MUSCLE SORENESS AND MUSCLE CRAMPS

By Caroline Hempel

Acute Muscle Soreness

Muscle pain during or immediately after exercise is often presented as muscle stiffness, aching or tenderness. Unless there is a pre-existing injury acute muscle soreness can occur due to lactate accumulation and tissue oedema. In heavy endurance training oedema leads to muscle swelling. This pain often disappears within several hours of rest.

Delayed-Onset of Muscle Soreness (DOMS)

DOMS occur a day or two after intensive exercise and can vary from mild muscle stiffness to severe debilitating pain. In general DOMS are induced by structural damage to the muscle (micro-trauma) and also to the surrounding connective tissue. There can be remarkable damage to the muscle tissue after a marathon competition. As you can see in Figure 5.14 there is a major disruption in the muscle filaments.

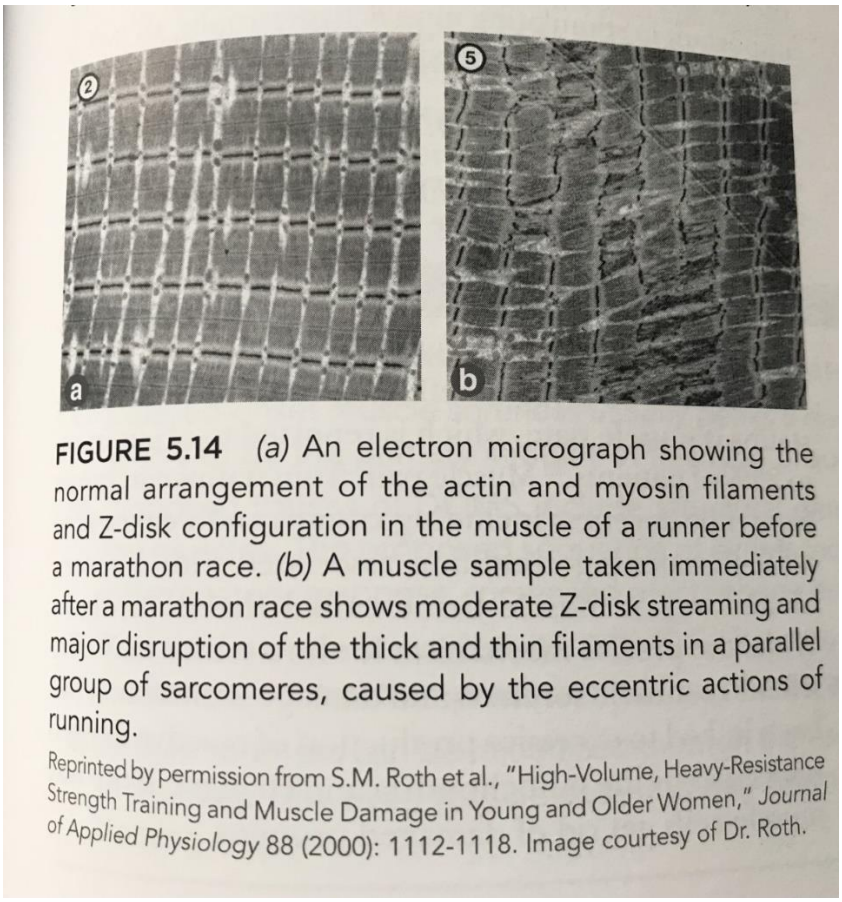

FIGURE 5.14 *(a)* An electron micrograph showing the normal arrangement of the actin and myosin filaments and Z-disk configuration in the muscle of a runner before a marathon race. *(b)* A muscle sample taken immediately after a marathon race shows moderate Z-disk streaming and major disruption of the thick and thin filaments in a parallel group of sarcomeres, caused by the eccentric actions of running.

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Muscle cell injury leads to an acute inflammatory response that is accompanied by oedema, recruitment of inflammatory cells and electrolyte shifts into the area that we experience as pain, tenderness and tissue swelling. With the muscle injury there is a considerable decrease in force-producing capacity of those muscles due to the anatomical disruption of muscle filaments, loss of contractile elements and an impacted excitation-contraction coupling process.

This degree of muscle damage and strain to the connective tissue surrounding the muscles requires time to regenerate (recovery is important!). The restoration of muscle glycogen which normally occurs within 12 hours is also significantly impaired as the muscle undergoes significant repair.

It is often impossible to fully avoid DOMS even if we start training at low intensity. Furthermore the factors associated with DOMS actually initiate trainings effects and muscle hypertrophy, however if pain and muscle damage become too severe it will have negative effects on trainings ability or causes chronic injuries particularly within the connective tissue (fascia) that is much less able to regenerate quickly and completely.

Exercise-associated Muscle Cramps (EAMCs)

EAMs are defined as painful, spasmodic and involuntary muscle contractions and often occur during times of muscle fatigue or exhaustion. Lack of conditioning, improper training, dehydration, depletion of muscle energy stores and electrolytes are factors associated with muscle fatigue and can lead to EAMs.

There are 2 different theories explaining EAMs, firstly the neuro-muscular control theory that explains EAMs based on abnormalities in the muscle innervation (abnormal firing of alpha motor neurons) and reduced inhibitory feedback in a fatigued muscle. Secondly the electrolyte depletion theory explains EAMs through the loss of electrolytes (mainly sodium and chloride) and dehydration with intense sweating that leads to "heat cramps".

Both types of cramps can be treated firstly by stretching of the muscle that increases muscle tension (tension of the Golgi-tendon organ within the muscle) that leads to inhibition of the overly active alpha motor-neurons. Heat cramps can be treated by drinking a high salt solution (3 g of sodium in 500ml of fluid every 10 min and then smaller amounts continued throughout the day).

To avoid EAMs we should:

- be well conditioned for the intensity of exercise.
- regularly stretch the muscles.
- maintain fluid and electrolyte status.
- maintain carbohydrate stores in our muscles (eat well at least 1.5 hours before the exercise to allow the body to digest the food and allow energy storage in the muscle).