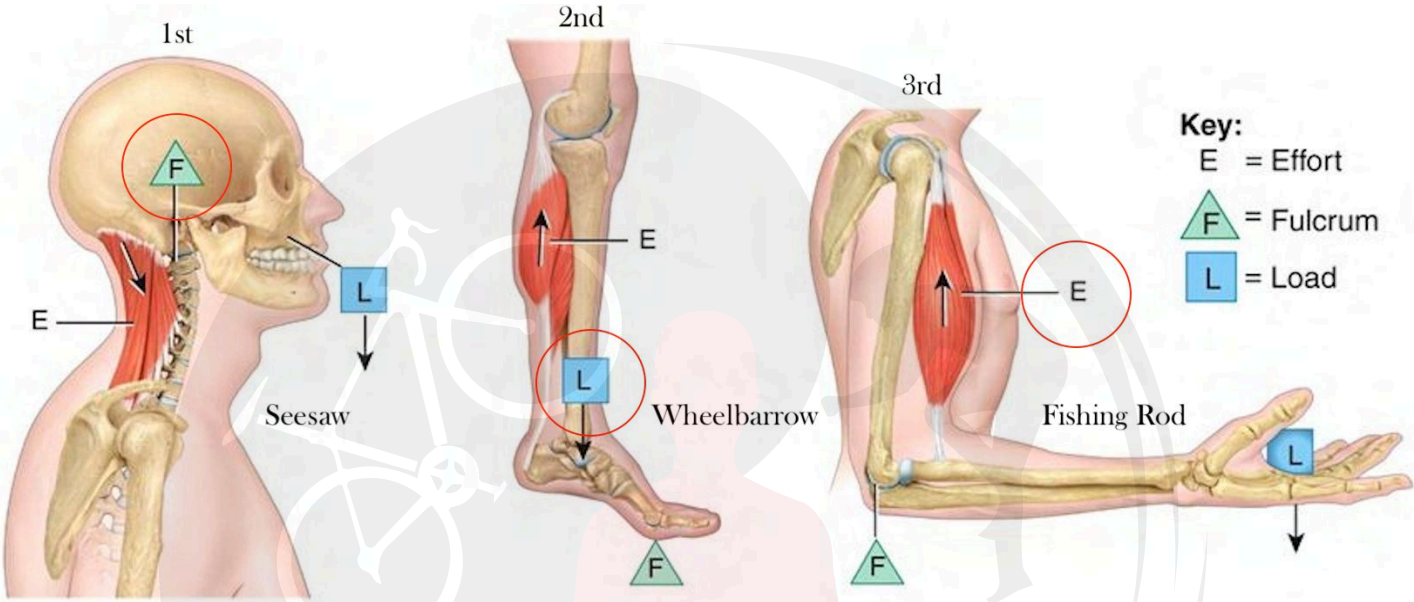
Newton's Laws



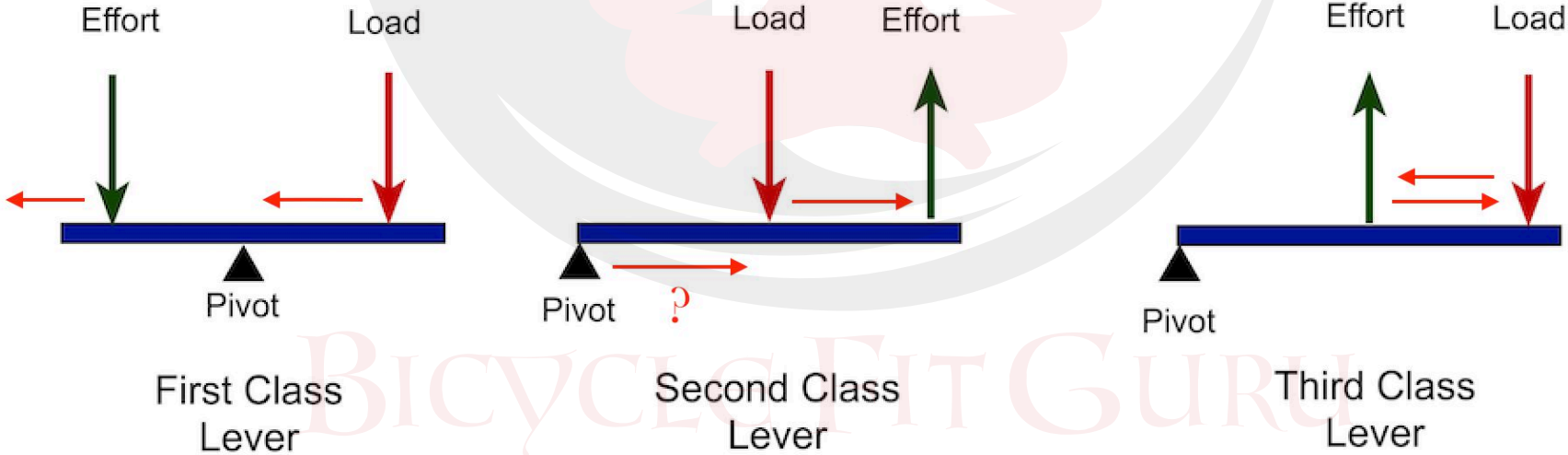
Levers



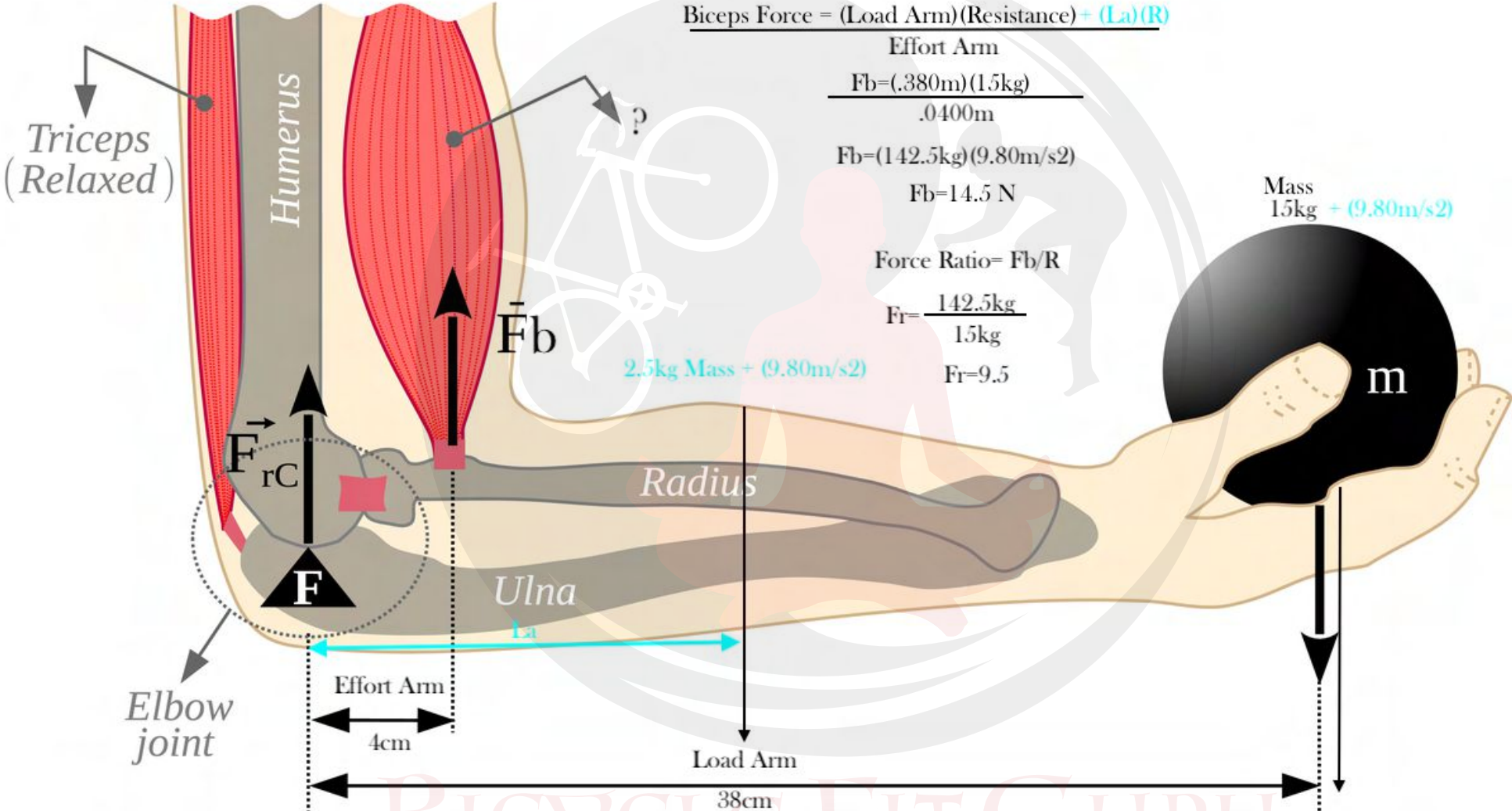
Lever Types



Improving Mechanical Advantage



Lever system force calculations



$$\text{Biceps Force} = \frac{(\text{Load Arm})(\text{Resistance}) + (La)(R)}{\text{Effort Arm}}$$

$$F_b = \frac{(.380m)(15kg)}{.0400m}$$

$$F_b = (142.5kg)(9.80m/s^2)$$

$$F_b = 14.5 \text{ N}$$

$$\text{Force Ratio} = F_b/R$$

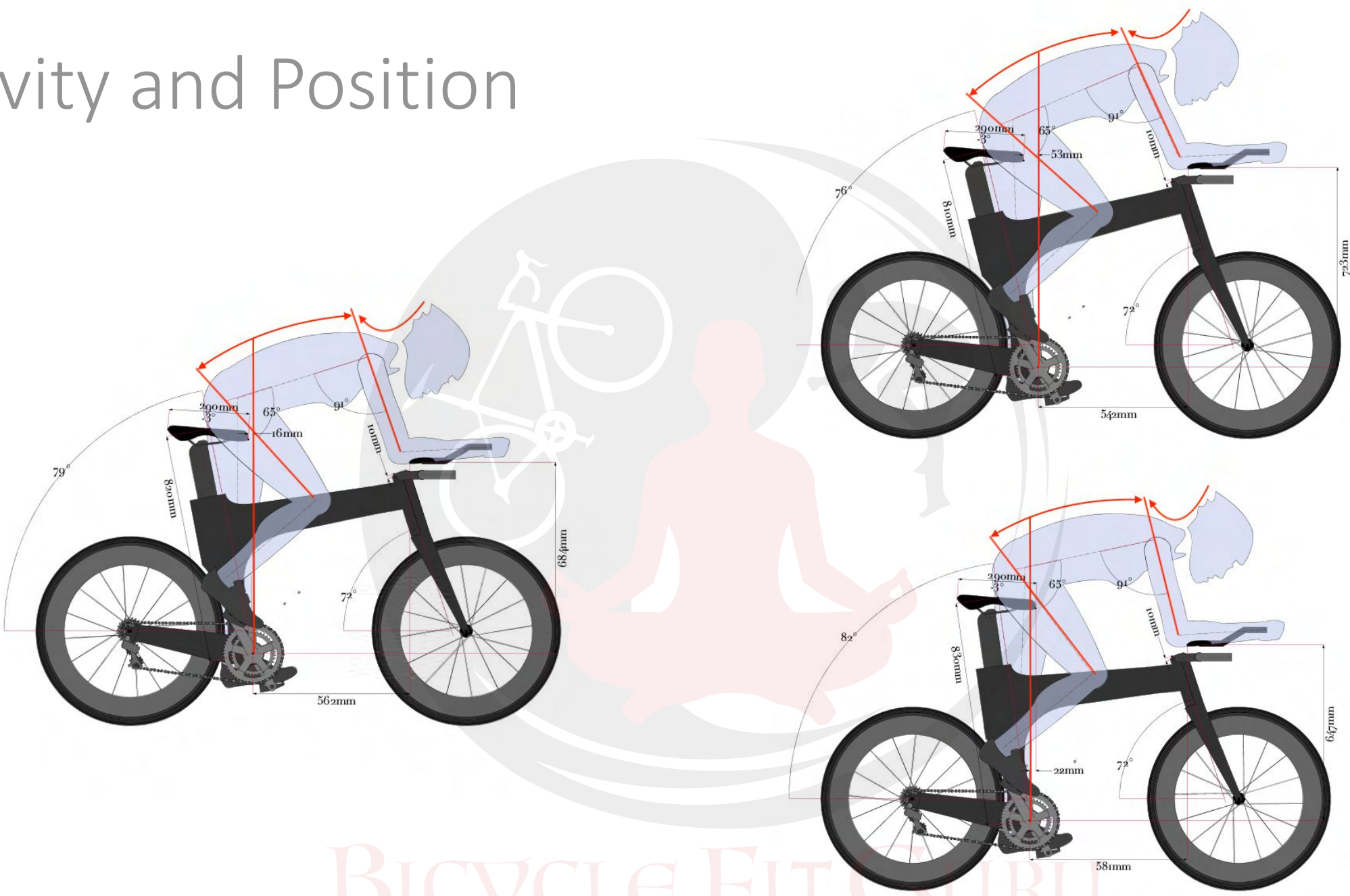
$$F_r = \frac{142.5kg}{15kg}$$

$$F_r = 9.5$$

Gravity




Gravity and Position



BICYCLE FIT GURU

Pressure



Force = 40kg (UBM @ Contact)

Area = 70cm (10cm x 7cm)

Contact @ 100% = .57
Contact @ 50% = 1.14
Contact @ 30% = 1.90

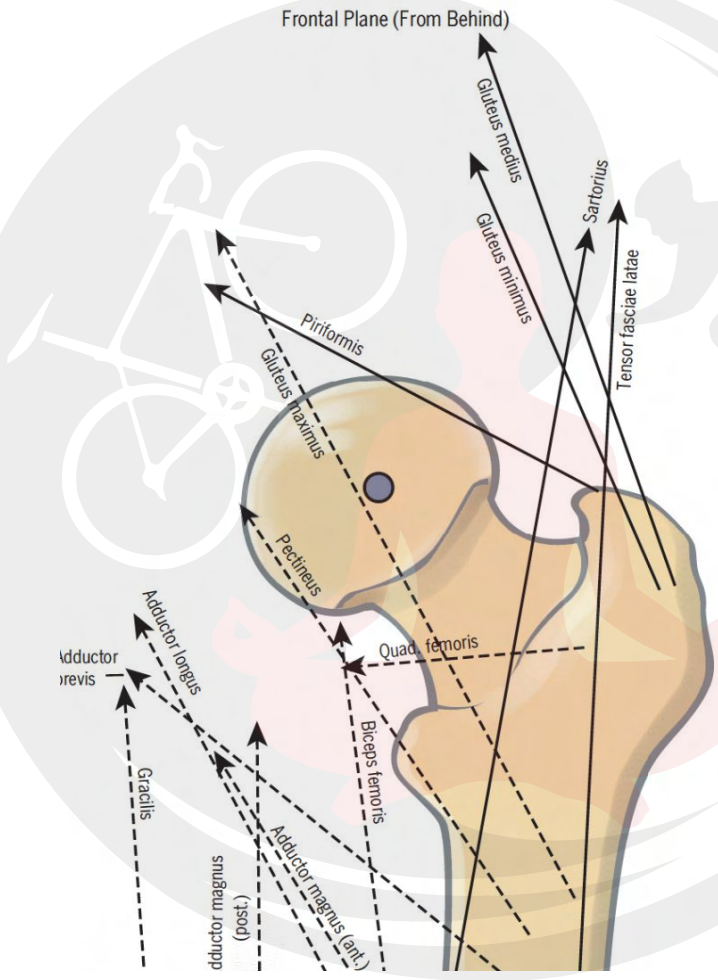
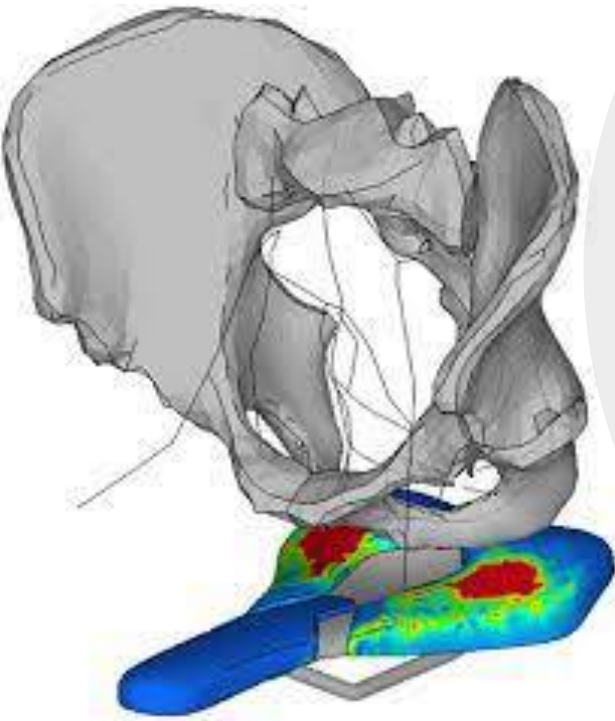
Pressure = $\frac{\text{Force}}{\text{Area}}$ ← Contact

Pressure = $\frac{40\text{kg}}{70\text{cm}}$

Pressure = .57kg per sq. cm

BICYCLE FIT GURU

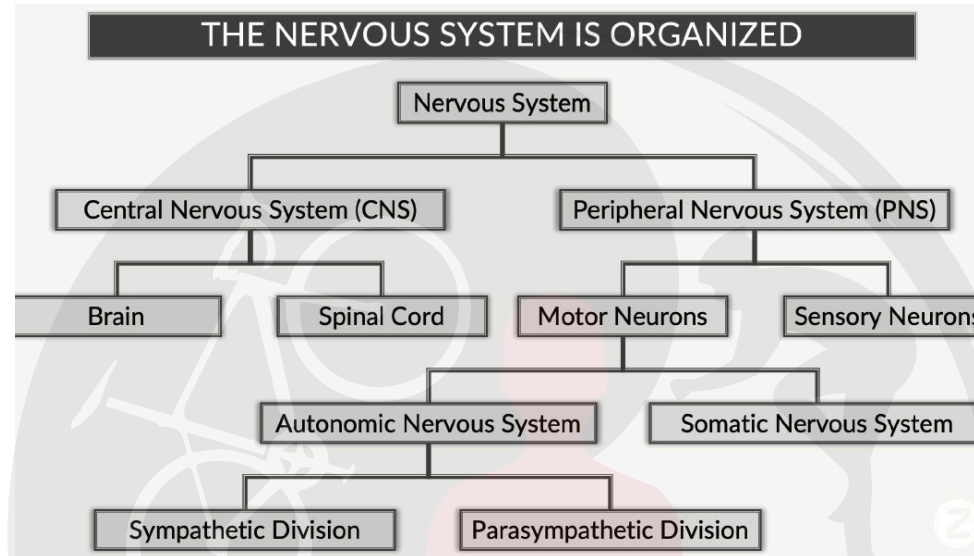
Pressure



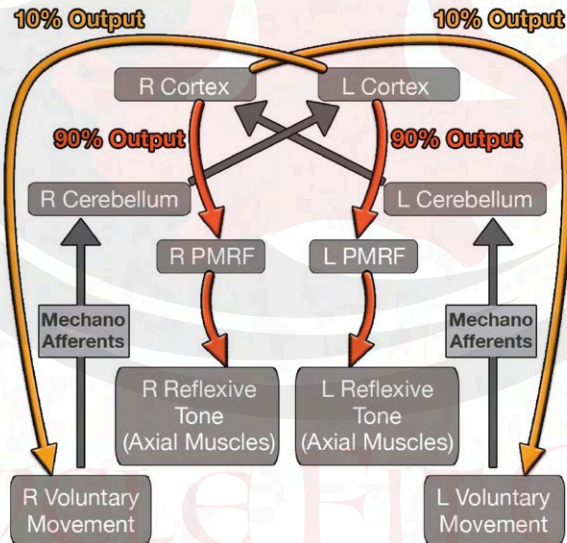
BICYCLE FIT GURU

Brain

Start Here!

