Nutritional Considerations In Athletic Injury Rehabilitation

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Nutrition in Athletic Training

• Part of CAATE Competencies for ATC Education
  – “Nutritional Aspects of Injuries and Illnesses”
    • “Identify nutritional considerations in rehabilitation, including nutrients involved in healing and nutritional risk factors.”

• ATC’s often a major source of nutrition info
  – TV, magazines, friends, family often 1° source
  – Athletes consider ATC’s knowledgeable about nutrition
  – Many ATC’s feel they should be the 1° source
• Limited availability of EB information
  – 1 textbook (1995)
  – No NATA position statements
  – No systematic reviews/meta-analyses
  – Limited Clinical Trials on nutrition interventions in athletic injuries
• Specific benefits of nutrients on healing process difficult to determine due to multi-factorial nature
Healing Response to Injury

- **Acute Inflammatory Stage**
  - Cascade of biochemical events
  - Redness, Swelling, Heat, Pain, Loss of Function

- **Repair (Regenerative) Stage**
  - Concomitant with Inflammatory Stage
  - Cell Growth, Extracellular matrix (collagen, proteoglycans)

- **Remodeling (Maturation) Stage**
  - Slow process
  - Collagen fibers realigned along lines of mechanical force
Caloric Intake

- BMR ↑ during early stages while activity ↓
  - ~15-20% based on severity of injury
  - Total calories less than when training/competing, but more than basal needs
  - Athletes should be advised against reducing total caloric intake during rehab out of fear of weight gain
    - 35 kcal/kg/day
- Too few calories when healthy can lead to injury/too few when injured can impair healing
- Strategy when injured similar to when healthy
  - Frequent feedings, adequate macro- and micro-nutrient intake
• Protein metabolized to amino acids
  – A.A.’s are “protein currency”
  – Essential for all cellular functions
  – Protein intake during injury healing
  • Determine a “normal” daily protein intake for each athlete (g/kg/day)
    – 3 day food records/24hr recall
  • Maintain this level during rehab as long as it is > 1.0g/kg/day
    – Ideally > 1.0g/pound
Carbohydrate

- No specific recommendations
  - Include adequate CHO to meet micronutrient needs and maintain insulin concentrations
    - Insulin = anabolic hormone
Macronutrient Strategies

• Frequency
  – Every 2-4 hrs
  – Protein – lean/complete proteins at each feeding
  – Veg/Fruit – 1-2 servings of both/either at each feeding
  – Minimally processed CHO (and fats and proteins for that matter)
  – Fats – 3-9g fish oil, plus “good” fats every day
Individual A.A.’s

- Arginine and ornithine-α-ketoglutarate (OKG)
  - Accelerate healing from surgery/other trauma
  - Clinical use of oral doses supported in literature
    - Guidelines
      - Arginine: 10-30g/day over 3-4 doses
      - OKG: 5-20g/day over 2-3 doses
- Glutamine
  - Important in metabolism of lymphocytes and enterocytes
    - Evidence indicates 14g arginine, 3g HMB, 14g glutamine over 14 days sig increased collagen synthesis
• Leucine (BCAA) metabolite
  – Inhibits muscle protein breakdown, increase net protein balance
  – Increases collagen deposition
  – Improves nitrogen balance
Proteases

• Proteolytic enzymes (sever peptide bonds)
  – Documented to absorb intact, retain activity, and localize at inflamed sites

• Potential Mechanisms
  – Inactivate eicosanoid forming enzymes
  – Inactivate bradykinins
  – Reduce viscosity of Extracellular Fluid
  – Activate endogenous proteases
  – Induce antiproteases
  – Substitute for endogenous proteases
  – Molecular debridement
Proteases

• Sources
  – Papaya (papain)
  – Pineapple (bromelain)
  – Cheese (chymotrypsin, trypsin)
  – Whole grains
    • Sourdough
    • Rye
Proteases

• Research
  – Most reports date to the 1960’s
    • Overall, administration of protease supplements either prophylactically or immediately following athletic injury resulted in sig. improved recovery times
  – 3 European studies in 1990
    • Supplement including multiple proteases had sig effect on inflammation and improved the outcomes of therapy including quicker return to recover, work, training.
Proteases

• Indications
  - Acute, traumatic injuries
    • Bruises, sprains, strains, lacerations, fractures, etc.
  - Surgery
  - Low Back Pain
  - Chronic joint conditions?
    • Rheumatoid arthritis, Osteoarthritis, Bursitis, Tendinitis
Proteases

• Guidelines
  – Use prophylactically if feasible, otherwise begin as soon as possible following injury
  – 2-8 tablets, 3-5x/day on empty stomach (water or juice)
  – Use enteric coated tablets
  – Combinations of proteases are preferred
  – Continue for 1 week or until improvement noticed
Fatty Acids

- Omega-3 vs. Omega-6 fatty acids
  - Depends on location of “first” double bond
- Biochemistry of Fatty acids
  - Broken down into eicosanoids in cell membranes
    - Cyclooxygenase pathway
      - Prostaglandins, Thromboxanes
    - Lipoxygenase pathway
      - Leukotrienes, Hydroxy fatty acids, Lipoxins
Eicosanoids

- Three types derived from fatty acids
  - Series 1 (from DHGLA, an ω-6 fatty acid)
  - Series 2 (from arachidonic acid, an ω-6 fatty acid)
  - Series 3 (from EPA, an ω-3 fatty acid)
- Formed on demand, short lived, local regulatory effects
  - Quickly inactivated/destroyed near site of production

