Elastic energy storage in tendons

Elastic strain energy is stored and released from long, distal tendons such as the Achilles during locomotion, reducing locomotor energy cost by minimising muscle shortening distance and speed ...

In general, the hindlimb contributed two-thirds and the forelimb one-third to overall energy storage. Comparison of tendon elastic energy savings with mechanical work showed a maximum 40% recovery of mechanical work by elastic savings when the horses changed gait from a walk to a slow trot. Percentage of recovery then decreased with increased ...

The viscous component for mineralized turkey tendons was about the same as that of self-assembled collagen fibers aged for 6 months, a result suggesting that addition of mineral does not alter the viscous properties of tendon. It is concluded that elastic energy storage in tendons involves direct stretching of the collagen triple-helix ...

The differences in material properties between mature flexor and extensor tendons are correlated with their physiological functions, i.e., the flexor is much better suited to act as an effective biological spring than is the extensor. We investigated the possibility that tendons that normally experience relatively high stresses and function as springs during locomotion, such ...

It is shown by means of a generalized model that muscles and tendons could both be important as elastic energy stores for large mammals, and that these conclusions presumably apply to large mammals in general. Large mammals save much of the energy they would otherwise need for running by means of elastic structures in their legs. Kinetic and potential energy, lost at one ...

Patellar and Achilles tendon capacity to utilize elastic energy storage and release was assessed in the same positions in which subjects performed maximal voluntary ...

Allometry of muscle, tendon, and elastic energy storage capacity in mammals Am J Physiol. 1994 Mar;266(3 Pt 2):R1022-31. doi: 10.1152/ajpregu.1994.266.3.R1022. ... Consequently, the capacity for elastic energy storage scales with positive allometry in these tendons but is isometric in the digital extensors, which probably do not function as ...

It is concluded that mineralization is an efficient means for increasing the amount of elastic energy storage that is required for increased load-bearing ability needed for locomotion of adult birds. Animals store elastic energy in leg and foot tendons during locomotion. In the turkey, much of the locomotive force generated by the gastrocnemius muscle is stored as elastic energy during ...

al., 1977). This capacity for elastic energy storage and recovery has been broadly investigated, with highly effective "biological springs" present across a range of terrestrial mammals ... animals implies greater tendon deformation and thus increased potential for elastic energy storage and recovery via tendon recoil (Alexander, 1984). For ...

Furthermore, these alterations in elastic properties occur to a significantly greater degree in the high-load-bearing flexors than in the low-stress extensors. At maturity the pig digital flexor tendons have twice the tensile strength and elastic modulus but only half the strain energy dissipation of the corresponding extensor tendons.

Elastic energy storage is an extremely important mechanical characteristic of collagenous tissues, tendons and ligaments are examples of musculoskeletal tissues that store and transmit energy ...

estimate tendon stress and elastic energy storage. We nd that moment arm length signicantly determines the spring-like behavior of the Achilles tendon, as well as estimates of mass-specic

Besides the important tendon energy recoil during the propulsion phase (7.8 to 11.3 J), we found a recoil of elastic strain energy at the beginning of the stance phase of running (70-77 ms after ...

Muscles and tendons play a significant role in elastic energy storage, where tendons can act like springs, storing energy during the eccentric phase of movement. Proper technique in exercises like squats and jumps can improve the efficiency of elastic energy utilization, resulting in better overall strength output.

For example, grasshoppers store energy as potential energy in an elastic material in their tendons. When they need to jump, that energy converts into kinetic energy, providing the force needed to escape predators. ... The presence of elastic energy storage and recoil in submaximal jumps may also be informative in future investigations into the ...

Calculations of elastic strain energy storage based on tendon stress showed similar patterns of increase with change of speed and gait, with the greatest contribution to elastic savings by the DDF ...

Muscle and tendon energy storage represents the strain energy that is stored within a muscle-tendon complex as a muscle and tendon are stretched by the force developed by the muscle when it contracts. This energy may be subsequently recovered elastically when the muscle relaxes.

Both the elastic spring constant and the elastic energy stored, calculated up to a strain of 20%, were found to be proportional to tendon mineral content. It is concluded that mineralization is an efficient means for increasing the amount of elastic energy storage that is required for increased load-bearing ability needed for locomotion of ...

We investigated the possibility that tendons that normally experience relatively high stresses and function as springs during locomotion, such as digital flexors, might develop different ...

It is widely believed that elastic energy storage is more important in the locomotion of larger mammals. This is based on: (a) comparison of kangaroos with the smaller kangaroo rat; and (b) calculations that predict that the capacity for elastic energy storage relative to body mass increases with size.

Elastic energy storage in muscle and tendon is important in at least three contexts (i) metabolic energy savings derived from reduced muscle work, (ii) amplification of muscle-tendon power during jumping, and (iii) stabilization of muscle-tendon force transmission for control of movement.

Yet, the proposed role for elastic energy storage and recovery is the reduction of muscle work, and at least for one study of frog muscles, it does not appear that replacing muscle work with tendon work reduces cost (Holt et al., 2014). We have more to learn about the energetic significance of elastic energy storage and recovery in cyclic motions.

One common explanation for why AEL should enhance power is that increased load in the eccentric phase amplifies elastic energy storage in the tendon and aponeurosis, which can be released in the concentric phase . For instance, AEL CMJ may result in greater force generation in the descent to decelerate the added mass or resist the added force ...

These tendons differ from more proximally located tendons, not only in their length but also their strain energy storage capacity (higher), failure/injury rating (higher force and strain yield points), and hysteresis (lower) or elastic modulus (higher) (Thorpe et al., 2015).

Muscle work is effectively performed when force is transmitted via stiffer tendons while it is minimized with tendons returning high amounts of elastic energy (1). Also tendon design can influence ...

A morphometric analysis of the digital muscles provides an estimate of maximal in vivo tendon stresses and suggests that the muscle-tendon unit of the digital flexor is designed ...

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Tendon and ligament compliance allows elastic energy to be stored and returned to offset energy fluctuations of the body''s center of mass during locomotion, conserving muscle work and reducing the metabolic energy cost of locomotor movement. Tendon architecture greatly affects the storage and recovery of elastic strain energy, with long, thin ...

An important difference between the elastic behavior of spring elements within muscles versus those in tendons is that energy storage is coupled to muscle length change for intramuscular ...

in the muscles and tendons that are stretched by the impact with the ground. Elastic recoil in the tendons converts most of the stored energy into kinetic energy as the foot leaves the ground [1, 2]. In contrast to the energy storage function of tendon, ligaments absorb energy during movement in order to protect joints from damage.

Our results provide support for the relationship between short Achilles tendon moment arms and increased elastic energy storage, providing an empirical mechanical ...

Labonte and Holt provide a comparative account of the potential for the storage and return of elastic stain energy to reduce the metabolic cost of cyclical movements. They consider the properties of biological springs, the capacity for such springs to replace muscle work, and the potential for this replacement of work to reduce metabolic costs.