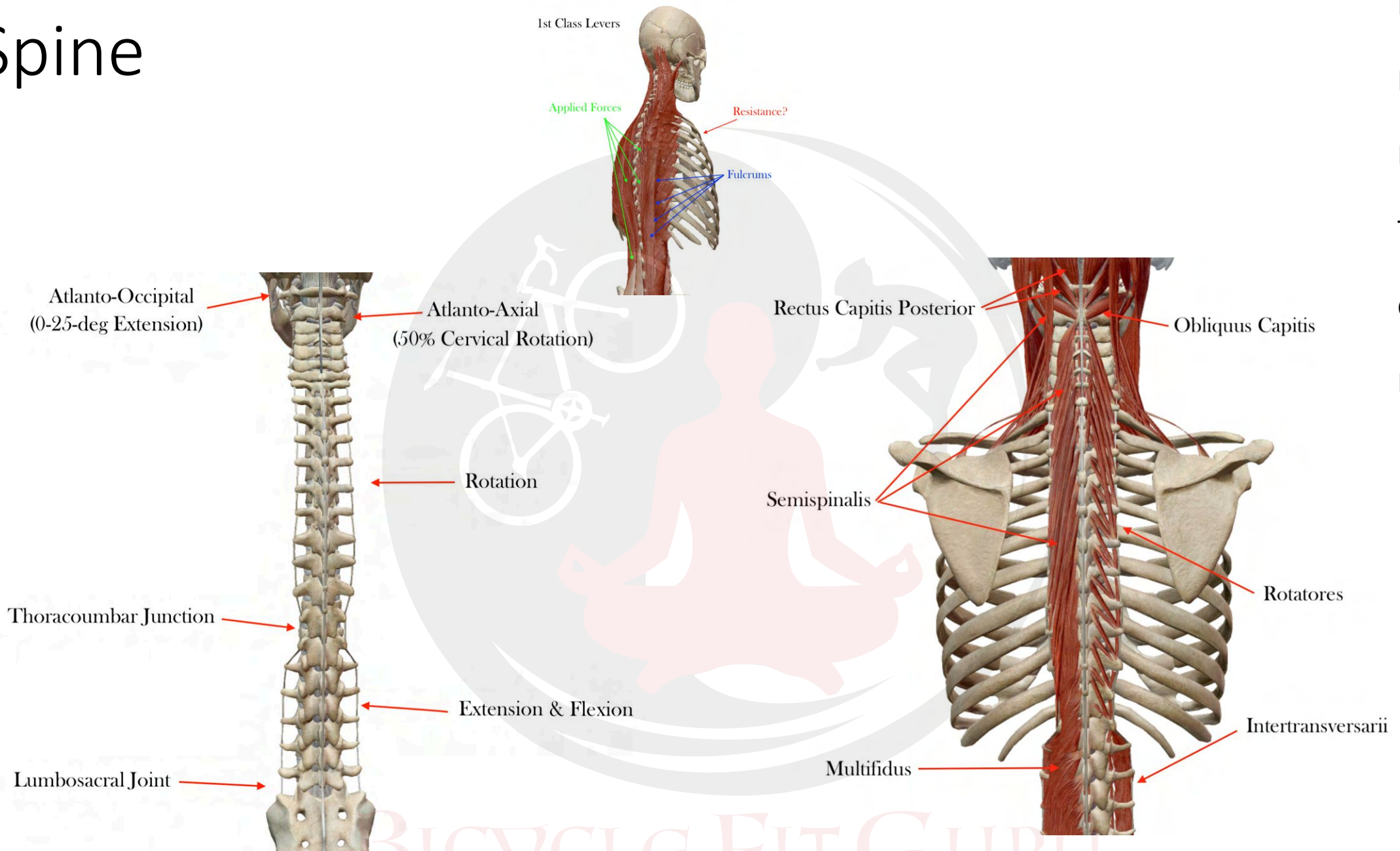


Neurofundamentals Z-Health



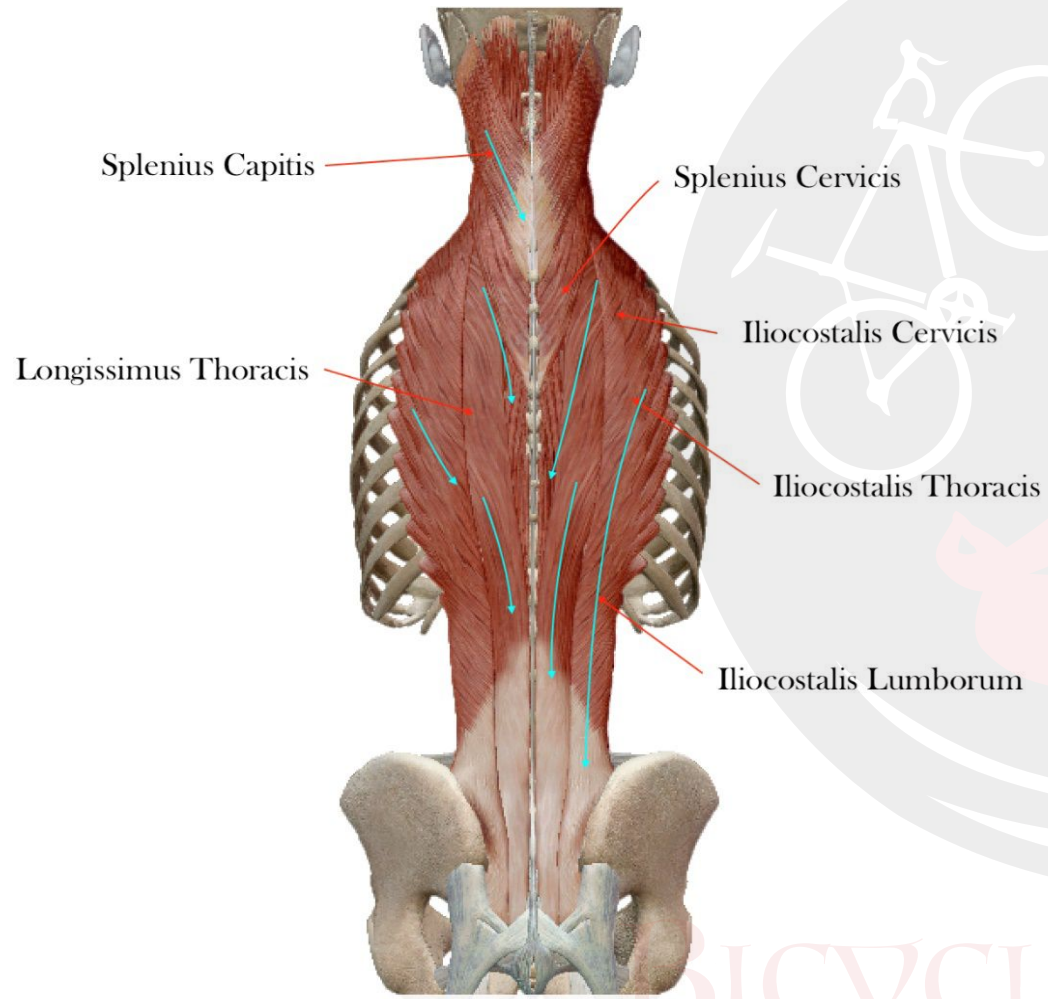
BICYCLE FIT SURU

Spine

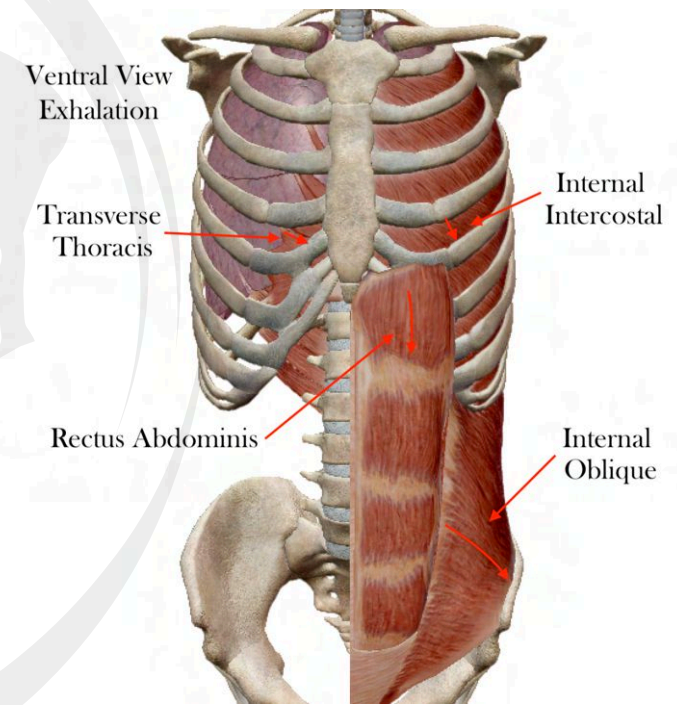
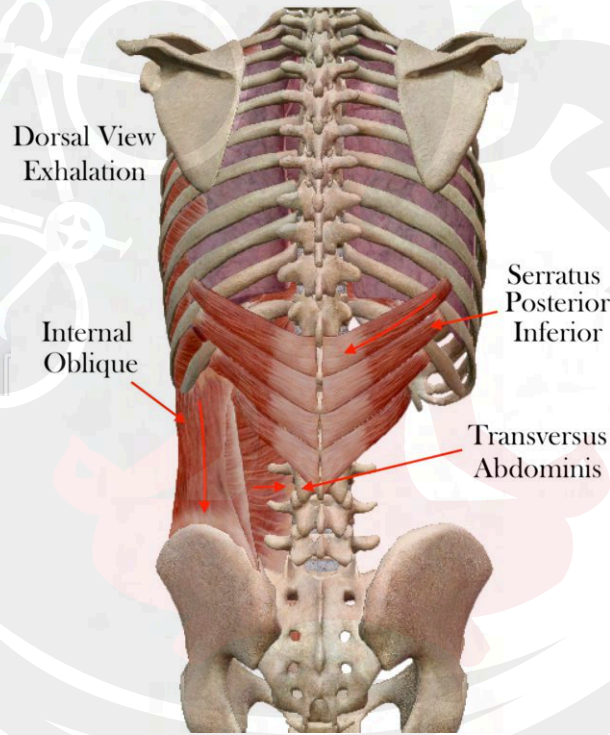
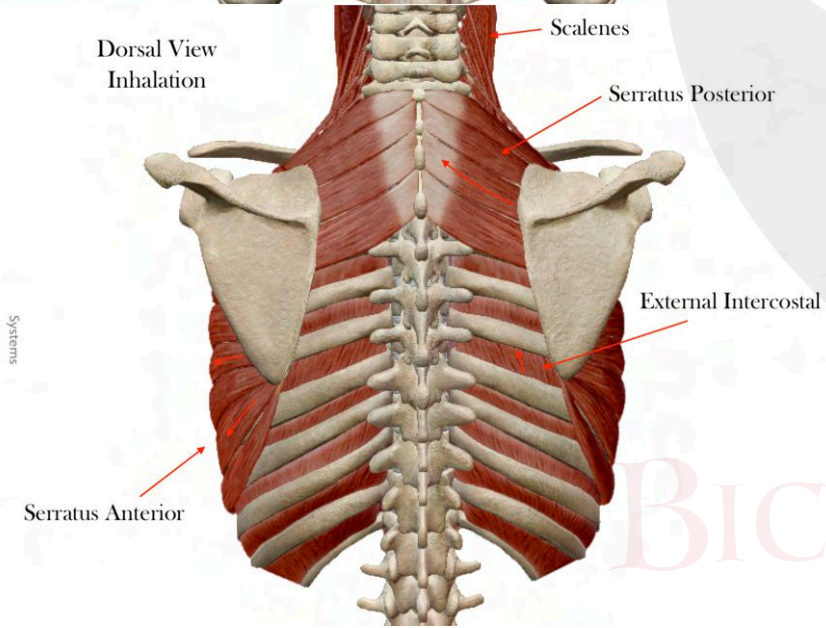
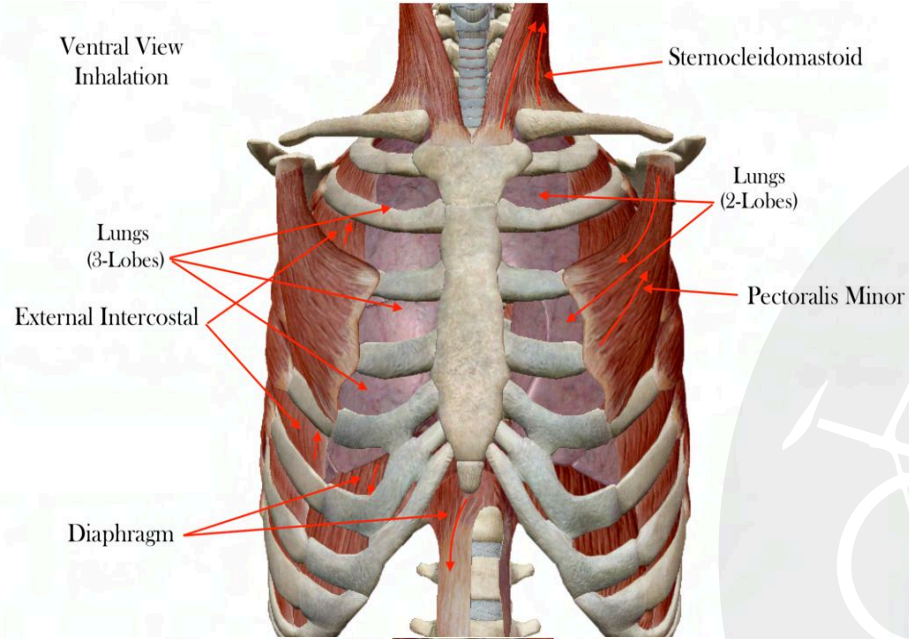


- FORCE
- INERTIA
- LEVERS
- TORQUE
- GRAVITY
- PRESSURE

Large Muscles



Respiration



FORCE

INERTIA

LEVERS

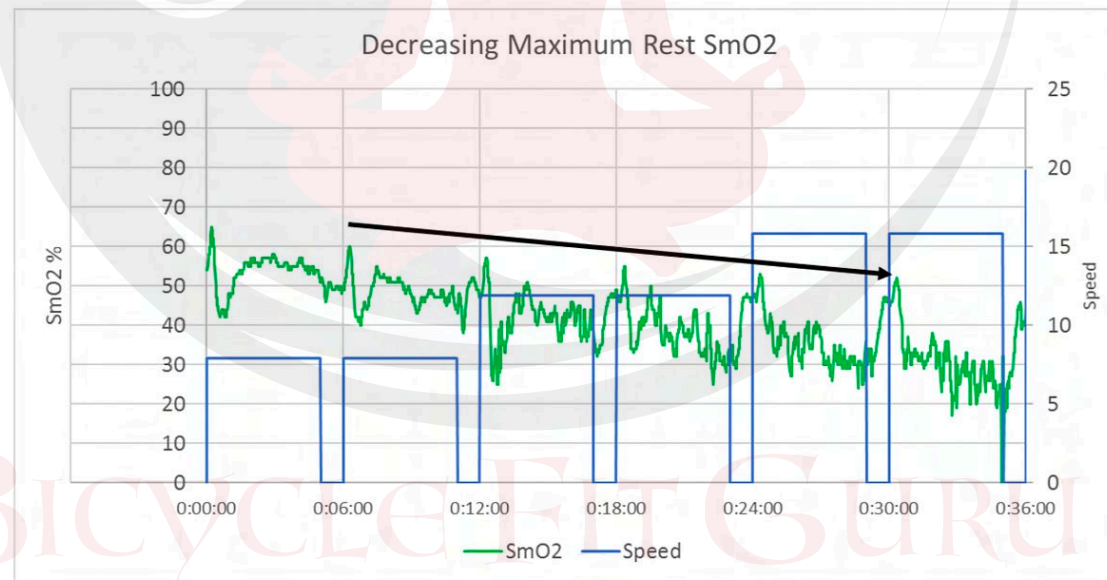
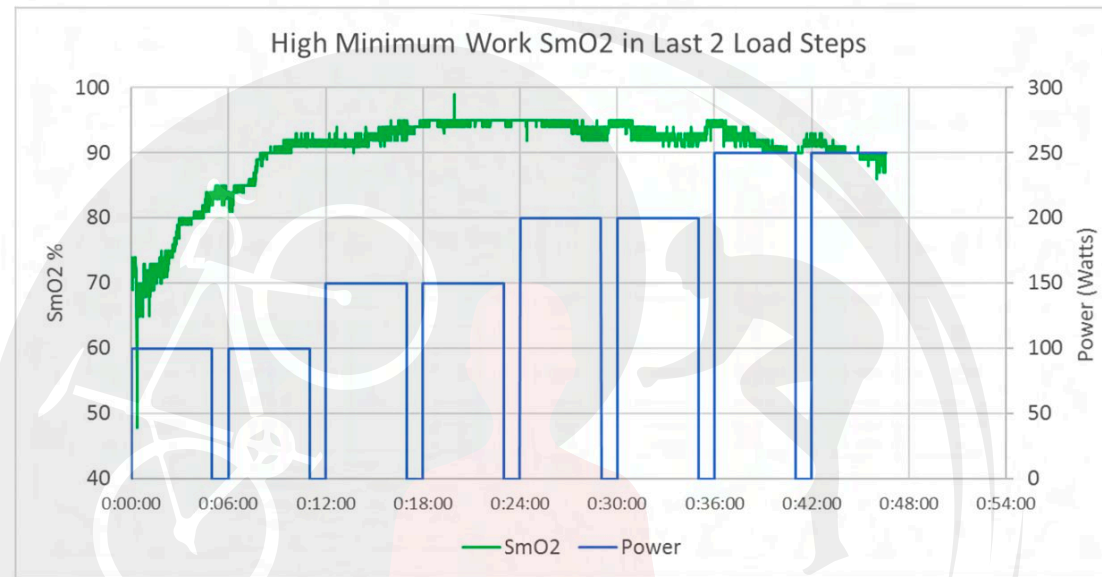
TORQUE

