

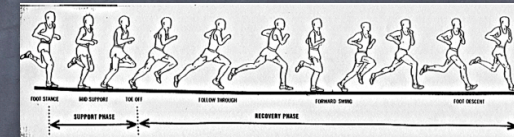
## Biomeccanica II

### Lez. BM9

Giovedì 30 Aprile 2009 14:15:30

Luca P. Ardigò

### Fasi della corsa



### Walking vs. Running

#### Camminata vs corsa

##### Camminata:

- Fase di doppio supporto
- Il CM raggiunge la massima altezza quando l'anca è sopra la caviglia (midstance);  
Nello stesso istante la velocità di progressione è minima

Durante lo swing l'energia meccanica varia poco

##### Corsa:

- Fase aerea con velocità di progressione costante
- Il CM raggiunge la minima altezza quando la velocità di progressione è minima

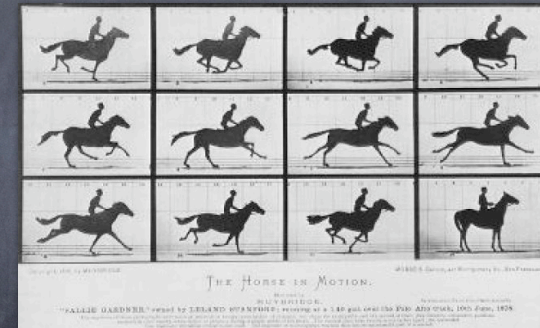
Durante lo swing grandi fluttuazioni di energia meccanica



www.sporting-heroes.net

## Corsa

- La corsa è l'andatura a piedi più veloce negli animali;
- è un'andatura durante la quale, in una certa fase del ciclo, entrambi i piedi si trovano contemporaneamente in volo; ed
- è una forma di esercizio sia anaerobica e sia aerobica.



## Movimento degli arti inferiori

- La corsa è una sequenza di passi alternativamente sinistri e destri;
- ogni passo è costituito da: supporto e spinta (contatto), e recupero (volo); e
- durante ogni (a singolo piede) contatto, un piede è in recupero e durante ogni (a doppio piede) volo, entrambi i piedi sono in recupero.

## Supporto

During the support phase, the foot is in contact with the ground and supports the body against gravity. The body's center of mass is typically somewhere in the lower abdominal area between the hips. The supporting foot touches ground slightly ahead of the point that lies directly below the body's center of mass. The knee joint is at its greatest extension just prior to the support phase; when contact is made with the ground, the knee joint begins to flex. To what extent it flexes varies with the running style. There exist stiff-legged running styles which reduce knee flexion, and looser, or more dynamic running styles which increase it (*vispa ferens*). As the supporting leg bends at the knee, the pelvis dips down on the opposite side. These motions absorb shock and are opposed by the coordinated action of several muscles. The pelvic dip is opposed by the ilio-tibial band of the supporting leg, the hip abductor, and the abdominals and lower back muscles. The knee flexion is opposed by the eccentric contraction of the quadriceps muscle. The supporting hip continues to extend and the body's center of mass passes over the supporting leg. The knee then begins to extend, and the opposite hip rises from its brief dip.

## Spinta

The drive leg extends at the knee joint, and at the hip, such that the toe maintains contact with the ground as that leg trails behind the body. The foot pushes backward and also down, creating a diagonal force vector, which, in an efficient running style, is aimed squarely at the runner's center of mass. Since the diagonal vector has a vertical component, the drive phase continues to provide some support against gravity and can be regarded as an extension of the support phase. During the drive, the foot may extend also, by a flexing of the soleus and gastrocnemius muscle in the calf. In some running styles, notably long-distance "shuffles" which keep the feet close to the ground, the ankle remains more or less rigid during drive. Because the knee joint straightens, though not completely, much of the power of the drive comes from the quadriceps muscle group, and in some running styles, additional power comes from the calves as they extend the foot for a longer drive. This motion is most exhibited in sprinting.

## Recupero

When the driving toe loses contact with the ground, the recovery phase begins. During recovery, the hip flexes, which rapidly drives the knee forward. Much of the motion of the lower leg is driven by the forces transferred from the upper leg rather than by the action of the muscles. As the knee kicks forward, it exerts torque against the lower leg through the knee joint, causing the leg to snap upward. The degree of leg lift can be consciously adjusted by the runner, with additional muscle power. During the last stage of recovery, the hip achieves maximal flexion, and, as the lower leg rapidly unfolds, which it does in a passive way (**paradosso degli estensori\***), the knee joint also reaches its greatest, though not full, extension. During this extension of the leg and flexion of the hip, the hamstring and gluteal muscles are required to rapidly stretch. Muscles which are stretched respond by contracting by a reflex action. Recovery ends when the foot comes into contact with the ground, transitioning again into the support phase.

\* paradosso degli estensori = quadricipite off

## Movimento degli arti superiori

- I movimenti della parte superiore del corpo sono funzionali al mantenimento di equilibrio (compensazione rotazionale) e progressione;
- gli arti superiori possono non essere coinvolti (velocità bassa), ma colonna vertebrale e spalle no;
- movimenti reciproci ( $W_{int}$ ) e;
- maggiore è la velocità e maggiori sono i movimenti compensatori (sprinters vs. endurance).

