Dietary Strategies to Attenuate Muscle Loss during Recovery from Injury

Kevin D. Tipton

Impairments in muscle size, strength and function often result from athletic injuries. Injuries resulting in reduced training and immobilization of the injured limb will lead to loss of muscle mass and function. One aspect of recovery that is often overlooked is nutrition.

Inflammation

Immediately following a severe injury, an inflammatory response is initiated. The type and severity of the injury will determine the magnitude and duration of this response. Given that inflammation may be crucial for healing, elimination of the inflammation by nutritional or pharmacological means is unlikely to be ideal for healing.

Loss of Muscle Mass during Immobility

The most obvious result is loss of muscle function resulting from changes in tendon and loss of muscle mass. The primary metabolic factor leading to muscle loss is a decrease in the rate of myofibrillar protein synthesis [1]. Nutritional interventions should focus on alleviating, as much as possible, the decrease in rates of muscle protein synthesis so that both the magnitude and duration of periods of negative muscle protein balance will be minimized.

Anabolic Resistance

The response of muscle to anabolic stimuli, in particular protein ingestion, is reduced during immobility [1]. Thus, the effectiveness of protein ingestion is impaired. It is possible that higher doses of protein intake may be important at any given meal. However, there is a limit to the amount of

protein that can be used for muscle protein synthesis at any one time [2]. Thus, more than ~30 g of protein in one sitting should be the maximum amount.

There is preliminary evidence that leucine and omega-3 fatty acids also may help overcome the resistance of muscle protein synthesis to anabolic stimuli. However, to date, no study has specifically examined the impact of ingesting these substances on muscle protein synthesis and muscle loss in humans.

Energy Intake

Another important consideration during injury-induced immobilization is the appropriate energy intake. Total energy expenditure likely will decrease during immobility. However, the healing process increases energy expenditure – particularly early on and if the injury is severe – by up to as much as 20%. Moreover, ambulation by crutching is more energy expensive than walking [3]. So, the decrease in overall energy expenditure will depend a great deal on the activity level of the injured athlete. Thus, whereas energy expenditure may still be less than during training, the total may not be as low as many may assume.

Finally, energy intake during immobilization also may have an impact on muscle protein synthesis. Care should be taken to ensure that any decrease in energy intake is not so much that optimal muscle protein synthesis is unsupported. Clearly, the proper balance should be sought to avoid too much weight gain, yet support proper healing.

Bone, Tendons and Ligaments

Bone, tendons and ligaments are important for exercise performance and also are impacted negatively by immobilization. The connective tissue protein collagen is the primary component of tendons and ligaments, as well as bone. Decreased collagen synthesis from immobilization results in changes in tendon mechanical properties. Bone collagen synthesis, an important aspect of bone healing, responds to increased amino acid levels [4]. Certainly, sufficient intake of calcium and vitamin D is important for optimal healing.

Conclusions and Recommendations

Limb immobilization from injuries has profound implications for muscle and tendon metabolism leading to loss of muscle size, strength and function. Nutrient deficiencies, including energy and protein, should be avoided (fig. 1). Perhaps a 'first do no harm' or risk/benefit concept is

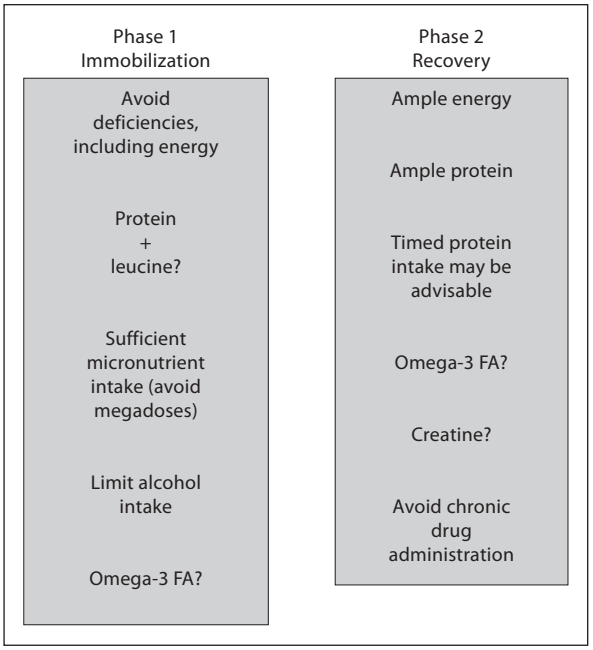

Fig. 1. Summary of nutritional suggestions for immobilization and rehabilitation phases after an activity-induced injury. FA = Fatty acids.

the best recommendation. Thus, a well-balanced diet with ample fruits and vegetables likely will not go amiss. Potentially, increased leucine and fish oil intake may be helpful to ameliorate muscle loss.

References

1 Glover EI, Phillips SM, Oates BR, et al: Immobilization induces anabolic resistance in human myofibrillar protein synthesis with low and high dose amino acid infusion. J Physiol (Lond) 2008;586:6049–6061.
2 Moore DR, Robinson MJ, Fry JL, et al: Ingested protein dose response of muscle and albumin protein synthesis after resistance exercise in young men. Am J Clin Nutr 2008;89:161–168.
3 Waters RL, Campbell J, Perry J: Energy cost of three-point crutch ambulation in fracture patients. J Orthop Trauma 1987;1:170–173.
4 Babraj JA, Cuthbertson DJ, Smith K, et al: Collagen synthesis in human musculoskeletal tissues and skin. Am J Physiol Endocrinol Metab 2005;289:E864–E869.