GRAVITY

PRESSURE

BICYCLE FIT GURU

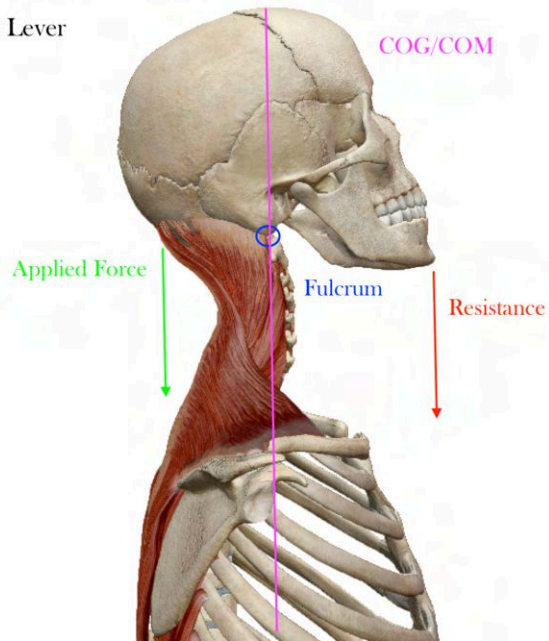
Oxygen Delivery and Utilization



BICYCLE FIT GURU

Neck

1st Class Lever



C3-C5
Phrenic Nerve

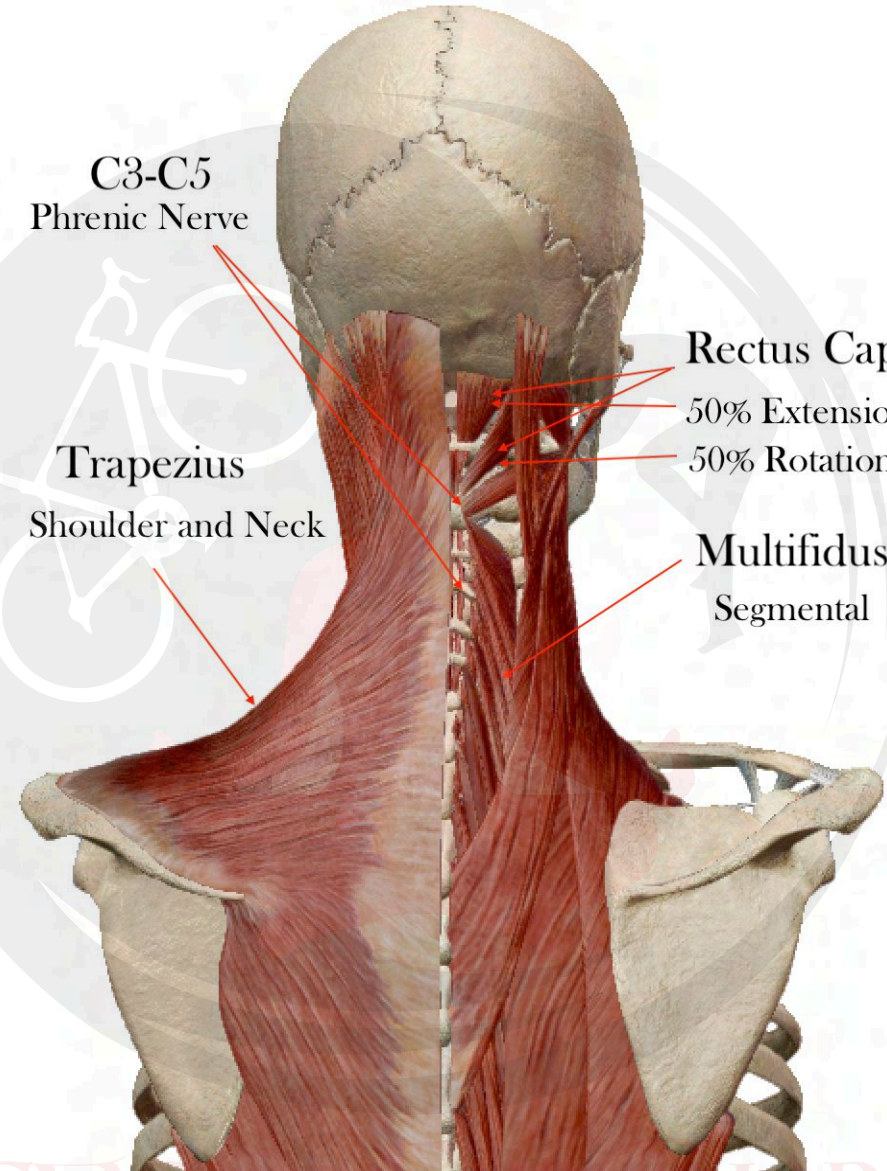
Trapezius
Shoulder and Neck

Rectus Capitis Major/Minor

50% Extension

50% Rotation

Multifidus
Segmental



FORCE

INERTIA

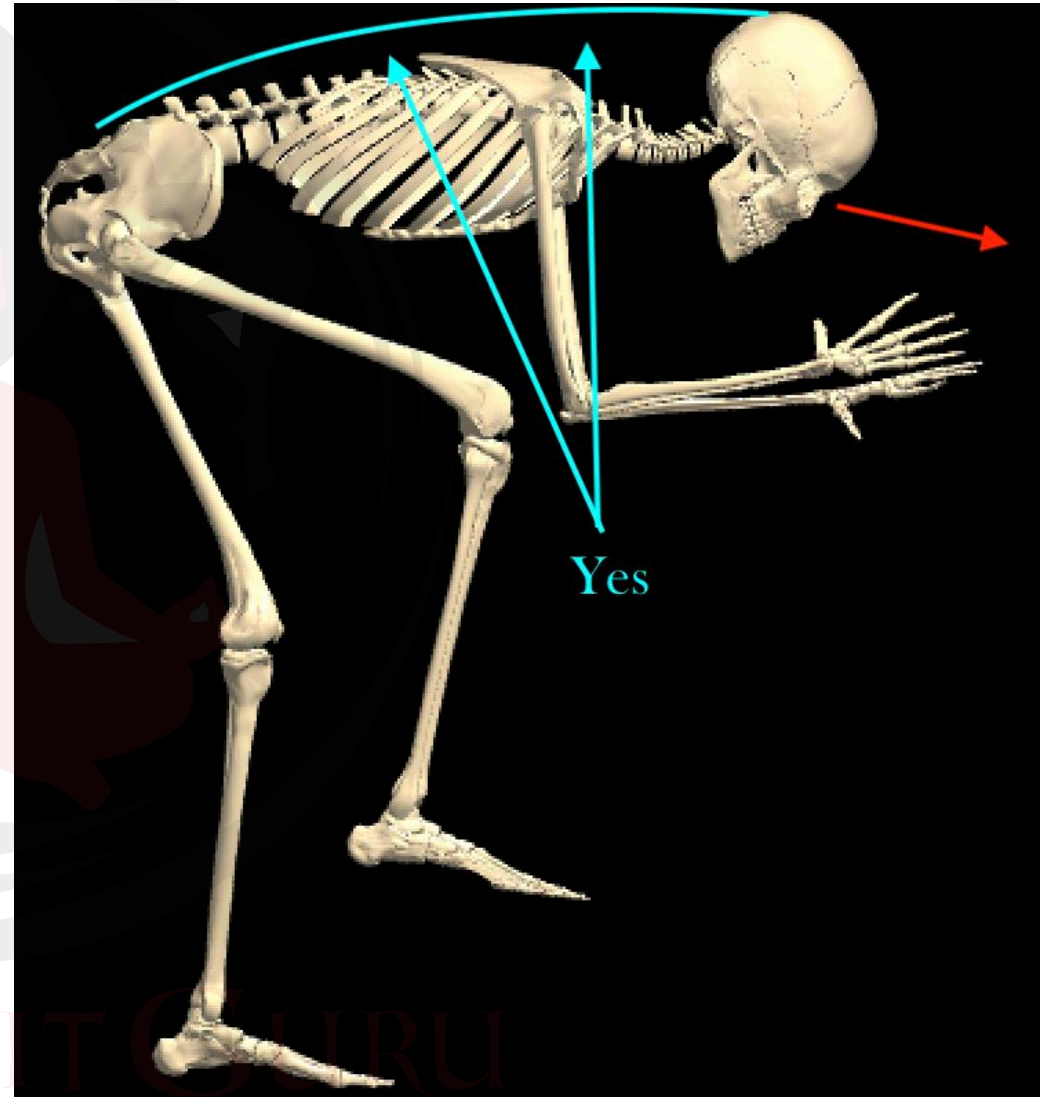
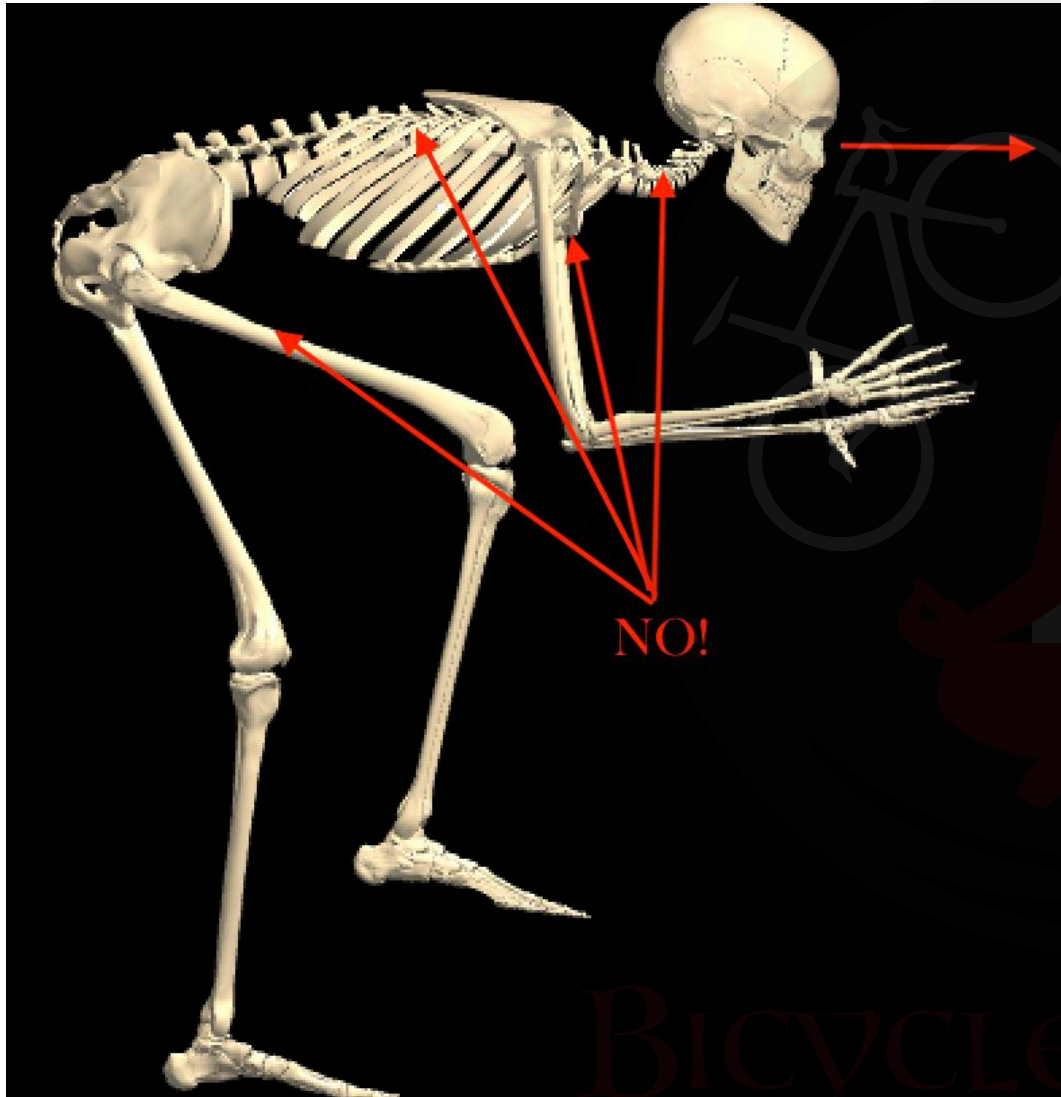
LEVERS

TORQUE

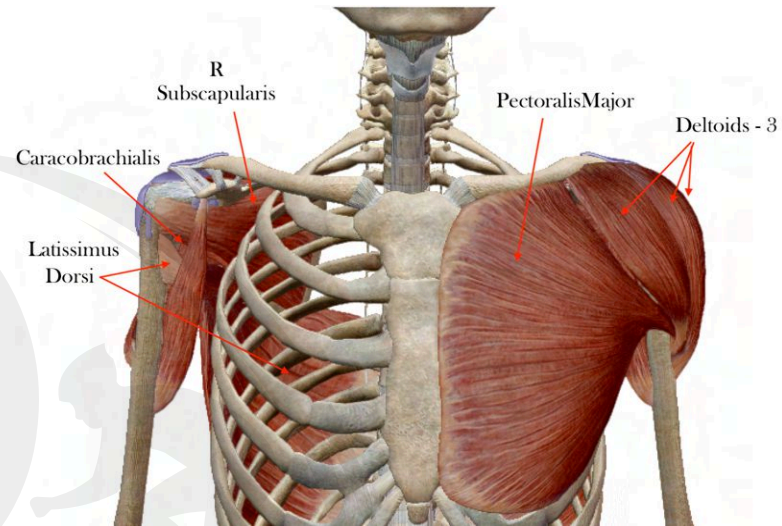
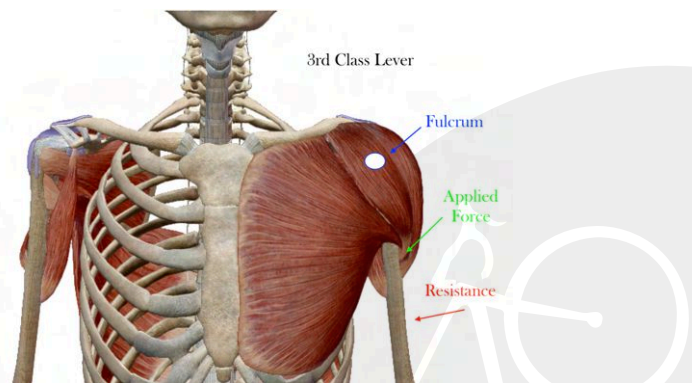
GRAVITY