## 'Buona tecnica'

- **Postura eretta e 'lieve sporgersi in avanti'**;
  - 'sporgersi un po' in avanti' a) sposta il BCOM tanto quanto basta per atterrare non 'di tallone', bensì più 'di punta', potendo così sfruttare l'elasticità dell'arco plantare, e b) evita un atterraggio anteriore alla posizione
  - sempre del BCOM - con conseguente frenata;
- **frequenza di passo ottimale**;
  - nei 'corridori' di livello, la frequenza di passo è costante ( $185\pm 200 \text{ min}^{-1}$ ) e la differenza di velocità (distanza e tempo) è ottenuta per lo più per mezzo di una variazione della lunghezza del passo stesso (velocità = passi o  $\text{km}^{-1}$ );

## 'Buona tecnica' /2

### - movimento 'rotondo':

(es. Africani dell'Africa Orientale); e

### - corsa vs. marcia;

- correndo, si paga più DM a parità di distanza (più Cal e meno 'efficienza effettiva'), ma si va più lontano a parità di tempo (aumento velocità <- cambio andatura).

## Infortunati

- Data la sua natura di esercizio 'a medio-alto impatto', vi sono molti tipi di infortunio:

- 'ginocchio del corridore', sindrome della loggia tibiale anteriore, stiramento (ischiocrurali), irritazione al capezzolo, slogatura della caviglia, sindrome della fascia iliotibiale, fascite plantare e tendinite al tendine d'Achille; e

- frattura da stress;

- contromisure: riscaldamento, scarpe adatte, buona tecnica di corsa, allenamento della forza e riposo; ed

- anche stretching (pre **ni**, post **si**).

## Jogging

- Vago, corsa lenta o 'corsetta' (US, 1960s e 1970s, roadwork -> UK, jogging -> running).

## Sport

- 'essenziale' o parte/allenamento di altri sport con componenti di corsa o resistenza;

- come sport in se stesso, diverse distanze ma anche variazioni (ostacoli e siepi); e

- probabilmente da sempre (già nel programma dei Giochi Olimpici antichi).

## Corse agonistiche

- Corsa in pista;

- corsa su strada;

- corsa campestre;

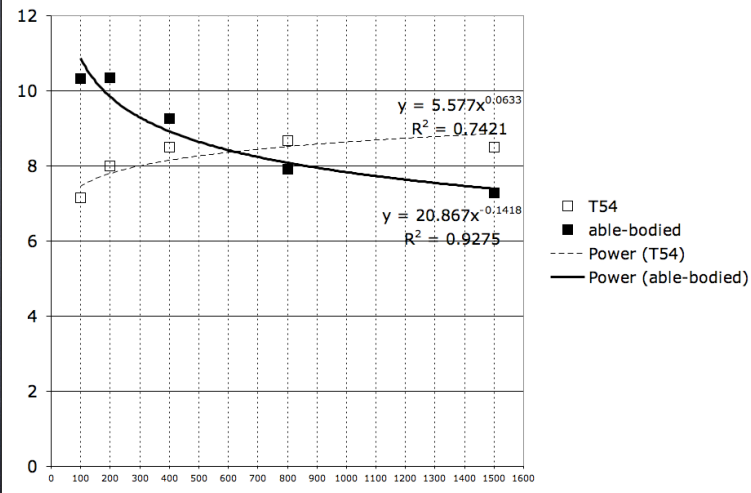
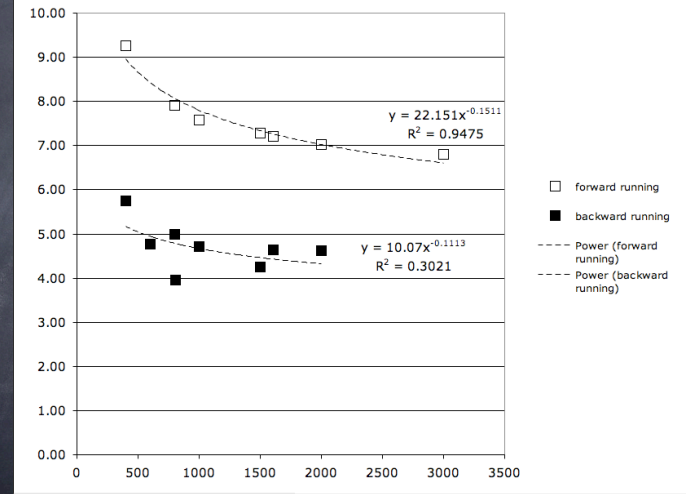
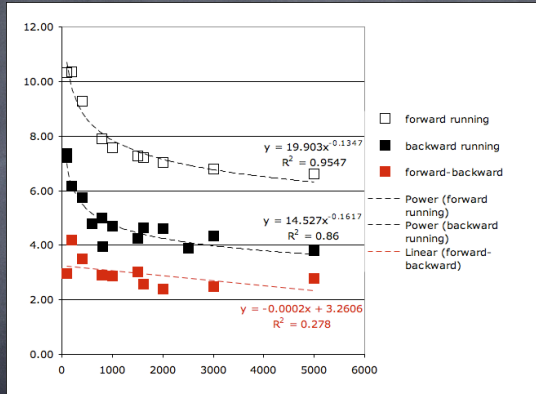
- trail running;

