Sex inequity in tendon metabolism?

Our understanding of most structural and metabolic aspects of human connective tissue structures, like tendons, has been relatively limited because of a lack of methodologies to study the tendon in humans outside of surgical injury repair or noninvasive imaging techniques. Recently, however, new tendon biopsy (5, 7–10), stable isotope tracer (1, 8), and imaging (3, 4, 11) techniques have been introduced. As evidenced by Miller et al. (7) in this issue of the Journal of Applied Physiology and recent work by this group and others, it is clear that these new methodologies will allow for a significant expansion of our understanding of tendon physiology and metabolism. The impact will likely be similar to the muscle biopsy technique reintroduction over 40 yr ago (2), which researchers coupled with biochemistry, stable isotope tracer, and molecular biology techniques to greatly expand our understanding of skeletal muscle adaptations.

In recent years, it has been realized that the connective tissue component of the musculotendinous structures is metabolically active and responsive to physical activity, which may play a role in the etiology of and recovery from overuse injuries. Because evidence suggests that women are more susceptible to injuries of tissues that have a large collagen component, such as tendons and ligaments, it is likely that the structure and/or metabolism of these tissues may be different between women and men. The paper in this issue of the Journal of Applied Physiology by Miller et al. (7) addresses the hypothesis of gender differences in tendon metabolism by directly measuring the patellar tendon collagen synthesis in women and comparing these data with similar data previously collected by these investigators in men (8). Using the aforementioned recently developed tracer and tendon biopsy techniques, they show that the resting synthesis rate of patellar tendon collagen is significantly lower in women than men. They also show that the large increase in tendon collagen synthesis seen in men for up to 72 h following a strenuous bout of aerobic exercise is significantly less in women, if they even respond at all. That is, fewer time points were studied in the women than the men, with the women showing no change in tendon collagen synthesis at 72 h after the exercise bout. Data on the women and men from microdialysis measurements made near the tendon, as well as the fact that the men showed a peak increase in tendon collagen synthesis earlier than 72 h (at 24 h), suggest that the women likely do respond to an aerobic exercise stimulus. Apparently, the “area under the curve” for the collagen synthesis response after exercise is much less in women than in men.

An obvious difference between men and women is the menstrual cycle hormones, which in animals and isolated tissues appear to play a role in tendon metabolism. The study by Miller et al. (7) also examined the possibility that hormone levels in the different phases of the menstrual cycle may influence tendon collagen metabolism in humans. They were unable to show a menstrual cycle effect on tendon collagen synthesis, which is similar to what they have shown for muscle collagen synthesis following a similar 1-h aerobic exercise bout (6). Thus other factors must cause the differences between women and men in resting and postexercise tendon collagen synthesis.

These findings and methodologies have profound implications for sports medicine clinicians, physical therapists, and exercise physiologists. We now have some insight and tools that will allow us to further determine how tendons adapt to increased and decreased activity levels. More specifically, these findings imply that if tendon collagen turnover is related to the recovery from injury and if activity is part of the rehabilitation process, a different strategy and a different time course of rehabilitation and recovery may need to be considered for women compared with men.

References

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