PRESSURE

Gaze

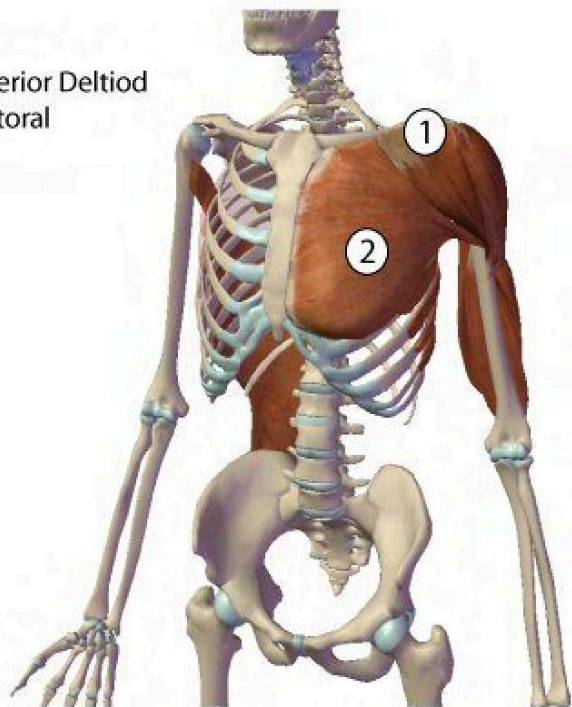


Shoulders

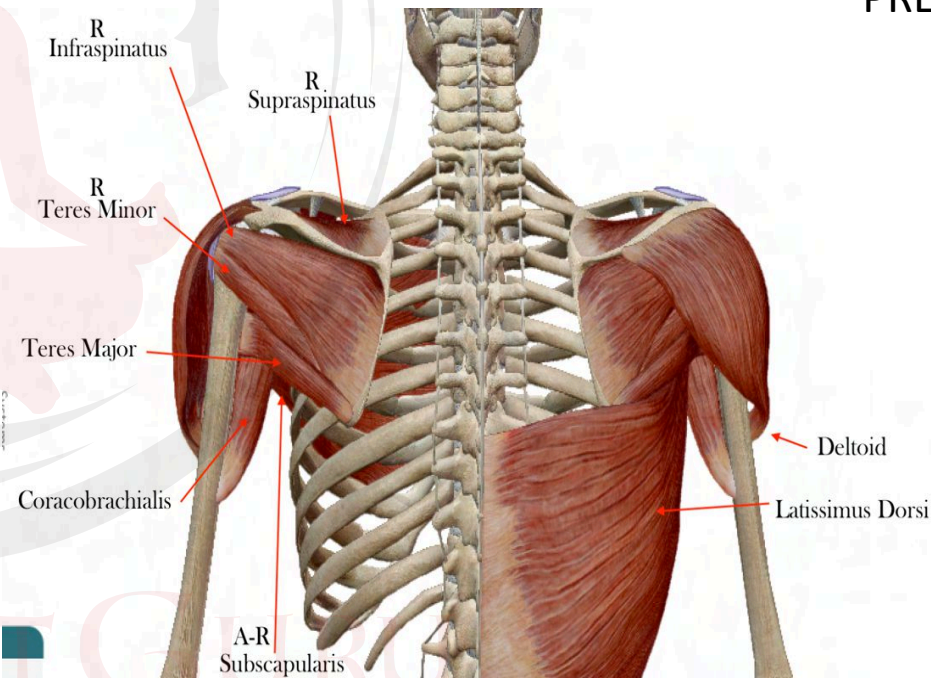
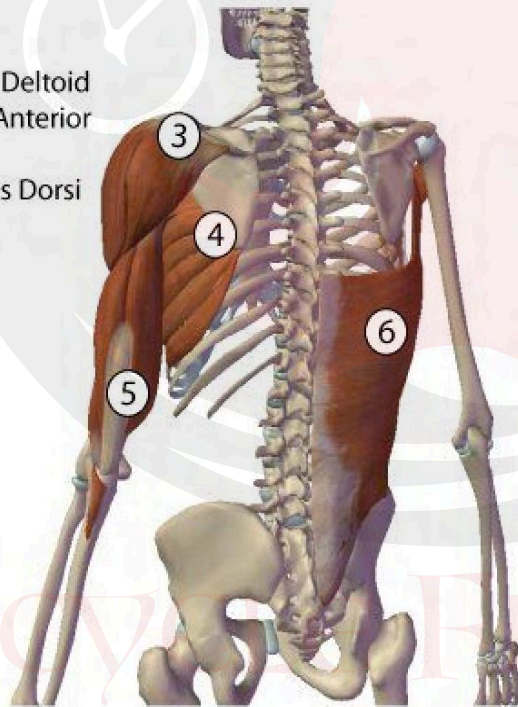


- FORCE
- INERTIA
- LEVERS
- TORQUE
- GRAVITY
- PRESSURE

1. Anterior Deltoid
2. Pectoral

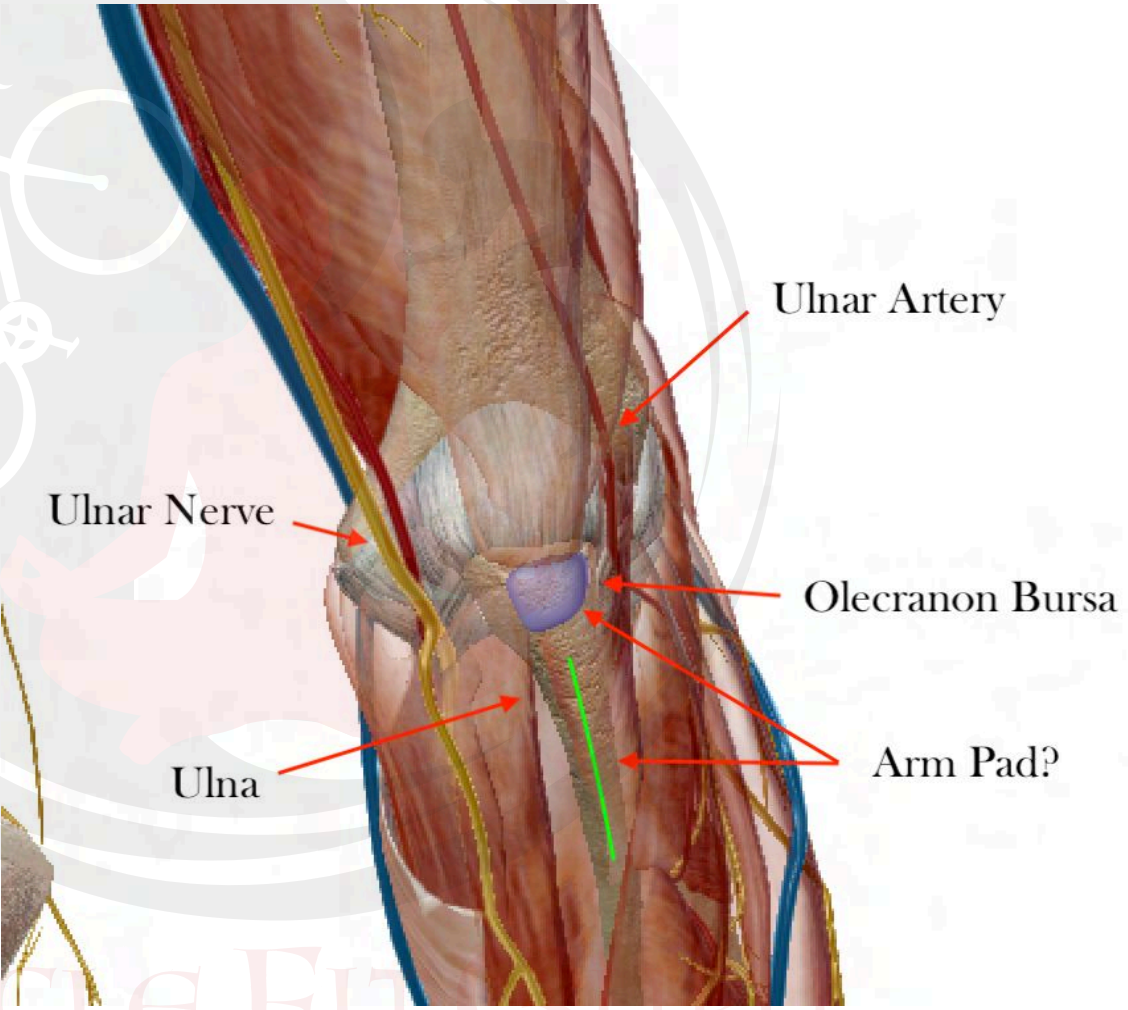
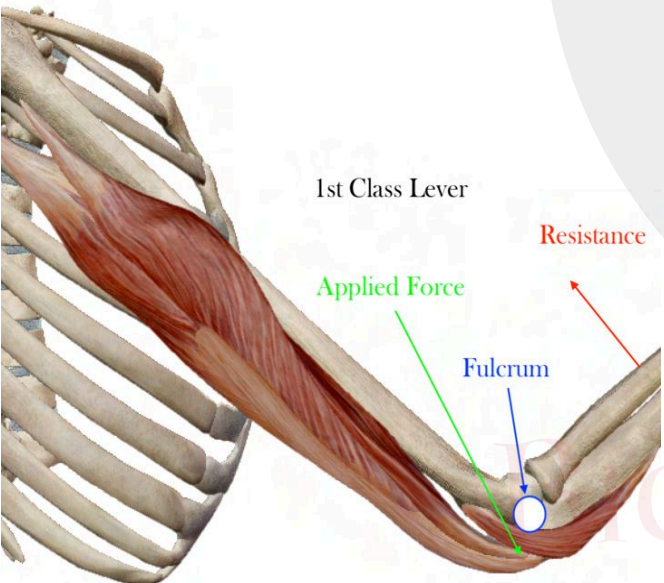
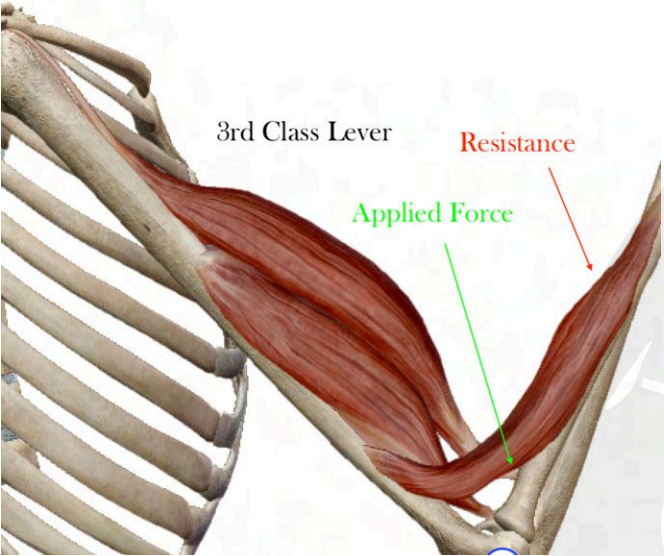


3. Posterior Deltoid
4. Serratus Anterior
5. Triceps
6. Latissimus Dorsi



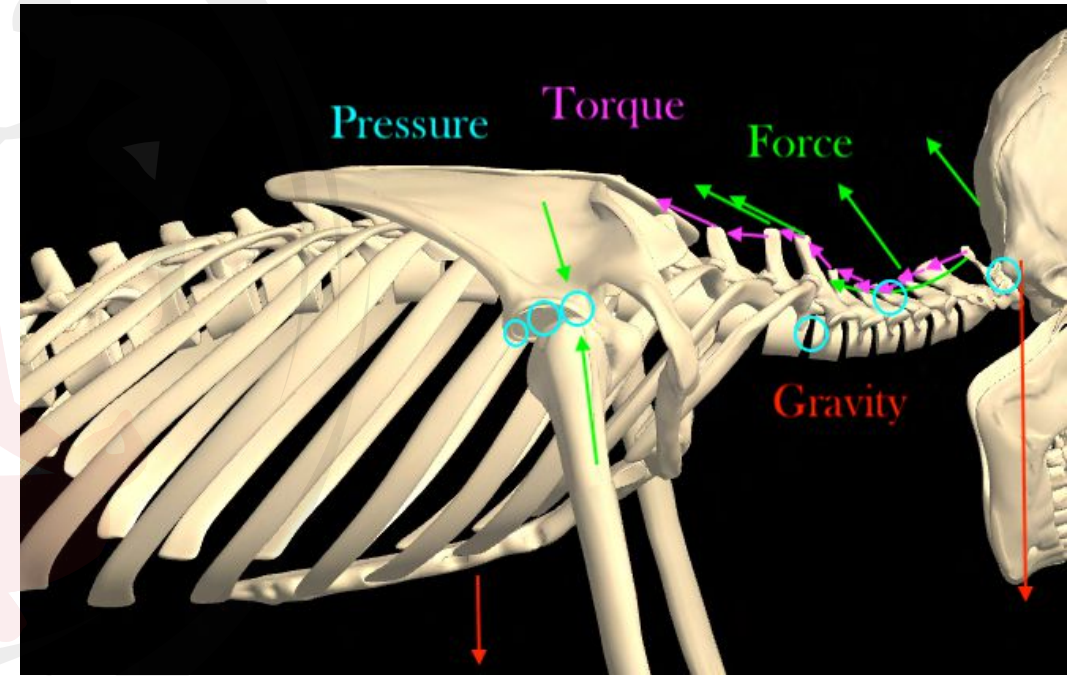
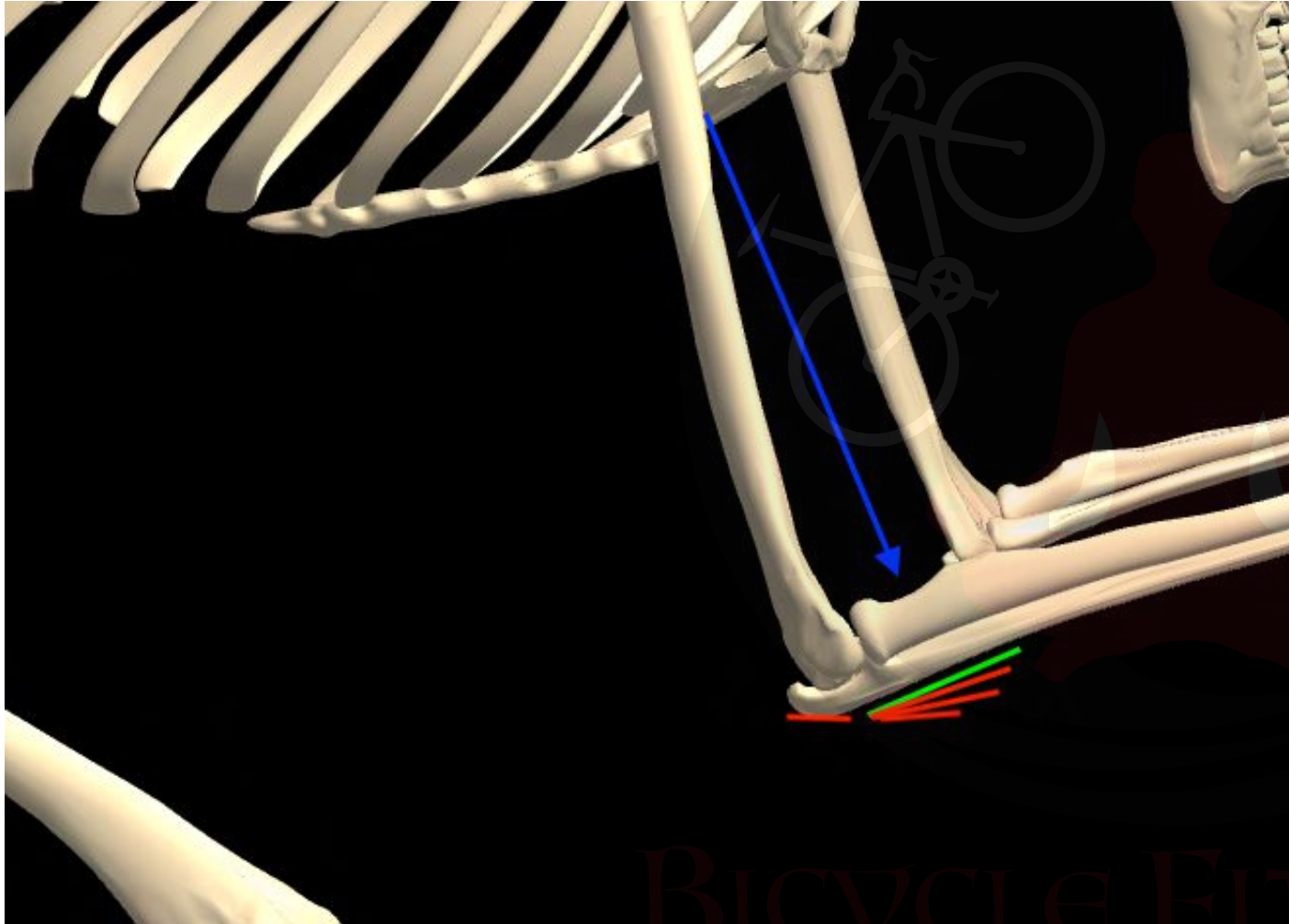
Elbows