- sky running;

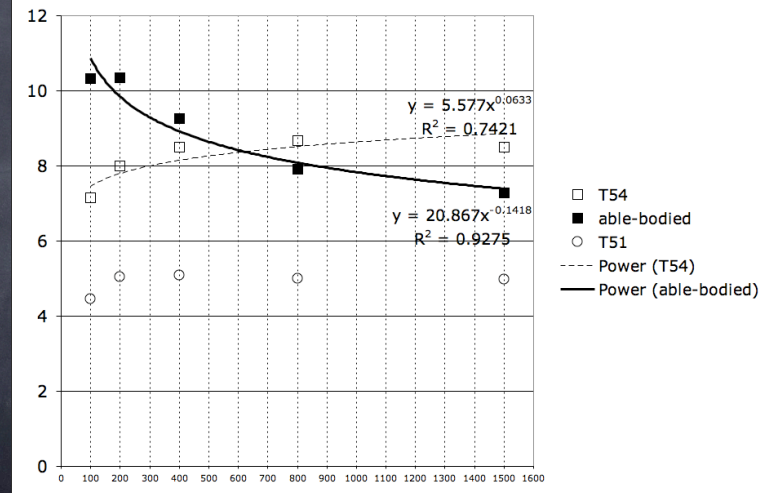
- fell running;

- staffetta; e

- corsa all'indietro.

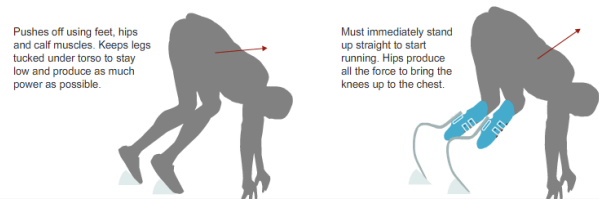


Normalmente abili (?) vs. T54



### Comparing an Amputee and an Able-Bodied Runner

The two runners differ mainly in their burst from the blocks and their stride.



Pushes off using feet, hips and calf muscles. Keeps legs tucked under torso to stay low and produce as much power as possible.

Must immediately stand up straight to start running. Hips produce all the force to bring the knees up to the chest.

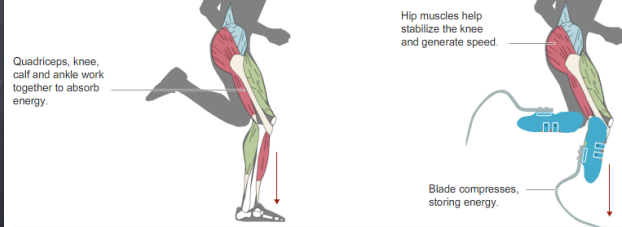
Sources: Dr. Robert Galley, University of Miami; Frank Angulo drawings, Oesur

The New York Times

### The Stride: Foot Strikes the Ground

Deceleration and energy absorption occurs.

- Power-producing contractions
- Energy-absorbing contractions
- Stabilizing contractions



Quadriceps, knee, calf and ankle work together to absorb energy.

Hip muscles help stabilize the knee and generate speed.

Blade compresses, storing energy.

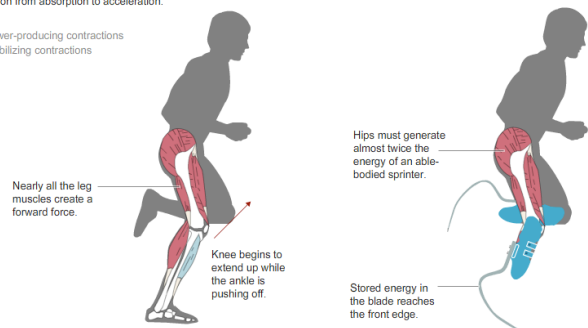
Sources: Dr. Robert Galley, University of Miami; Frank Angulo drawings, Oesur

The New York Times

### Mid Stance

Transition from absorption to acceleration.

- Power-producing contractions
- Stabilizing contractions



Nearly all the leg muscles create a forward force.

Knee begins to extend up while the ankle is pushing off.

Hips must generate almost twice the energy of an able-bodied sprinter.

Stored energy in the blade reaches the front edge.

Sources: Dr. Robert Galley, University of Miami; Frank Angulo drawings, Oesur

The New York Times

### Take Off

The acceleration or speed-generation phase.

As the foot pushes off, the lower leg generates more than twice the energy that was stored when the foot struck down.

Energy in the blade releases like a spring, propelling the runner forward. Only 80 percent of the energy stored in the compression phase is released.

Sources: Dr. Robert Galley, University of Miami; Frank Angulo drawings, Oesur

The New York Times