

## **PAC490 (W09) – Discussion Topics and Readings**

### **Discussion 1: Philosophy**

#### **Questions:**

1. What is a philosophy? What are the defining characteristics of a philosophy?
2. How does one develop a philosophy?
3. What is a curriculum?

#### **Required Readings:**

1. Forscher, B.K. Chaos in the brickyard. **Science**. 142:339. 1963.
2. Enoka, R.M. Strength training for exercise performance and rehabilitation. **Scandinavian Journal of Medicine & Science in Sports**. 17(1):1. 2007.

### **Discussion 2: “Base” Training**

#### **Questions:**

1. What is “base” training?
  - a. How is “base” training commonly prescribed?
2. What is an “aerobic base”
3. What are the physiologic principles behind developing a “base”?
  - a. How are muscle fibres classified? (hint: metabolic ≠ contraction velocity)
  - b. What are the metabolic adaptations to training?
  - c. How do metabolic adaptations influence successive training?
4. Is “base” training necessary for...
  - a. ... general health & wellness?
  - b. ... strength & power athletes?
  - c. ... tactical athletes?
  - d. ... endurance athletes?
5. If “base” training is necessary, how is it best accomplished?

#### **Required Readings:**

Textbook – Chapters 2, 4 & 10

Gjøvaag, T.F., and H.A. Dahl. Effect of training with different intensities and volumes on muscle fibre enzyme activity and cross sectional area in the m. triceps brachii. **European Journal of Applied Physiology**. 103:399-409. 2008.

Kyröläinen, H., R. Kivelä, S. Koskinen, J. McBride, J.L. Andersen, T. Takala, S. Sipilä, and P.V. Komi. Interrelationships between muscle structure, muscle strength, and running economy. **Medicine and Science in Sports and Exercise**. 35(1):45-49. 2003.

Harber, M.P., P.M. Gallagher, A.R. Creer, K.M. Minchev, and S.W. Trappe. Single muscle fiber contractile properties during a competitive season in male runners. **American Journal of Physiology**. 287:R1124-R1131. 2004.

#### **Suggested Readings:**

Hartman, M.J., D.A. Fields, N.M. Byrne, and G.R. Hunter. Resistance training improves metabolic economy during functional tasks in older adults. **Journal of Strength and Conditioning Research**. 21(1):91-95. 2007.

Burgomaster, K.A., S.C. Hughes, G.J.F. Heigenhauser, S.N. Bradwell, and M.J. Gibala. Six sessions of sprint interval training increases muscle oxidative potential and cycle endurance capacity in humans. **Journal of Applied Physiology**. 98:1985-1990. 2005.

Hewson, D.J., W.G. Hopkins. Specificity of training and its relation to the performance of distance runners. **International Journal of Sports Medicine**. 17(3):199-204. 1996.

Stone, M.H., G.D. Wilson, D. Blessing, and R. Rozenek. Cardiovascular responses to short-term Olympic style weight-training in young men. **Canadian Journal of Applied Sport Sciences**. 8(3):134-139.

### **Discussion 3: Periodization**

#### **Questions:**

1. What is periodization?
  - a. What is “linear” periodization?
  - b. What is “non-linear” periodization?
  - c. What is “undulating” periodization?
2. What is the time course of adaptations?
  - a. How long does it take to stimulate...
    - i. ... neural adaptations?
    - ii. ... muscular adaptations?
    - iii. ... metabolic adaptations?
  - b. Is there a sequence in which adaptations must be stimulated?
3. What is staleness? Overtraining?
4. Physiologically, what contributes to staleness?
  - a. How frequently must training parameters be modified to avoid staleness?
  - b. What are the consequences of too frequent changes to training parameters?

#### **Required Readings:**

Textbook – Chapters 1, 10 & 13

Chiu, L.Z.F. and J.L. Barnes. The fitness-fatigue model revisited – implications for planning short- and long-term training. **Strength and Conditioning Journal**. 25(6):42-51. 2003.

Stone, M. and D. Wathen. Letter to the editor. **Strength and Conditioning Journal** 23(5):7-9. 2001.

Zatsiorsky, V.M., and W.J. Kraemer. Nonlinear periodized program (handout). From: **Science and Practice of Strength Training, 2<sup>nd</sup> Ed.** Human Kinetics. 2006.

#### **Suggested Readings:**

Stone, M.H., G.D. Wilson, D. Blessing, and R. Rozenek. Cardiovascular responses to short-term Olympic style weight-training in young men. **Canadian Journal of Applied Sport Sciences**. 8(3):134-139.