- FORCE
- INERTIA
- LEVERS
- TORQUE
- GRAVITY
- PRESSURE

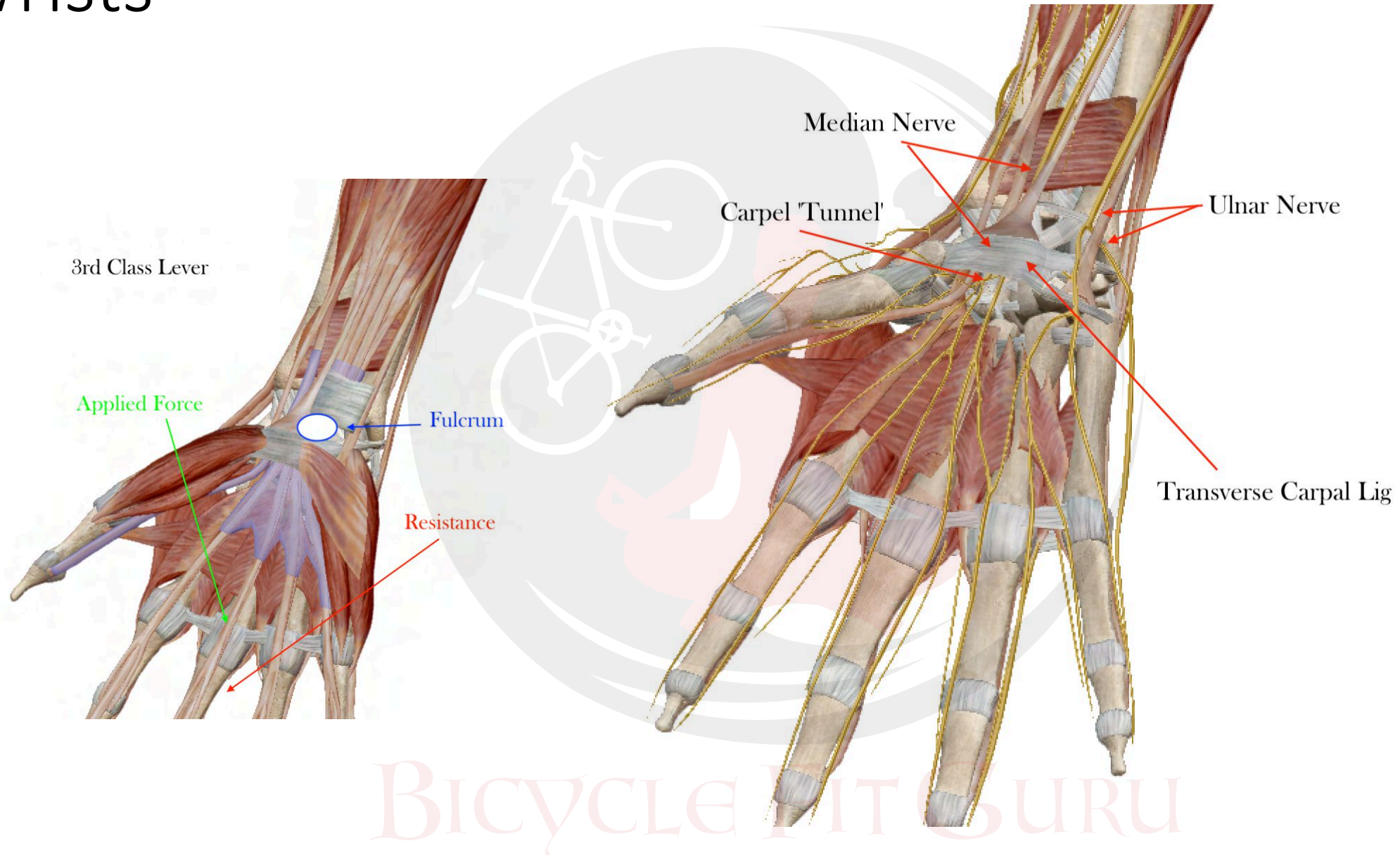


Bicycle Fit Guru

Contact area and pressure distribution



Wrists



FORCE

INERTIA

LEVERS

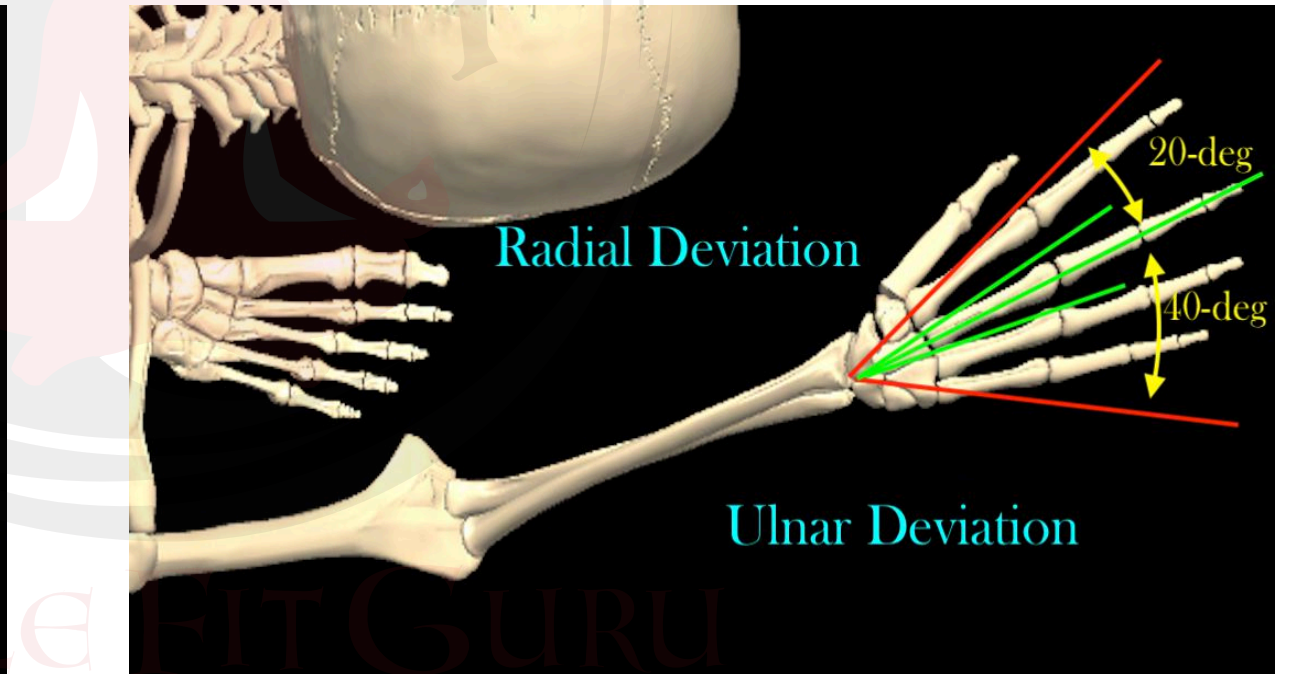
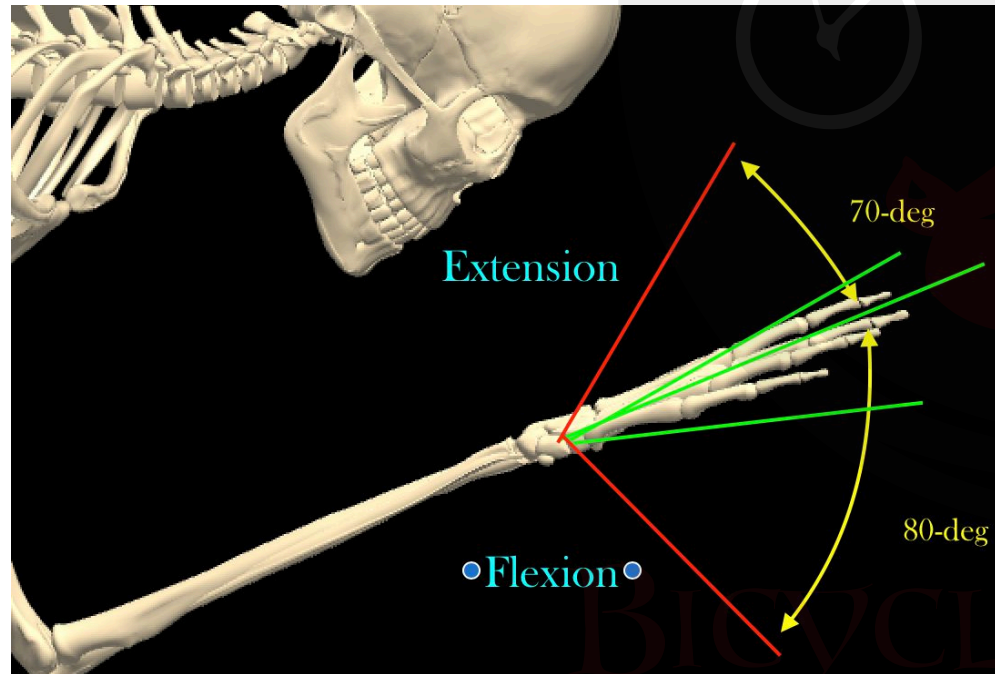
TORQUE

GRAVITY

PRESSURE

BICYCLE FIT GURU

Neutral Wrist



Lumbopelvic Function

FORCE

INERTIA

LEVERS

TORQUE

GRAVITY

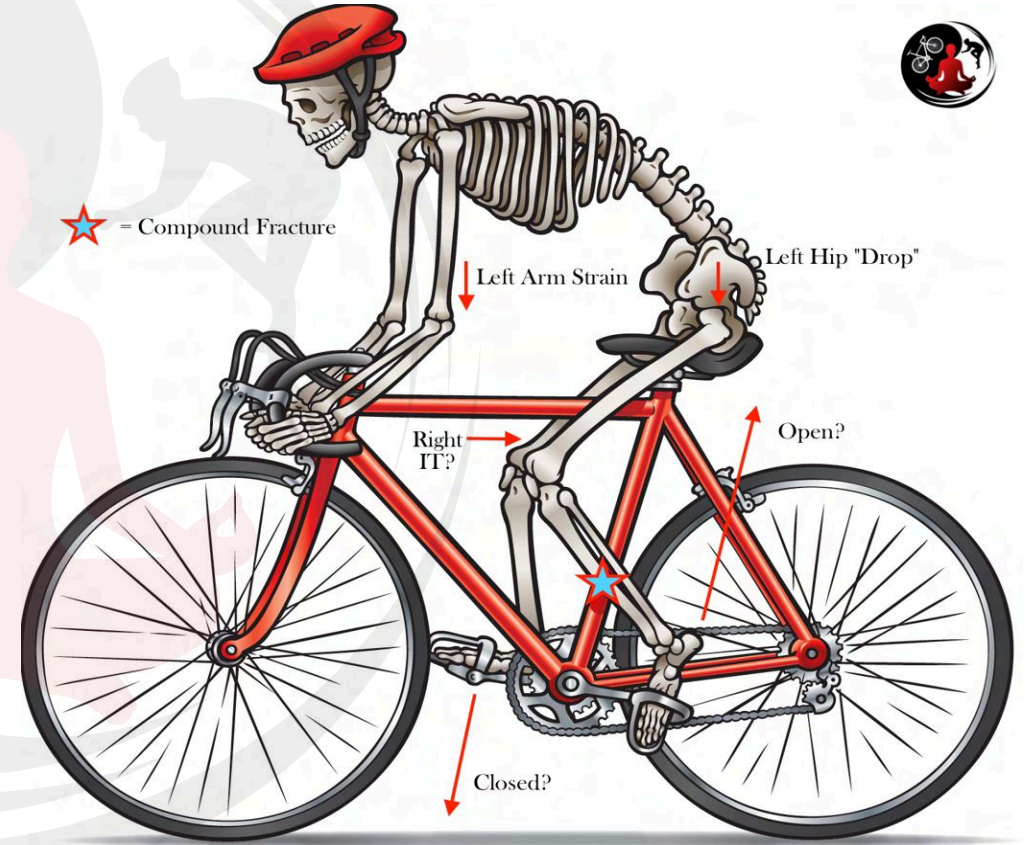
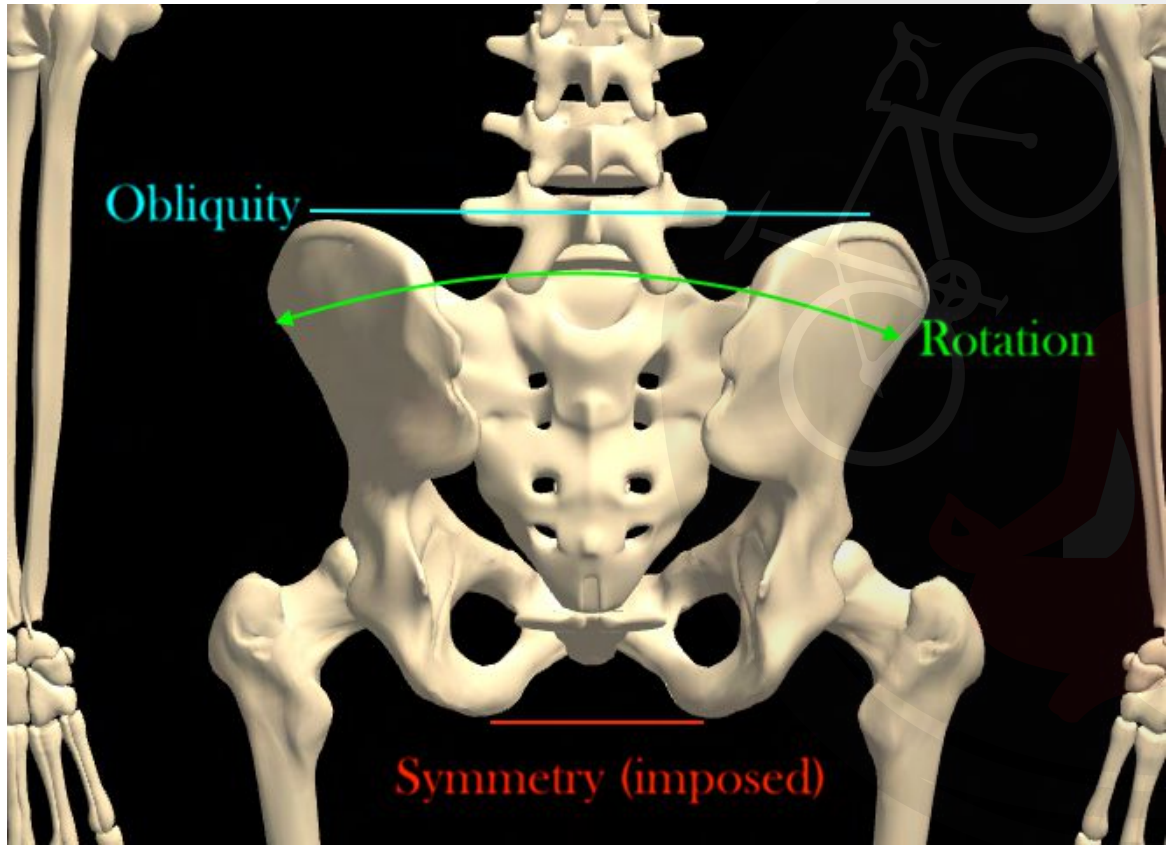
PRESSURE



Lumbar Mobility & TDC

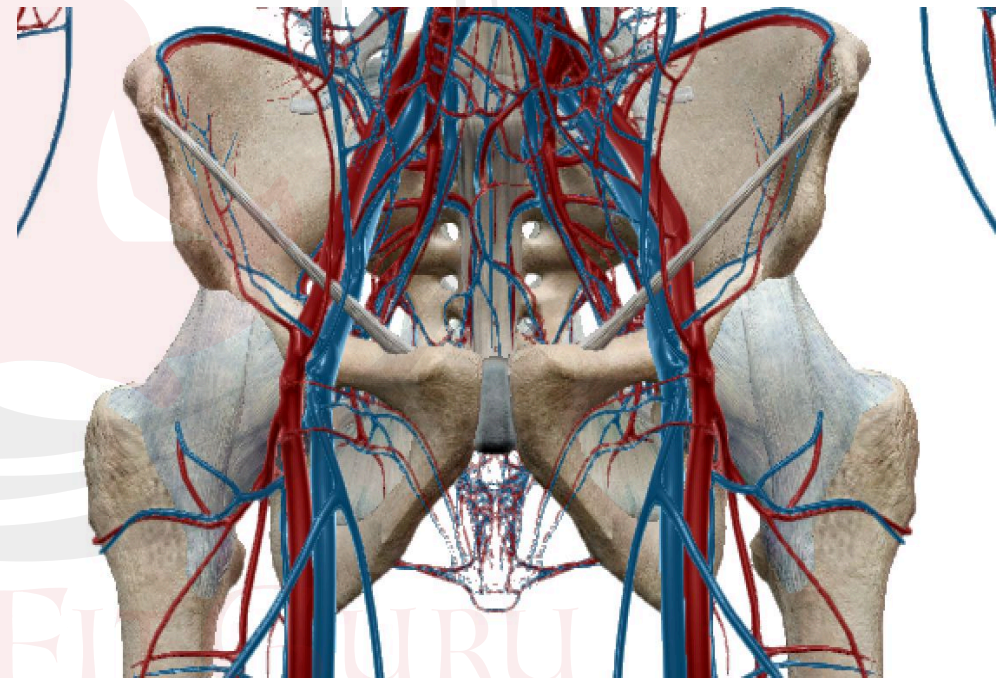
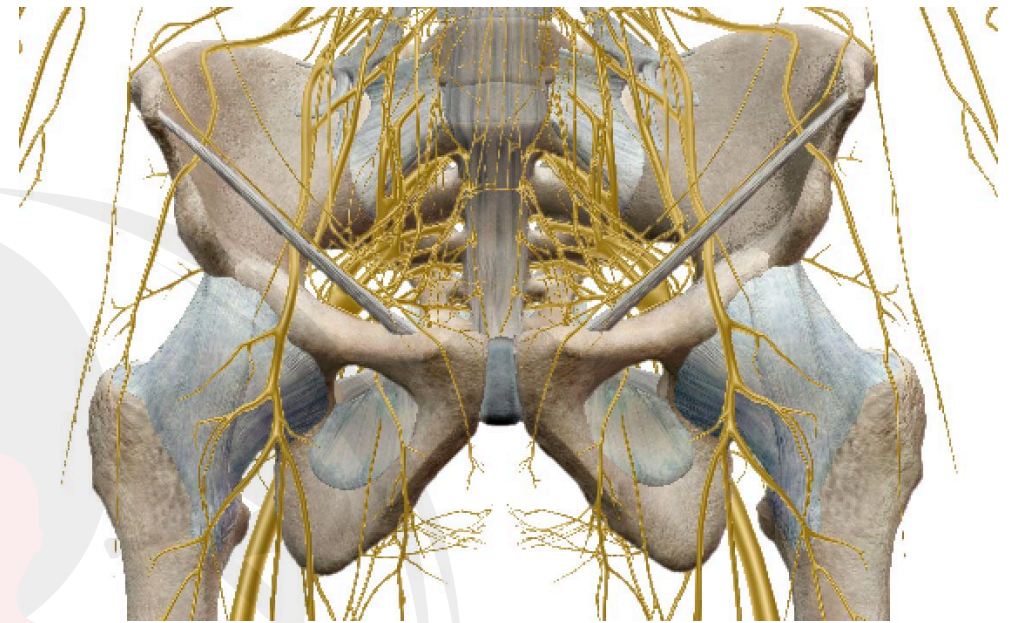
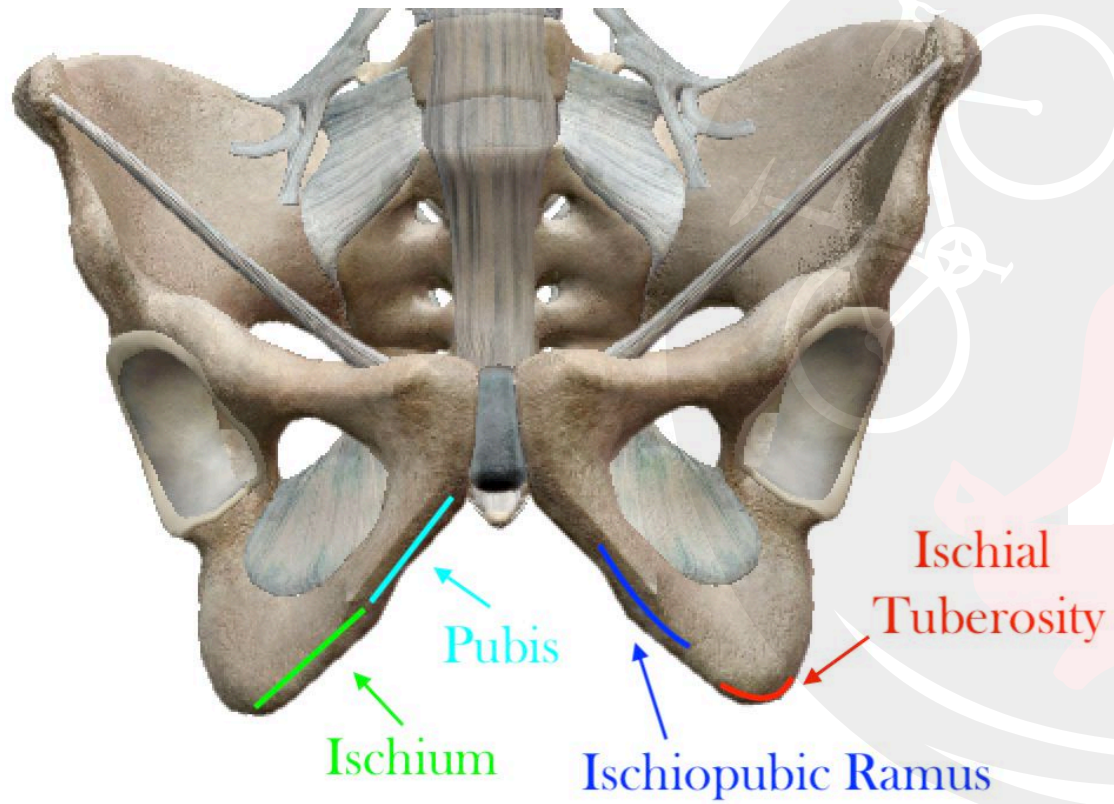