![Comparison of Series 1 and Series 2 Eicosanoids](https://www.omega3md.com/faqs.html)
Eicosanoids and Healing

- Series 1 and 3 exert anti-inflammatory effects
- Series 2 exerts pro-inflammatory effects
  - Both are necessary for homeostasis even during healing from an injury
  - Cyclooxygenase pathway dominates following acute injury
    - NSAID’s block this pathway
    - Manipulating fatty acid levels in the cell membranes via ω-3 supplementation may work as well

Omega-3 Fatty acids

- ω-3 supplementation increases ALA, EPA, and DHA in cell membranes
  - Production of series 3 eicosanoids
  - Have lower affinity for COX and lipoxygenase pathways, reducing total eicosanoids when ω-3 FA’s predominate

- Balance of series 1, 2, and 3 needed
  - Maintain tissue repair with least inflammation
Evidence supports its use as an antiinflammatory agent:

- ↓IL-1β and TNF following 18g/day fish oil for 6wks
- ↓Leukotriene and Platelet-Activating factor (PAF)
  - Impaired neutrophil adherence, margination, and diapedesis into inflammatory sites in response to leukotrienes.
- ↑outcomes and QOL in RA patients
- Low ω6:ω3 ratio supports tissue healing
Fat Recommendations during Injury

• Improve ω6:ω3, add healthy MUFA’s, balance SAT’s, MUFA’s, and PUFA’s (Berardi and Andrews)
  – ↑intake of olive oil, mixed nuts, avocados, flax oil (or ground flax), and other seeds
  – Add 3-9g/day of fish oil while ↓intake of veg oils like corn, sunflower, safflower, cottonseed, and soybean

Medium Chain Triglycerides

• SAT’s of 6-12 C in length
  – Found in coconut, palm kernel, babassu, cohune, and tucum oils (and human milk)
  – Source of calories (no eicosanoids produced)
  – Rapidly/completely absorbed into portal circulation
    - Albumin, rather than chylomicrons, chief carrier
    - Transported directly to oxidative sites in mitochondria
    - Rapidly (perhaps preferentially) oxidized to produce energy
      - 8kcal/g rather than 9kcal/g
  – Not easily stored as body fat, assist in mobilization of body fat stores, can spare lean muscle (by serving as extra source of calories)
  – Adding MCT’s in injury rehab could provide extra calories to fuel healing process, spare lean muscle mass, and not add body fat
    - No clinical trials on recovery from sports medicine injuries
Herbs and Phytochemicals

- **Turmeric**
  - Curcumin (active ingredient) likely responsible for anti-inflammatory effects
  - Adding curry to the diet may be beneficial
    - 400-600mg of turmeric extract 3x/day recommended

- **Garlic**
  - Inhibits cyclooxygenase and lipoxygenase activity
  - 600-1200mg garlic extract (2-4g garlic cloves) recommended
Herbs and Phytochemicals

- Bromelain
  - Protease from pineapple

- Boswellia
  - Inhibits lipoxygenase
  - 300mg 3x/day

- Flavanoids
  - Compounds found in cocoa, tea, red wine, fruits, vegetables, and legumes
  - Anti-oxidant effects may help manage inflammation
    - More likely benefit cell signaling
Herbs and Phytochemicals

- Additional anti-inflammatory flavanoid supplements
  - Blueberry extract
  - Grape extract
  - Green tea extract
  - Citrus extract (hesperedin, naringin)
  - Bioflavanoids (quercetin/dihydroquercetin, rutin)
Strategy

• Remember, the goal is management of the inflammatory process, not cessation

• Focus on adding foods with anti-inflammatory effects prophylactically, and add supplements during periods of acute injury
  - Curry powder/Turmeric
  - Garlic
  - Pineapple
  - Cocoa
  - Tea
  - Blueberries
Micronutrients

• Vit A, B, C, D, (but not E) play important role
  – Vit E may slow healing, best to avoid supplementing during injury

• Ca, Cu, Fe, Mg, Mn, Zn important

• First, ensure diet meets DRI’s for each of these
  – The role of additional supplementation not well understood currently
Vitamin A

- Supports early inflammation, reverse post-injury immune suppression, assist in collagen formation
  - Supplementation improves collagen cross-link strength and recovery times
  - 10,000IU/day for first 1-2 weeks post-injury
- Vit A can reach toxic levels (tolerable upper limit: 10K IU)

fertility.amuchbetterway.com/vitamin-an-essential-fertility-vitamin/
Vitamin C

- Enhances neutrophil and lymphocyte activity, helps with collagen synthesis
  - Also an antioxidant and immune system modulator
- 1-2g/day recommended during periods of injury repair
Copper

- Assists in RBC formation
- Works with Vit C to form elastin and strengthen connective tissue
- 2-4mg/day recommended during first 2 weeks of injury repair
Zinc

• Important component of many enzymes
  – DNA and protein synthesis, cell division

• Zn deficiencies are common

• 15-30mg/day supplementation recommended during injury healing

www.newworldencyclopedia.org/entry/Zinc
Calcium and Iron

- Both play important roles in bone health
- Deficiencies in both are common
  - May increase risk of stress fractures
Resources

• Injury Rehabilitation – why is nutrition ignored? (http://get-asixpack.com/42)
• Nutritional Sports Injury Therapies (http://www.sportsinjurybulletin.com/archive/nutritional-therapies.html)
Questions?