Stone, M.H., H. O’Bryant, and J. Garhammer. A hypothetical model for strength training. **Journal of Sports Medicine and Physical Fitness**. 21(4):342-351.

### **Discussion 4: Training to Failure**

#### **Questions:**

1. What is training to failure?
2. What is the physiologic rationale for training to failure?
3. Is failure necessary to elicit training adaptations?
4. Specifically, what are the stimuli for eliciting adaptations?

#### **Required Readings:**

Folland, J.P., C.S. Irish, J.C. Roberts, J.E. Tarr, and D.A. Jones. Fatigue is not a necessary stimulus for strength gains during resistance training. **British Journal of Sports Medicine**. 36:370-374. 2002.

Drinkwater, E.J., T.W. Lawton, R.P. Lindsell, D.B. Pyne, P.H. Hunt, and M.J. McKenna. Training leading to repetition failure enhances bench press strength gains in elite junior athletes. **Journal of Strength and Conditioning Research**. 19(2):382-388.

#### **Suggested Readings:**

González-Badillo, J.J., E.M. Gorostiaga, R. Arellano, and M. Izquierdo. Moderate resistance training volume produces more favourable strength gains than high or low volumes during a short-term training cycle. **Journal of Strength and Conditioning Research**. 19(3):689-697. 2005.

#### **Discussion 5: Specificity**

##### **Questions:**

1. What is the principle of specificity?
  - a. Is the specificity principle valid?
2. What is the SAID principle?
3. What is variability? Physiologically, why is variability important?
4. Should training exercises attempt to simulate performance skills?
5. What are the sites for...
  - a. ... strength adaptations?
  - b. ... motor learning?

##### **Required Readings:**

Textbook – Chapters 1 & 12

Schubert, M., S. Beck, W. Taube, F. Amtage, M. Faist, and M. Gruber. Balance training and ballistic strength training are associated with task-specific corticospinal adaptations. **European Journal of Neuroscience**. 27:2007-2018. 2008.

Jensen, J.L., P.C.D. Marstrand, and J.B. Nielsen. Motor skill training and strength training are associated with different plastic changes in the central nervous system. **Journal of Applied Physiology**. 99:1558-1568. 2005.

Carroll, T.J., S. Riek, and R.G. Carson. The sites of neural adaptation induced by resistance training in humans. **Journal of Physiology**. 544(2):641-652. 2002.

##### **Suggested Readings:**

Carroll, T.J., S. Riek, and R.G. Carson. Neural adaptations to resistance training. Implications for movement control. **Sports Medicine**. 31(12):829-840. 2001.

Hoffman, J.R., N.A. Ratamess, M. Klatt, A.D. Faigenbaum, and J. Kang. Do bilateral power deficits influence direction-specific movement patterns? **Research in Sports Medicine**. 15:125-132. 2007.

Barnes, J.L., B.K. Schilling, M.J. Falvo, L.W. Weiss, A.K. Creasy, and A.C. Fry. Relationship of jumping and agility performance in female volleyball players. **Journal of Strength and Conditioning Research**. 21(4):1192-1196. 2007.

Chiu, L.Z.F., and G.J. Salem. Comparison of joint kinetics during free weight and flywheel resistance exercise. **Journal of Strength and Conditioning Research**. 20(3):555-562. 2006.

#### **Discussion 6: Free Weights versus Machines**

##### **Questions:**

1. Is one training modality superior to the other?
2. How do the mechanics differ between free weight and machine training?
3. What are the pros and cons of free weight training?
4. What are the pros and cons of machine training?

5. Can muscles be “isolated”?
6. Is machine training safer than free weight training?

### **Required Readings:**

Textbook – Chapter 12

Rutherford, O.M., and D.A. Jones. The role of learning and coordination in strength training. **European Journal of Applied Physiology**. 55:100-105. 1986.

Andersen, L.L., S.P. Magnusson, M. Nielsen, J. Haleem, K. Poulsen, and P. Aagaard. Neuromuscular activation in conventional therapeutic exercises and heavy resistance exercises: implications for rehabilitation. **Physical Therapy**. 86(5):683-697. 2006.

Augustsson, J., A. Esko, R. Thomeé, and U. Svantesson. Weight training of the thigh muscles using closed vs. open kinetic chain exercises: a comparison of performance enhancement. **Journal of Orthopaedic and Sports Physical Therapy**. 27(1):3-8. 1998.

