OVERVIEW

- Muscle tissue – minimize atrophy
- Connective tissue
- Bone
- Inflammation & Pain
- Energy
Metabolic and Functional Consequences of Immobilization Following an Exercise-Induced Injury
Muscle Proteins

Amino Acids

Muscle Protein Synthesis

Muscle Protein Breakdown

1-2%/d (300-600 g)

Mechanical load

Amino Acids

Amino Acids
How much muscle do you think can be lost per day when your leg is in a cast?
1-2 Weeks of Immobilization:

- Healthy, inactive muscle atrophies ~0.5% per day
- 150-400 g muscle can be lost
- Strength decreases at 3x the rate muscle tissue is lost

IMMOBILIZATION

Resulting In:

↓ **MPS**

**Anabolic resistance**
*(decreased response to protein)*

↓ **Calories** accelerates muscle loss

Immediate need for countermeasures to decrease atrophy & support rehabilitation

Usually little/no exercise intervention

Need non-exercise strategies

Alleviate anabolic resistance through nutrition
Protein Intake Helps to Manage Anabolic Resistance

- 1.6-2.5 g/kg/d protein
- 20-40 g every 3-4 h
- Pre-Sleep (casein?)
- Leucine

Building block for new muscle

Signaling molecule to initiate muscle protein synthesis

Figure 4: The ‘leucine trigger’ concept with data adapted from (Tang et al., 2009) as shown for whey protein, soy protein, and casein proteins. These proteins would be digested in the following order: whey > soy >> casein, and the following leucine content: whey > casein > soy. Thus, a greater and more rapid rise in blood leucine triggers a greater rise in MPS.
OTHER NUTRITIONAL CONSIDERATIONS

- **HMB?** (3 g/d)
- **Creatine?** (20 g/d)
- **Fish oil?** (4-5 g/d)
OTHER NUTRITIONAL CONSIDERATIONS

**HMB**
- b-hydroxyl-b-methylbutyrate
  - Metabolite of leucine
  - May increases MPS, decrease breakdown
  - Preserved muscle mass during bed rest in older adults
  - Likely not beneficial for healthy athletes; more research needed during injury

**Creatine**
- Slowed loss of muscle during 7 d upper arm immobilization
- Did not preserve muscle or strength during 7 d leg immobilization

**Fish Oil**
- May promote anabolism by increasing sensitivity to amino acid ingestion
- In one study, slowed decreases in muscle thickness, arm girth and BMC during arm immobilization

• 20-40 g (≈0.25-0.3 g/kg) protein shortly after each rehab session
• Leucine-rich, complete protein
• Regular protein intake pattern
• Limit/avoid alcohol

EXAMPLE STUDY

30 individuals
ACL injury

3x/week
12 weeks

PRO (10 g)

Post-exercise protein improved:

Quadriceps CSA

Peak torque

*With only 10 g protein!

Vitamin C 48 mg + Amino Acids (proline, lysine, hydroxyproline, hydroxylysine) = ↑ collagen synthesis

Gelatin (15 g)
1 hour prior to 6 min rope skipping

Dr. Keith Baar
UC Davis
Consuming Vitamin C-enriched gelatin or a collagen supplement prior to rehab exercises may help promote healing of connective tissue.

Dr. Keith Baar
UC Davis
How to Deliver Gelatin: Gummie Recipe from Dr. Baar.
Ensure consumption of the RDA for calcium (1000 mg/d)

Consider assessing Vitamin D status

Consume adequate calories
Acute inflammation important for wound healing

Chronic inflammation impairs recovery

Analgesics target inflammatory pathways
In an otherwise healthy athlete, an injury is unlikely to cause uncontrolled inflammation.

Use caution and judgement when suggesting anti-inflammatory foods in the acute phase post-injury.
Do you think an athlete should restrict calories when injured? Why or why not?
Ensuring the right energy balance promotes healing

Measure RMR if possible

Monitor for significant changes in body weight
Resting EE may increase ~15-50% with injury

Crutching increases EE 2-3x

Energy needs of healing

Reduced activity
Summary

“The single most important nutritional consideration during reduced muscle activity and/or immobility is to avoid nutrient deficiencies. Deficiencies of energy, vitamins, minerals and macronutrients—particularly protein—will impair wound healing and exacerbate loss of muscle and tendon mass and function. Whereas healthy exercisers and athletes are unlikely to suffer from malnourishment, choices made during recovery from an injury need to be carefully considered to optimize recovery and return to training.”

KEY TAKEAWAYS

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✓ Deficiencies of energy, vitamins, minerals and macronutrients—particularly protein—will impair wound healing and exacerbate loss of muscle and tendon mass and function.

✓ Whereas healthy exercisers and athletes are unlikely to suffer from malnourishment, choices made during recovery from an injury need to be carefully considered to optimize recovery and return to training.”