Symmetry



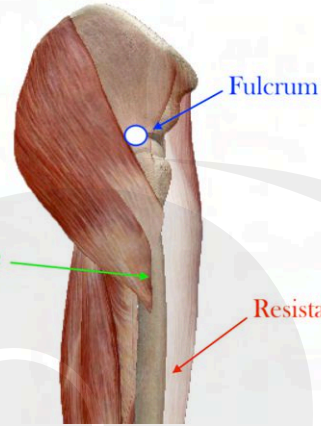
BICYCLE FIT GURU

Saddle Pressure



Hips

3rd Class Lever



Fulcrum

Applied Force

Resistance

FORCE

INERTIA

LEVERS

TORQUE

GRAVITY

PRESSURE



Moment Arms

Glute Max

Muscle Force

Biceps Femoris

Semitendinosus

Semimembranosus

Resistance

Movement

Resistance

Iliacus

Muscle Force

Psoas

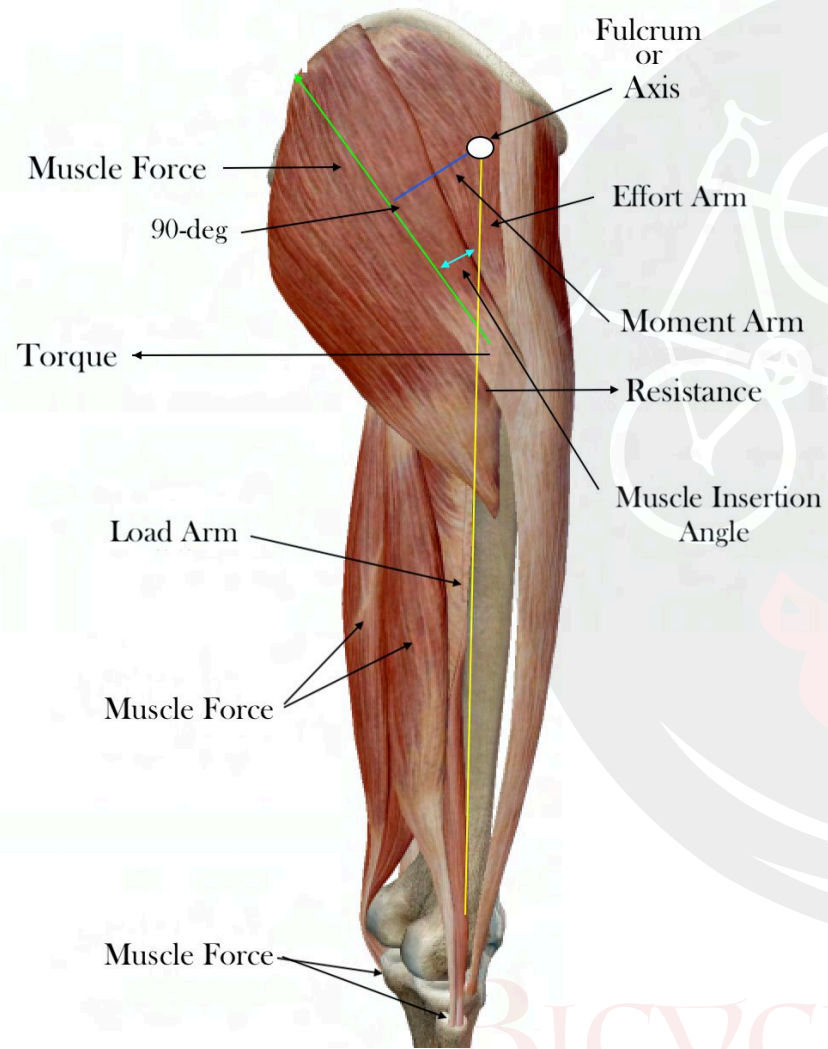
Moment Arms

Rectus Femoris

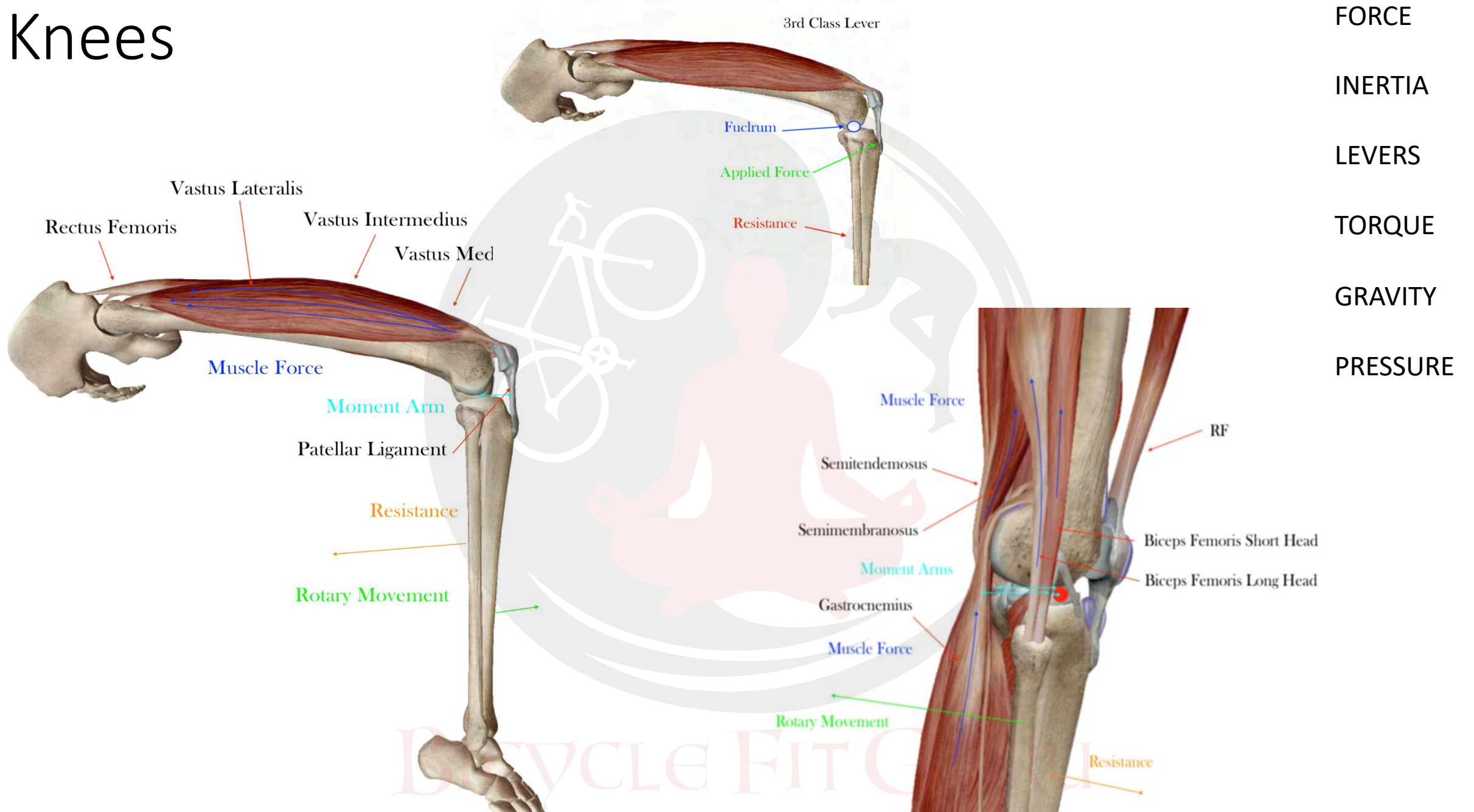
Muscle Force

Rotary Movement

Hip Extension – Two-Joint Muscles



Knees



FORCE

INERTIA

LEVERS

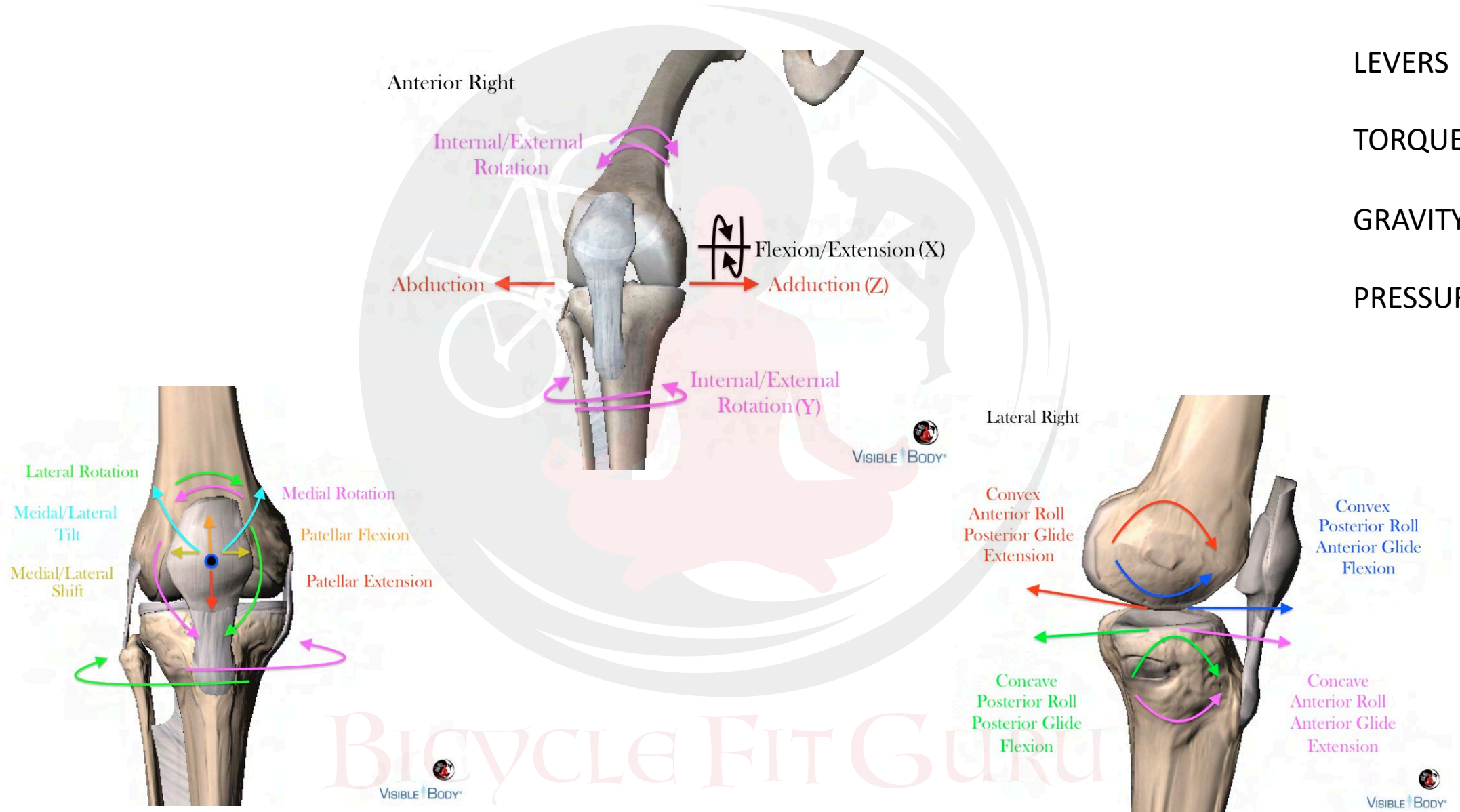
TORQUE

GRAVITY

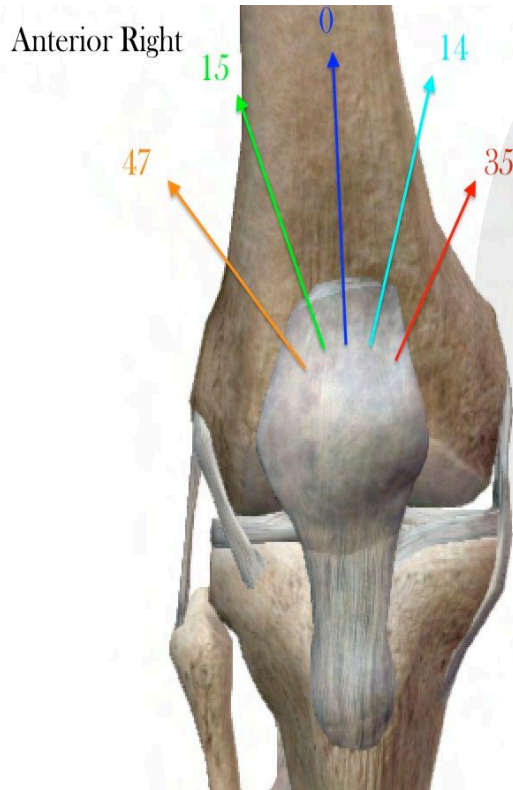
PRESSURE

Tibiofemoral Arthrokinematics

- FORCE
- INERTIA
- LEVERS
- TORQUE
- GRAVITY
- PRESSURE

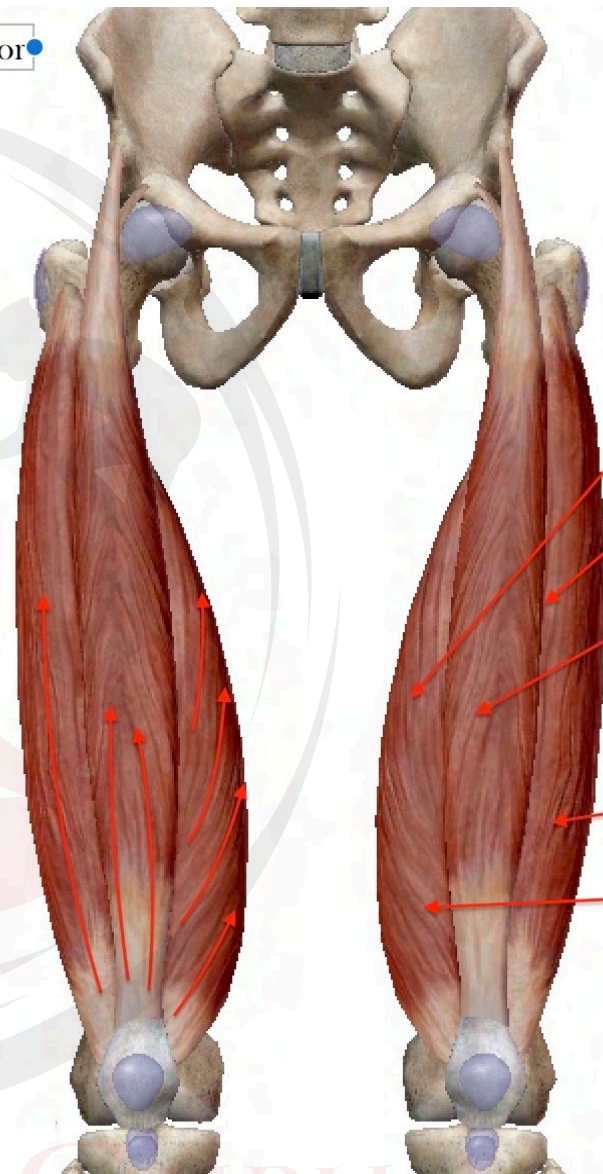


Line of Pull



- Vastus Lateralis Obliquus
- Vastus Lateralis Longus
- Rectus Femoris
- Vastus Intermedius
- Vastus Medialis Longus
- Vastus Medialis Obliquus

Anterior



- Vastus Medialis Longus
- Vastus Intermedius
- Rectus Femoris
- Vastus Lateralis
- Vastus Medialis Obliquus