### **Suggested Readings:**

Toutoungi, D.E., T.W. Lu, A. Leardini, F. Catani, and J.J. O'Connor. Cruciate ligament forces in the human knee during rehabilitation exercises. **Clinical Biomechanics**. 15:176-187. 2000.

Morrissey, M.C., E.A. Harman, and M.J. Johnson. Resistance training modes: specificity and effectiveness. **Medicine and Science in Sports and Exercise**. 27(5):648-660. 1995.

Chiu, L.Z.F. Training with barbells, dumbbells and kettlebells. <http://www.nscs-lift.org/hottopic/backissuetopic.asp>.

## **Discussion 7: Core Stability**

### **Questions:**

1. Define stability. Why is stability important...
  - a. ... for sports?
  - b. ... for activities of daily living?
2. How is stability generated...
  - a. ... at the system level?
  - b. ... at the segment level?
3. What is a feedback loop?
  - a. Why are feedback loops relevant for stability?
  - b. What sensory feedback is used to maintain stability?
4. Is stability transferable between activities?
5. Does stability training improve performance?

### **Required Readings:**

Paillard, T., C. Costes-Salon, C. Lafont, and P. Dupui. Are there differences in postural regulation according to the level of competition in judoists? **British Journal of Sports Medicine**. 36:304-305. 2002.

Söderman, K., S. Werner, T. Pietilä, B. Engström, and H. Alfredson. Balance board training: prevention of traumatic injuries of the lower extremities in female soccer players? **Knee Surgery, Sports Traumatology, Arthroscopy**. 8:356-363. 2000.

Paillard, T., R. Montoya, and P. Dupui. Postural adaptations specific to preferred throwing techniques practiced by competition-level judoists. **Journal of Electromyography and Kinesiology**. 17:241-244. 2007.

## **Discussion 8: Stretching**

### Questions:

1. What are the different types of stretching?
2. What are the “sites” of acute responses to stretching? What occurs at each of these “sites”?
3. What are the “sites” of adaptations to stretching? What occurs at each of these “sites”?
4. Does chronic stretching reduce the risk of injury?
5. Does acute stretching reduce the immediate risk of injury?
6. Should stretching be performed prior to exercise?

### Required Readings:

Trehearn, T.L., and R.J. Buresh. Sit-and-reach flexibility and running economy of men and women collegiate distance runners. **Journal of Strength and Conditioning Research**. ??(??):??-??. 2008.

Reisman, S., T.J. Allen, and U. Proske. Changes in passive tension after stretch of unexercised and eccentrically exercised human plantarflexor muscles. **Experimental Brain Research**. ??(??):??-??. 2008.

Cornwell, A., A.G. Nelson, and B. Sidaway. Acute effects of stretching on the neuromechanical properties of the triceps surae muscle complex. **European Journal of Applied Physiology**. 86(5):428-434. 2002.

### Suggested Readings:

Schilling, B.K., and M.H. Stone. Stretching: acute effects on strength and power performance. **Strength and Conditioning Journal**. 22(1):44-47. 2000.

Kokkonen, J., A.G. Nelson, C. Eldredge, and J.B. Winchester. Chronic static stretching improves exercise performance. **Medicine and Science in Sports and Exercise**. 39(10):1825-1831. 2007.

## Discussion 9: Plyometrics

### Questions:

1. What are plyometrics? Is all jump training plyometric?
2. What do plyometrics do acutely? What is the physiologic mechanism?
3. What do plyometrics do long-term? What is the physiologic mechanism?
4. What are the biomechanical demands of plyometrics?
5. For what populations are plyometric training effective?
6. Is plyometric training more effective than other forms of power training?

### Required Readings:

Ishikawa, M., P.V. Komi, T. Finni, and S. Kuitunen. Contribution of the tendinous tissue to force enhancement during stretch-shortening cycle exercise depends on the prestretch and concentric phase intensities. **Journal of Electromyography and Kinesiology**. 16:423-431. 2006.

Burgess, K.E., M.J. Connick, P. Graham-Smith, and S.J. Pearson. Plyometric vs. isometric training influences on tendon properties and muscle output. **Journal of Strength and Conditioning Research**. 21(3):986-989. 2007.

Young, W.B., G.J. Wilson, C. Byrne. A comparison of drop jump training methods: effects on leg extensor strength qualities and jumping performance. **International Journal of Sport Medicine**. 20(5):295-303. 1999.

