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AMAZING FASCIA

The Role of Fascia in Endurance Running

The Storage of Elastic Energy

Part B

Areas of fascial interest

- This presentation will focus primarily on 3 key areas of connective tissue
  1. The thoracolumbar fascia
  2. The ITB and the fascia lata and
  3. The Achilles tendon complex
- The elastic recoil phenomenon whereby stored energy is then released for propulsion is an energy efficiency adaptation

Thoracolumbar fascia

- The thoracolumbar fascia is primarily important because it provides for the connection between:
  - the **gluteus maximus**
  - and contralateral latissimus dorsi muscles
- This fascial sheet and its deeper connections become tensioned by the muscular contractions **creating a tension within the fascia capable of force transfer and recoil**

Thoracolumbar fascia: **Superficial layer**

- The **superficial lamina** derives from the aponeurosis of latissimus dorsi and attach to the supraspinal ligaments and spinous processes to L4
- Below L4-L5 the **superficial lamina is continuous with the gluteus maximus & part of external oblique abdominal**
- And is attached to the sacrum, PSIS & iliac crest

Superficial Layer TLF

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Functional Importance of the TLF

- **Energizes the posterior oblique muscular sling**
- Connects the trunk to the pelvis and to the lower limbs
- It is primarily the various layers of the thoracolumbar fascia wrapping around the muscles which stabilise, support and move the lower back

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Understanding the iliotibial band

- ***The most common view of the ITB's function is to stabilise the pelvis in the frontal plane when tensed by the inserting muscles***
- **The ITB stores about 14% as much energy as the Achilles tendon during fast running**
- The notion that the ***ITB acts as a spring to aid locomotion*** runs counter to the decades old belief that its primary function is to stabilize the hip during walking

ITB: Specialised for elastic energy storage

- The iliotibial band (ITB) is a unique structure in the human lower limb
- derived from the fascia lata (FL) of the thigh
- and may contribute to locomotor economy
- **The ITB is not present in other apes and this almost certainly evolved independently in hominids**
- Which suggests that the ITB may be specialized to increase the endurance running capabilities in humans

ITB specialised for elastic energy storage

- Is the human iliotibial band (ITB) specialised for elastic energy storage relative to the chimpanzee fascia lata (FL)?

1. **<u>Chimps walk with persistent hip flexion</u>**

- **The TFL and portions of GMax that insert on the fascia lata undergo smaller excursions than muscles that insert on the human ITB**

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Human ITB: Length changes

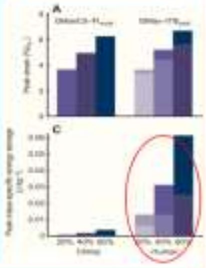
- In humans: The ITB MTUs undergo substantially greater length changes than the FL MTUs in the chimp model during bipedal walking
- The larger MTU excursion are not simply a result of larger human limbs

1. The data reflect differences between the moment arms of the chimp FL MTUs and the moment arms of the human ITB MTUs
2. As well as measured differences in hip and knees angles during walking

The human ITB has a great potential to store energy

1. Peak strain (% stretch of the ITB) was not dissimilar for both the human & chimp – Graph A
2. Activation of GMax had a significantly greater effect on the energy storage capacity of the ITB compared to the energy storage capacity in the chimp - Graph C

- **The elastic storage capacity in the human ITB increased substantially with 4 times as much elastic energy stored at 60% as with 20% activation of Gmax**



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Tendon elastic strain energy

- Data from gait experiments and musculoskeletal modelling at various speeds calculated:

1. Muscle tendon unit (MTU) work
2. Tendon elastic strain energy
3. Muscle fibre work for the ankle plantar-flexors

- 5 separate steady state speeds ranging from jogging ($2ms^{-1}$) to sprinting ($\geq 8ms^{-1}$)

Lai et al, 2014. Journal of Experimental Biology

Running speed, pace, distance

Speed ms^{-1}	Speed ms^{-1}	Time/ 1k m	5km pace	Projected Marathon
2ms	7.2km/hr	8:20/km	41min 40	5hr 50min
3ms	**10.8km/hr**	**5:33/km**	**27min 45**	**3hr 53min**
5ms	18km/hr	3:20/km	16min 40	2hr 20min

Olympic marathon winning times 2012, 2016: 2hr 08min

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