BICYCLE FIT GURU

Ankles



- FORCE
- INERTIA
- LEVERS
- TORQUE
- GRAVITY
- PRESSURE



CYCLE FIT GURU

Feet

FORCE

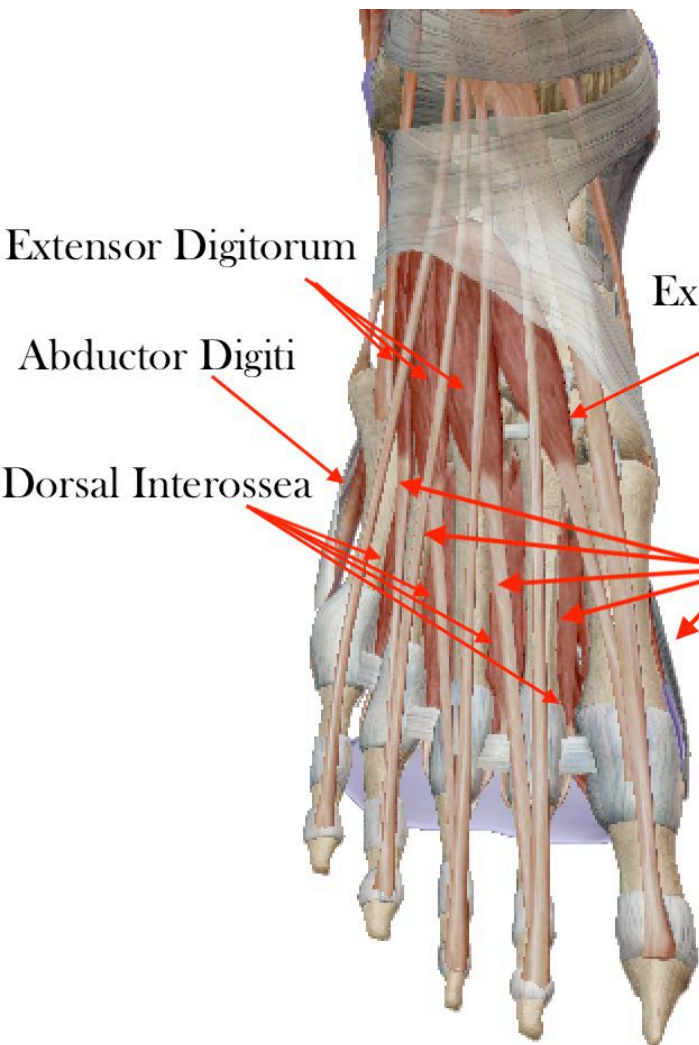
INERTIA

LEVERS

TORQUE

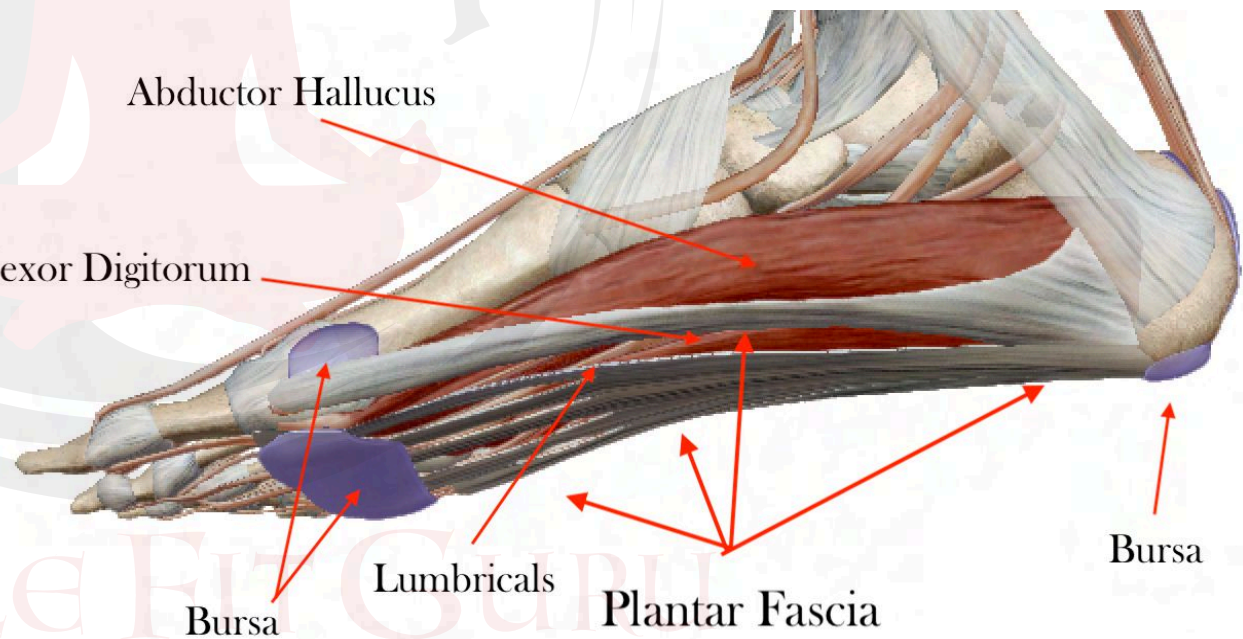
GRAVITY

PRESSURE



Extensor Hallucis

Metatarsal



BICYCLE FIT CLUB

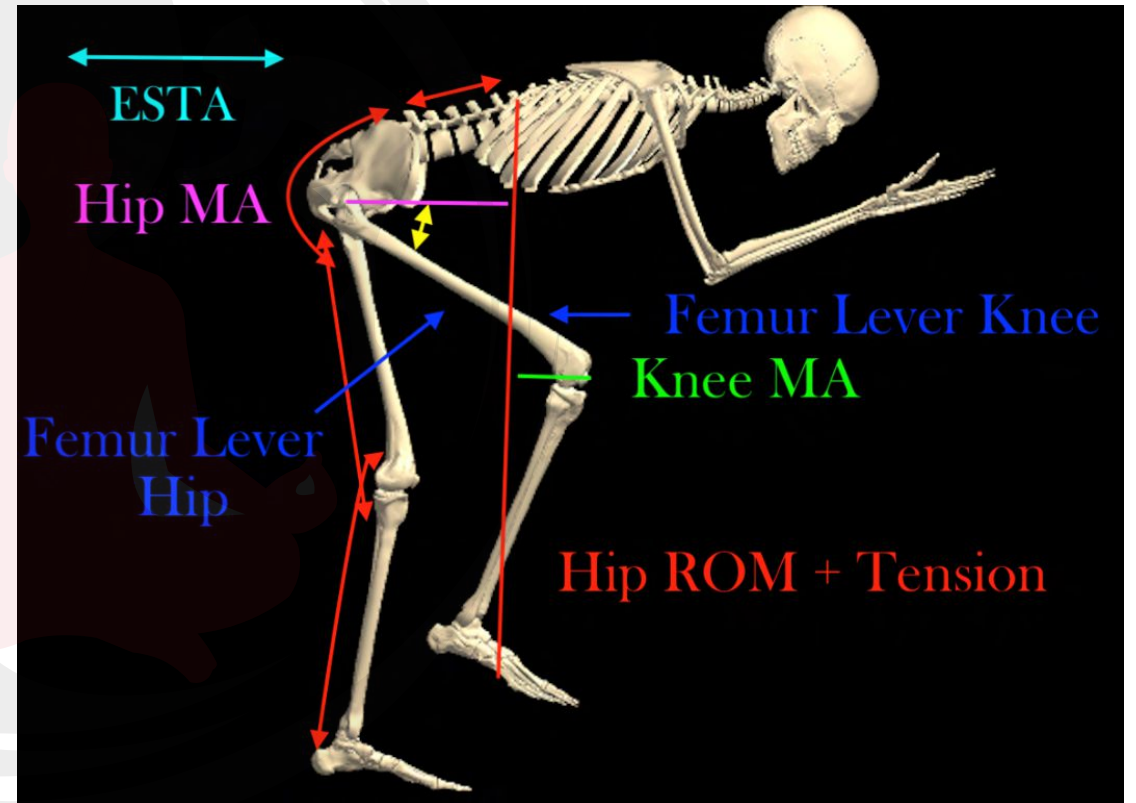
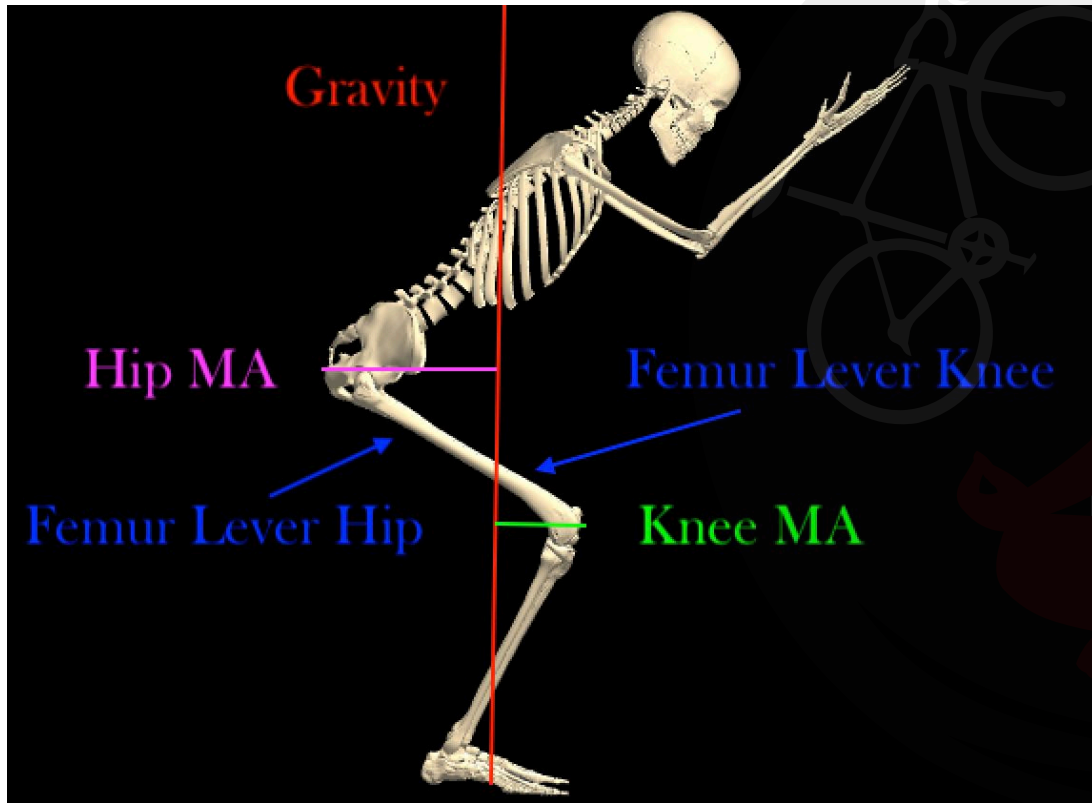
Shape and Pressure



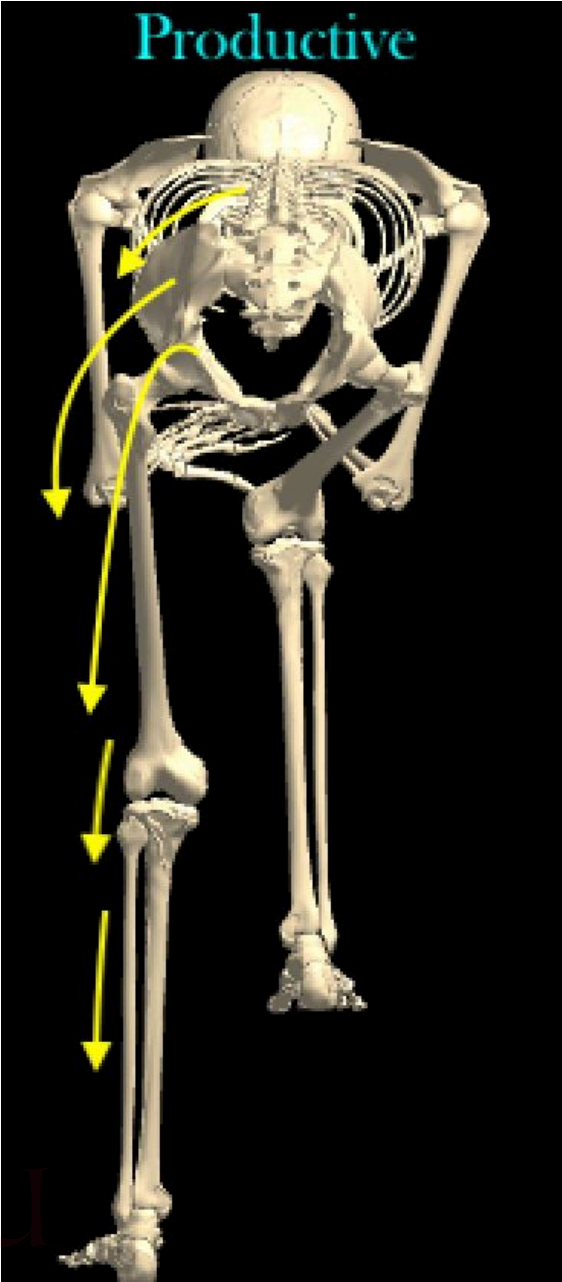
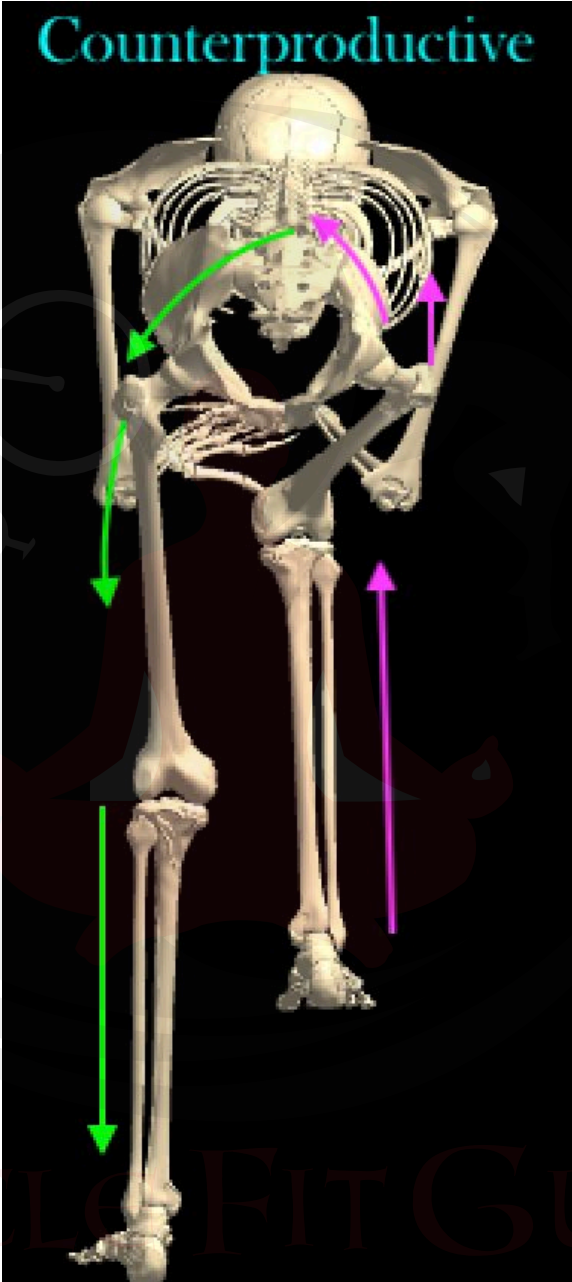
Identifying Pressure



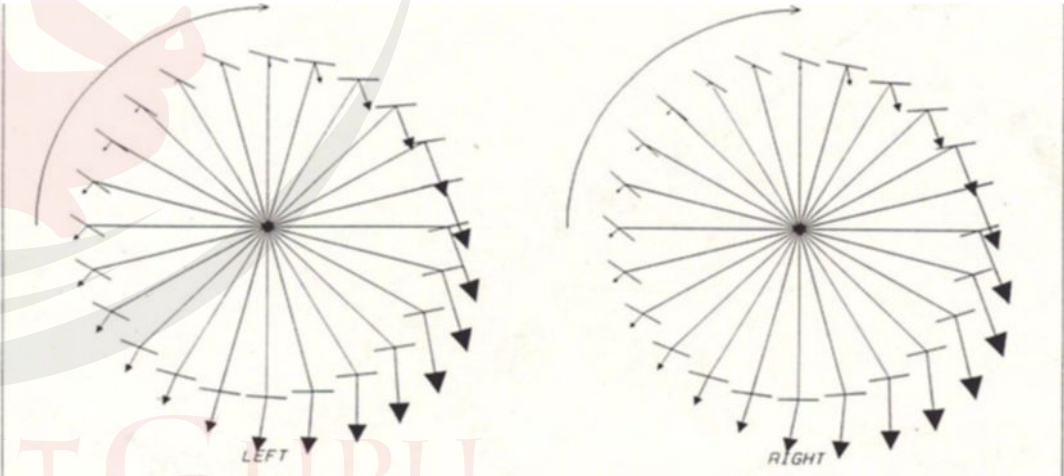
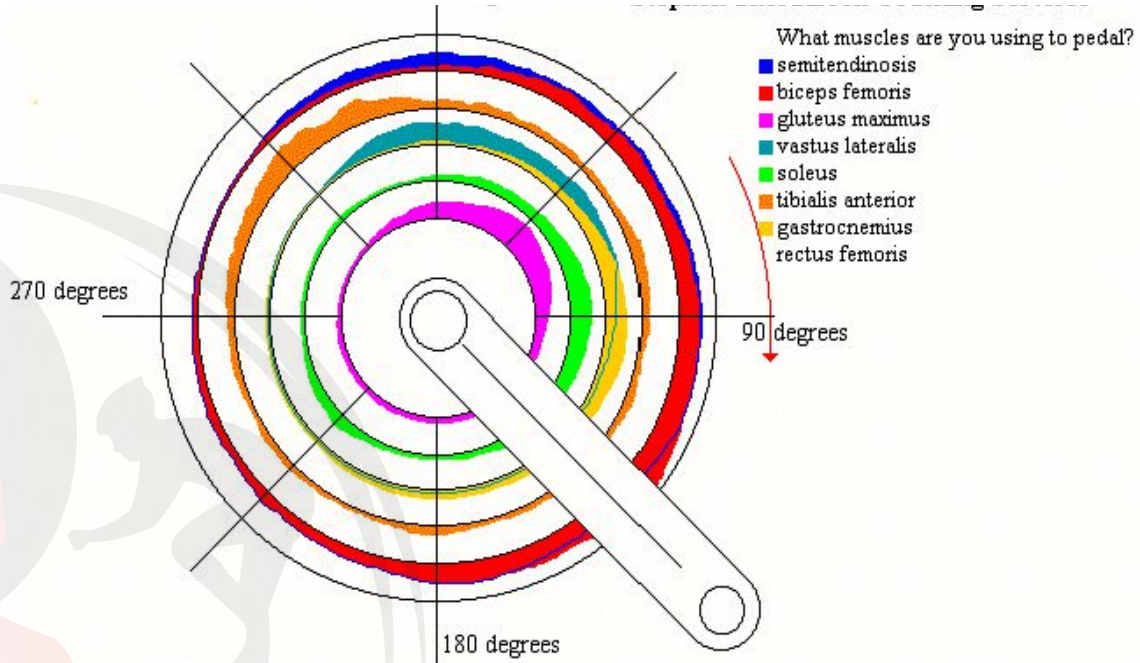
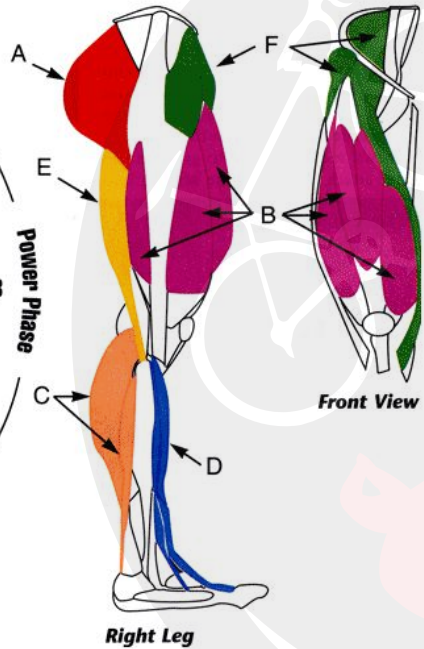
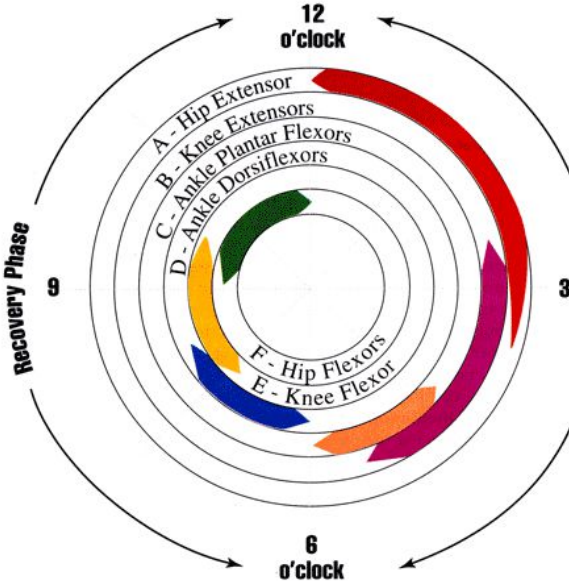
Pedaling -- Moments and Force Production



Pedaling Efficiency?



