## Muscle Function - Resistance Training

<table>
<thead>
<tr>
<th><strong>Work load</strong></th>
<th>15 ECTS; 40 hours of lecturing (each lecture hour = 45 min), + 6 hours of Experimental Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time of Year</strong></td>
<td>3rd Quarter</td>
</tr>
<tr>
<td><strong>Achieved Skills</strong></td>
<td>After completion of the Course the Student will achieve the following skills:</td>
</tr>
</tbody>
</table>

**Theoretical, Academic Skills**

- Can discuss adaptive changes in muscle mechanical function evoked by resistance training (Level 3).
- Can discuss adaptive changes in neural function, muscle morphology and architecture, tendon function and intracellular signalling events evoked by resistance training (Level 3).
- Can discuss age related changes in neuronal function, muscle morphology and muscle architecture, and to discuss the effect of resistance training on these parameters (Level 3).
- Can explain central molecular signalling pathways involved in muscle hypertrophy and atrophy (Level 2).
- Can explain the effects of resistance training on various disease and pathology conditions (type II diabetes, hip replacement, COPD, hyper tension, etc) (Level 2)

**Practical, Didactic Skills**

- Can select and present relevant scientific literature related to the above aspects, and provide theoretical and practical teaching in this field (Level 3).
- Can plan and supervise resistance training protocols within sports and exercise, in elderly individuals and clinical patients, and to prevent and rehabilitate various types of musculoskeletal overuse injury (Level 2).

**Content**

- The course will give insight in the influence of various cellular and neuronal factors on the expression of maximal skeletal muscle strength and power in vivo and in vitro.
- Further, the course will describe and explain how the above factors can be modified by training, aging, disuse, and with musculoskeletal injury.
- A central aspect in the course is the effect of resistance training on muscle mechanical function (particularly maximal eccentric muscle contraction strength, rapid force capacity: RFD, and maximal muscle power).
- Another central aspect is the effect of resistance training on the age-related loss in muscle mass (sarcopenia) and neuromotoric function.
- Also, the course will describe and discuss aspects of various...
hormonal, cellular and molecular signalling pathways involved with resistance training, and discuss how these pathways can be altered by aging, disuse and musculoskeletal injury.

- Finally, the effect of resistance training in relation to a number of clinical conditions and human health aspects will be presented and discussed.

**Form of Teaching**
Combinations of Lectures and student driven presentations. In addition, the students perform three Lab Exercises.

**Evaluation and Testing**
Exam: 4-hour written exam using external censoring. All types of written material can be used. However, computer and programmable calculator are not allowed.

**Scoring**
Exam scoring will be provided using the 7-scale. The grade ‘12’ will be given when the student demonstrates comprehensive knowledge in relation to the Contents and Achieved Skills of the Course.

---

**MUSCLE FUNCTION - RESISTANCE TRAINING**

Arranger of Course, Lecturer: Per Aagaard (PAa)

External Lecturers: Thue Kvorning (TK), Jesper L. Andersen (JLA), Charlotte Suetta (CS), Paolo Caserotti (PC), Lars L. Andersen (LA), Abigail Mackey (AM), Peter Schjerling (PS)


Lab Exercises: see end of document.

**Lectures (2-h sessions)**

1. Introduction (PAa) [pp. 11-23]
   a. Course introduction
   b. Factors of importance for maximal muscle strength (PAa) [Textbook pp. 50-71, 114-134]


10. Activation of myogenic growth factors with resistance training (IGF-1, MGF, myostatin, MRF) (PAa) [Bamman et al. 2001, Heinemeier et al. 2007, Kosek et al. 2006, (Rennie et al. 2004)]

11. Activation of myogenic satellite cells with resistance training (AM) [Kadi et al. 2004, Mackey et al. 2007, Petrella et al. 2006]


17b. Endocrine function: effects of resistance training on endogenous testosterone production and relationships to muscular adaptation (TK,PAa) [Textbook pp. 73-91, 361-387; Kraemer et al. 1998, Kvorning et al. 2007]


LITTERATURE

TEXTBOOK


[Optional Reading / not pensum]

REVIEW ARTICLES


Reeves ND, Narici MV, Maganaris CN. Myotendinous plasticity to ageing and resistance exercise in humans. Exp Physiol 91, 483-498, 2006


ORIGINAL STUDY ARTICLES


Kosek DJ, Kim JS, Petrella JK, Cross JM, Bamman MM. Efficacy of 3 days/wk resistance training on myofiber hypertrophy and myogenic mechanisms in young vs. older adults. J. Appl. Physiol. 101, 531–544, 2006


LAB EXERCISES

I. Assessment and evaluation of maximal concentric, eccentric, isometric and eksplosive muscle strength in vivo (isokinetic dynamometry, KinCom).

II. Assessment and evaluation of maximal muscle power in vivo (PowerRig, Force Plate)

III. Design of a 12 months periodized resistance training programme for (i) an athlete engaged in team sports and (ii) an athlete engaged in individual sport, respectively.