### Suggested Readings:

Kubo, K., M. Morimoto, T. Komuro, H. Yata, N. Tsunoda, H. Kanehisa, and T. Fukunaga. Effects of plyometric and weight training on muscle-tendon complex and jump performance. **Medicine and Science in Sports and Exercise**. 39(10):1801-1810. 2007.

Walshe, A.D., G.J. Wilson, and G.J.C. Ettema. Stretch-shorten cycle compared with isometric pre-load: contributions to enhanced muscular performance. **Journal of Applied Physiology**. 84(1):97-106. 1998.

Holcomb, W.R., J.E. Lander, R.M. Rutland, and G.D. Wilson. The effectiveness of a modified plyometric program on power and the vertical jump. **Journal of Strength and Conditioning Research**. 10(2):89-92. 1996.

### **Discussion 10: Training Women**

#### **Questions:**

1. Are there physiologic differences between men and women? If so, where (i.e. muscle, nervous system, etc.)? How would these differences influence training adaptations?
2. Are there anatomic/structural differences between men and women? Do these differences affect performance? How?
3. Do women adapt differently to resistance exercise than men?
4. Should women train differently than men?

#### **Required Readings:**

Staron, R.S., D.L. Karapondo, W.J. Kraemer, A.C. Fry, S.E. Gordon, J.E. Falkel, F.C. Hagerman, and R.S. Hikida. Skeletal muscle adaptations during early phase of heavy-resistance training in men and women. **Journal of Applied Physiology**. 76(3):1247-1255. 1994.

Garhammer, J. A comparison of maximal power outputs between elite male and female weightlifters in competition. **International Journal of Sport Biomechanics (now Journal of Applied Biomechanics)**. 7(1):3-11. 1991.

Hunter, S.K., A. Critchlow, I.-S. Shin, and R.M. Enoka. Men are more fatigable than strength-matched women when performing intermittent submaximal contractions. **Journal of Applied Physiology**. 96:2125-2132. 2004.

#### **Suggested Readings:**

Kraemer, W.J. S.A. Mazzetti, B.C. Nindl, L.A. Gotshalk, J.S. Volek, J.A. Bush, J.O. Marx, K. Dohi, A.L. Gómez, M. Miles, S.J. Fleck, R.U. Newton and K. Häkkinen. Effect of resistance training on women's strength/power and occupational performances. **Medicine and Science in Sports and Exercise**. 33(6):1011-1025. 2001.

Häkkinen, K. Neuromuscular fatigue and recovery in male and female athletes during heavy resistance exercise. **International Journal of Sports Medicine**. 14:53-59. 1993.

Häkkinen, K. Neuromuscular fatigue in males and females during strenuous heavy resistance loading. **Electromyography and Clinical Neurophysiology**. 34:205-214. 1994.

### **Discussion 11: Training Children**

#### **Questions:**

1. Is it safe for children and adolescents to participate in resistance exercise?
2. At what age can children begin resistance exercise?
3. Should children train differently than adults?
4. Is there a benefit to begin resistance exercise at an early age?

#### **Required Readings:**

Byrd, R., K. Pierce, L. Rielly, and J. Brady. Young weightlifters' performance across time. **Sports Biomechanics**. 2(1):13-140. 2003.

Faigenbaum, A.D., W.L. Westcott, R.L. Loud, and C. Long. The effects of different resistance training protocols on muscular strength and endurance development in children. **Pediatrics**. 104(1):e5. 1999.

Lillegaard, W.A., E.W. Brown, D.J. Wilson, R. Henderson, and E. Lewis. Efficacy of strength training in prepubescent to early postpubescent males and females: effects of gender and maturity. **Pediatric Rehabilitation**. 1(3):147-157. 1997.

Ramsay, J.A., C.J. Blimkie, K. Smith, S. Garner, J.D. MacDougall, and D.G. Sale. Strength training effects in prepubescent boys. **Medicine and Science in Sports and Exercise**. 22(5):605-614. 1990.

### **Suggested Readings:**

American Academy of Pediatrics. Policy Statement: Strength training by children and adolescents. **Pediatrics**. 121(4):835-840. 2008.

Behm, D.G., A.D. Faigenbaum, B. Falk, and P. Kientrou. Canadian Society for Exercise Physiology position paper: resistance training in children and adolescents. **Applied Physiology, Nutrition and Metabolism**. 33(3):547-561. 2008.