Pedaling - WTF?

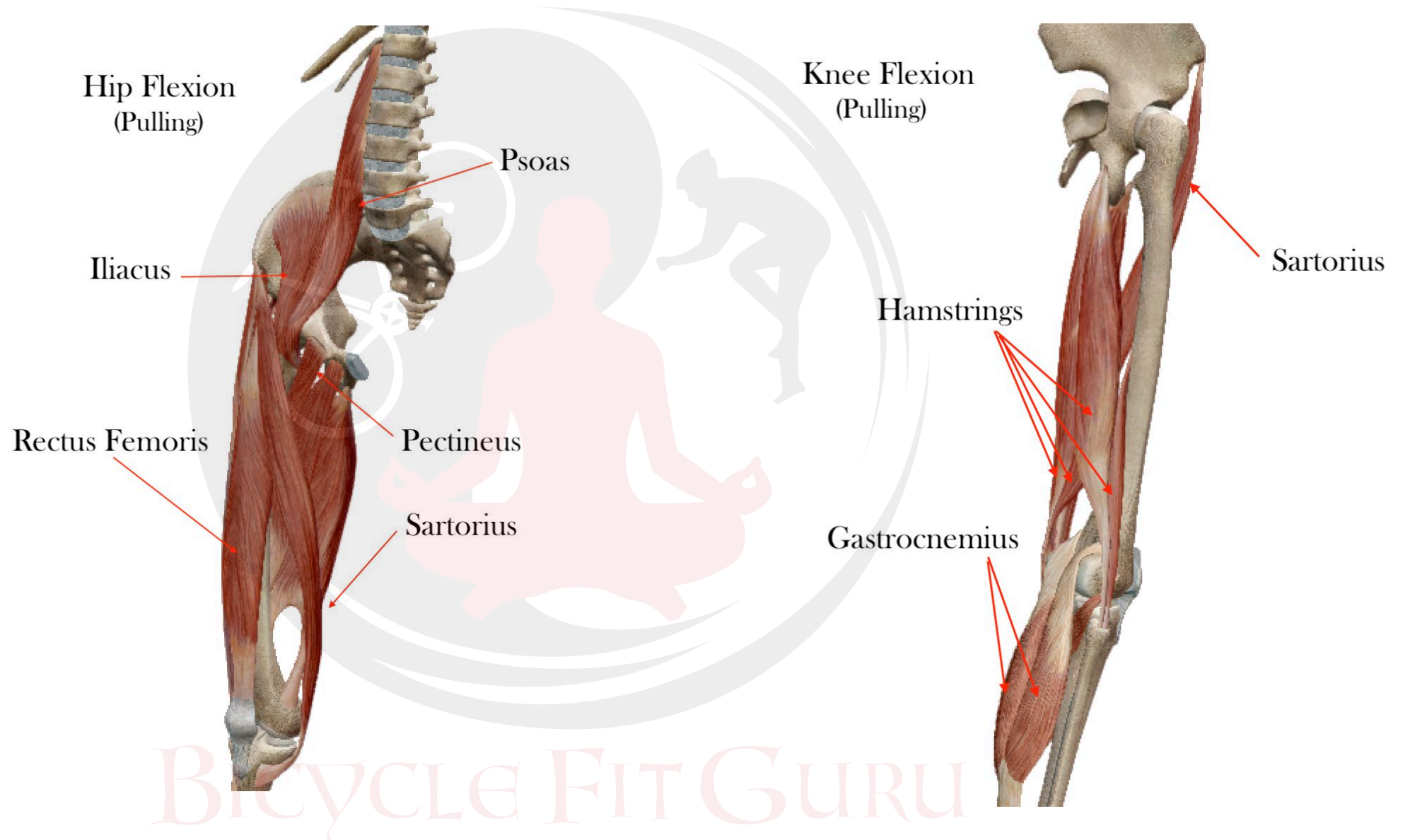


My studies...

MUSCLE		RANGE	PEAK
Gluteus maximus	Hip extension	340–130	80
Vastus lateralis	Knee extension	300–130	30
Vastus medialis	Knee extension	300–130	30
Rectus femoris	Knee extension/Hip flexion	200–110	20
Soleus	Ankle stabilizer	340–270	90
Gastrocnemius	Ankle stabilizer/Knee flexion	350–270	110
Tibialis anterior	Ankle stabilizer/Ankle flexion	000--360	280
Sememimembranosus/Semitendenosus	Knee Flexion	010–230	100
Biceps femoris	Knee flexion/Hip extension	350–230	110

BICYCLE FIT GURU

Pedaling -- Pulling



Pulling RF 😊

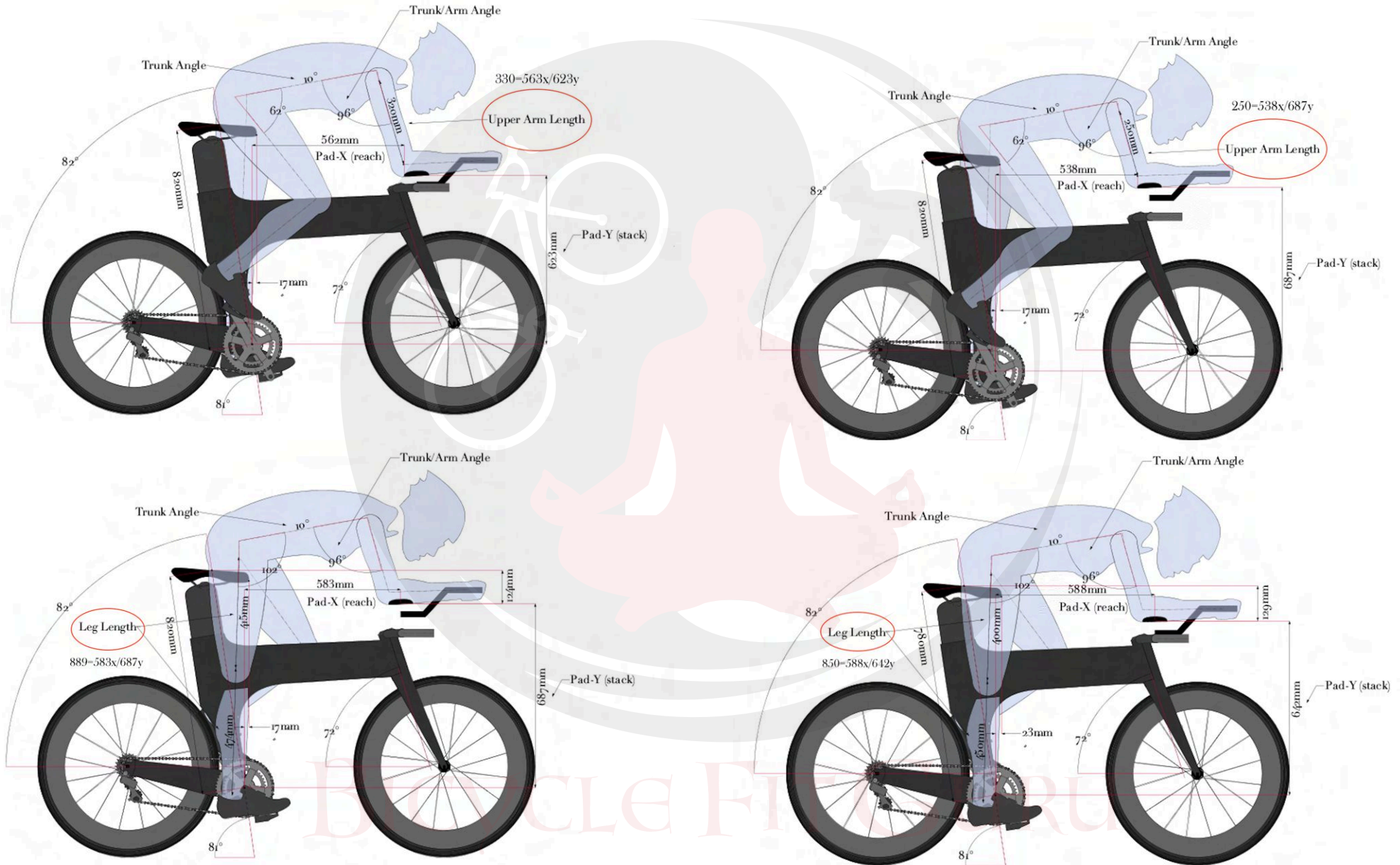


Beginner Triathlete



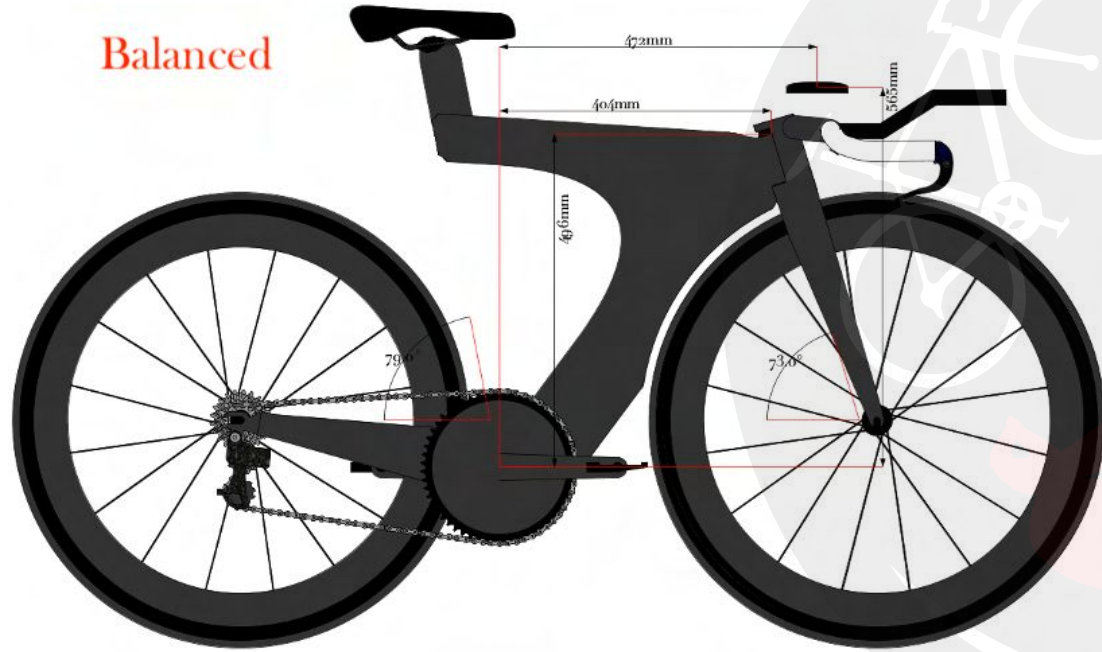
BICYCLE FIT GURU

Bike Fit -- Morphology

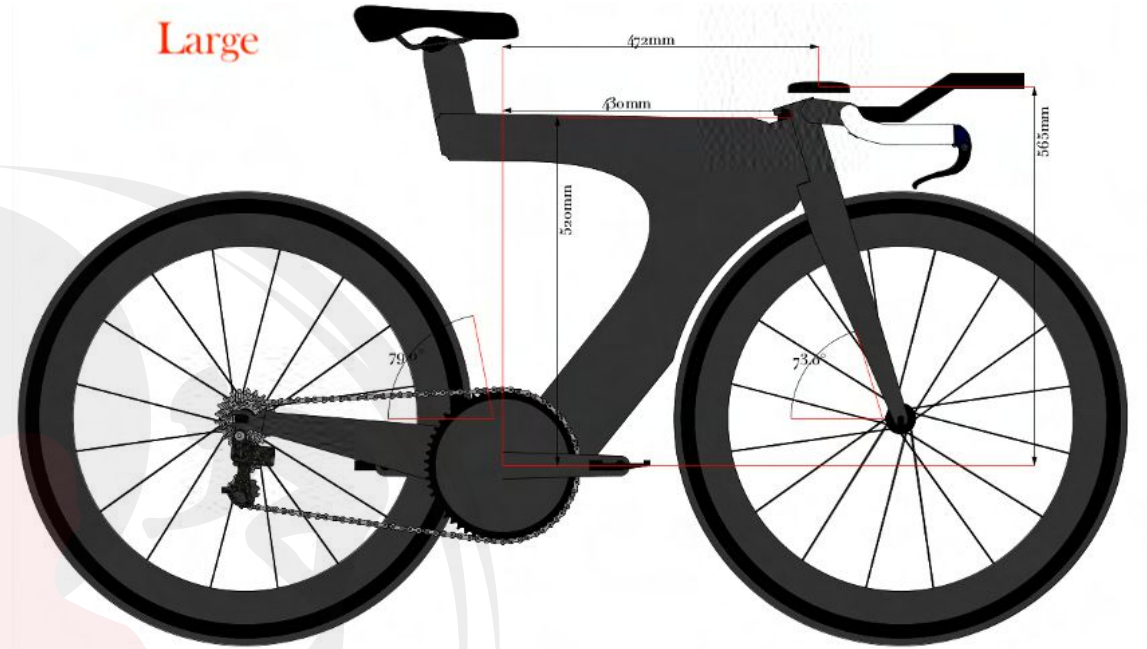


Pad Stack and Reach?

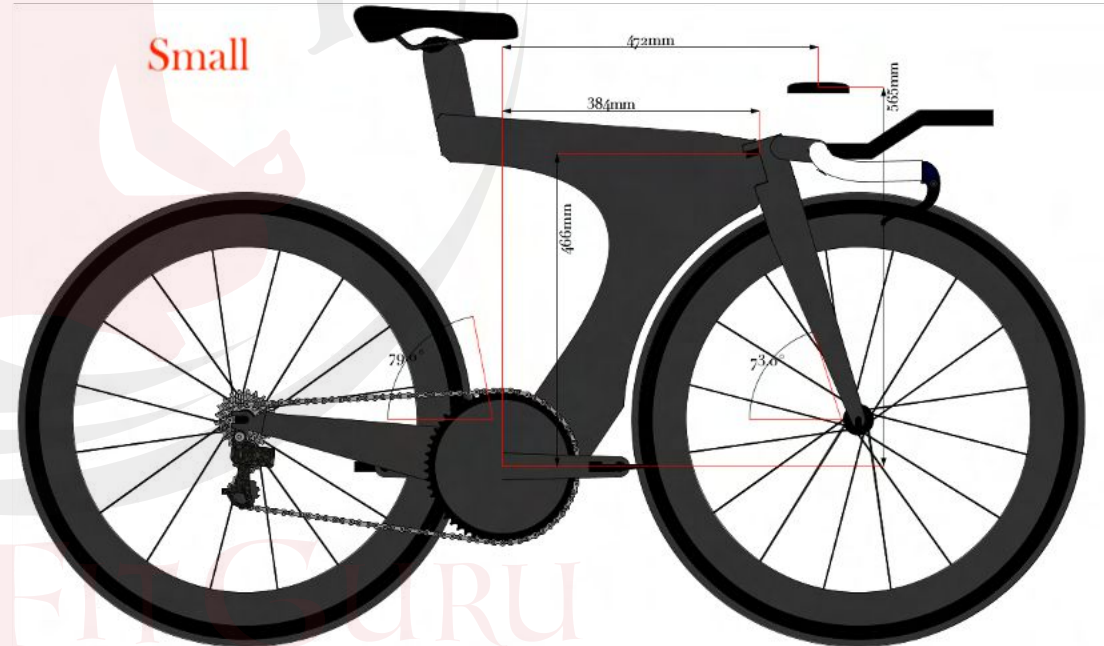
Balanced



Large



Small



What is good?



5-Min Aero Lesson



ITU Regulations



ITU

(ii) The races will be draft-legal or illegal according to this table:

	Junior and Youth	U23	Elite	Age Group	Paratriathlon Elite and Open
TRIATHLON					
Team Relay	Legal	Legal	Legal		
Sprint Distance	Legal	Legal	Legal	Both options	Illegal
Standard Distance		Legal	Legal	Illegal	Illegal
Middle and Long Distance			Illegal	Illegal	Illegal
DUATHLON					
Team Relay	Legal	Legal	Legal		
Sprint Distance	Legal	Legal	Legal	Both options	Illegal
Standard Distance		Legal	Legal	Illegal	Illegal
Middle and Long Distance			Illegal	Illegal	Illegal
AQUATHLON					
WINTER TRIATHLON (all distances)	Legal				
CROSS TRIATHLON AND DUATHLON (all distances)	Legal				
AQUABIKE				Illegal	

b.) Draft legal events:

- (i) It is forbidden to draft off a different gender athlete;
- (ii) It is forbidden to draft off a motorbike or vehicle.