

Some Things to Think About In Regards to Skeletal Muscles

These are thought questions. I will not post answers. I am willing to discuss them only if it is obvious to me that you have thought about them and tried to answer them. They can be discussed in either class, lab, review sessions, or office hours.

1. We have looked at a mechanical model of skeletal muscles. In this model, the same physical structures (for instance, the contractile fibrils) and may have two or more different functions assigned to them? Many people find this confusing. What does the model seek to clarify -- the relationship between mechanical features of the muscle or the structural relationships of muscle parts (does the model do one, the other, both or both but one with primacy)? Explain the usefulness of such models.
2. When a load is applied to a contracting muscle, such that it is stretched beyond L_0 , we say that negative work (work done on the muscle) has been done on the muscle.
 - When negative work is performed on a contracting muscle, what must be true of the magnitude of the externally applied force as compared to the force generated by the contractile elements of the muscle?
 - When negative work is done on a contracting muscle, if the work is not too great, the muscle does not usually fail and the overload is supported. Which of the functional parts of the muscle absorb the overload. (As one example, think about the leg muscles that act like springs -- see Schmidt Nielson). Give at least one example of normal use of muscle where external factors cause a contracting muscle be at a length greater than L_0 .
3. A muscle contracts and shortens slightly and then stops shortening but continues contracting and exactly supports a 500 N force. Give the force in:
 - (a) the parallel elastic elements
 - (b) the series elastic elements
 - (c) how much force is generated by the contractile elements?
 - (d) give the lengths (relative to rest) of the PEE, SEE, and CE.

ANS.: (a) 0 N; (b) 500 N; (c) 500 N; (d) PEE are shorter, SEE are longer, and CE are shorter.

Incidentally, explain how the myofilaments can be in both the SEE and CE and get both longer and shorter at the same time. Puzzle this one out on paper; no answers from me unless it is clear that you have put a good amount of effort in on this.

4. Are all motor units of one subtype activated together? How about before the next larger subtype? What are the contractile characteristics of type I vs. type II

motor units? Why is it that the increment of force from activating type I motor units is similar to that of activating type II motor units -- given the great differences in force per fiber?