## **Discussion 12: Supplements & Doping**

### **Questions:**

1. What constitutes “doping”? Who decides what is doping?
2. What constitutes use versus abuse?
3. Is “doping” immoral? Why or why not?
4. Is “doping” dangerous to an athlete’s health?
5. Is nutritional supplement use immoral? Why or why not?
6. Is nutritional supplement use effective?

### **Required Readings:**

Textbook – Chapters 6 & 7

Schulze, J.J., J. Lundmark, M. Garle, I. Skilving, L. Ekström, and A. Rane. Doping test results dependent on genotype of uridine diphospho-glucuronosyl transferase 2B17, the major enzyme for testosterone glucuronidation. **Journal of Clinical Endocrinology and Metabolism**. 93:2500-2506. 2008.

Savulescu, J., B. Foddy, and M. Clayton. Why we should allow performance enhancing drugs in sport. **British Journal of Sports Medicine**. 38:666-670. 2004.

Crowe, M.J., J.N. Weatherson, and Bruce F. Bowden. Effects of dietary leucine supplementation on exercise performance. **European Journal of Applied Physiology**. 97:664-672. 2006.

Scholey, A.B. and D.O. Kennedy. Cognitive and physiological effects of an “energy drink”: an evaluation of the whole drink and of glucose, caffeine and herbal flavouring fractions. **Psychopharmacology**. 176:320-330. 2004.

### **Suggested Readings:**

Alaranta, A., H. Alaranta, J. Holmila, P. Palmu, K. Pietilä, and I. Helenius. Self-reported attitudes of elite athletes towards doping: differences between type of sport. **International Journal of Sports Medicine**. 27:842-846. 2006.

Erdman, K.A., T.S. Fung, and R.A. Reimer. Influence of performance level on dietary supplementation in elite Canadian athletes. **Medicine and Science in Sports and Exercise**. 38(2):349-356. 2006.

Bloomer, R.J. The role of nutritional supplements in the prevention and treatment of resistance exercise-induced skeletal muscle injury. **Sports Medicine**. 37(6):519-532. 2007.

## **Discussion 13: Return to Activity**

### **Questions:**

1. What are the mechanisms for response to injury and repair?
2. What is pain? Should pain limit physical performance?
3. Is inactivity (i.e. rest) beneficial or harmful following injury?
4. What is detraining? What is the time-course for detraining?
5. Is rehabilitation alone effective for return to activity?

#### **Required Readings:**

Gisslén, K., L. Öhberg, and H. Alfredson. Is the chronic painful tendinosis tendon a strong tendon? A case study involving an Olympic weightlifter with chronic painful Jumper's knee. **Knee Surgery, Sports Traumatology and Arthroscopy**. 14:397-902. 2006.

Marsolais, D., É. Duchesne, C.H. Côté, and J. Frenette. Inflammatory cells do not decrease the ultimate tensile strength of intact tendons in vivo and in vitro: protective role of mechanical loading. **Journal of Applied Physiology**. 102:11-17. 2007.

Young, M.A., J.L. Cook, C.R. Purdam, Z.S. Kiss, and H. Alfredson. Eccentric decline squat protocol offers superior results at 12 months compared with traditional eccentric protocol for patellar tendinopathy in volleyball players. **British Journal of Sports Medicine**. 39:102-105. 2005.

#### **Suggested Readings:**

Salem, G.J., R. Salinas, and F.V. Harding. Bilateral kinematic and kinetic analysis of the squat exercise after anterior cruciate ligament reconstruction. **Archives of Physical Medicine and Rehabilitation**. 84:1211-1216. 2003.

See, E.K.N., G.Y.F. Ng, C.O.Y. Ng, and D.T.C. Fung. Running exercises improve the strength of a partially ruptured Achilles tendon. **British Journal of Sports Medicine**. 38:597-600. 2004.

Barton, C.J., K.E. Webster, and H.B. Menz. Evaluation of the scope and quality of systematic reviews on nonpharmacological conservative treatment for patellofemoral pain syndrome. **Journal of Orthopaedic and Sports Physical Therapy**. 38(9):529-541. 2008.

Alfredson, H., and L. Öhberg. Neovascularisation in chronic painful patellar tendinosis – promising results after sclerosing neovessels outside the tendon challenge the need for surgery. **Knee Surgery, Sports Traumatology and Arthroscopy**. 13:74-80. 2005.