Question # 1 (10 points). Truls Raastad

Strength training for elderly

Discuss the possible underlying mechanisms for the observed reduction in specific strength with aging!

Sensor guide:

Definition of specific strength: Force normalized to the cross-sectional area or mass of a muscle or muscle group (N/cm2 or N/kg).

In general strength reduced by 15% per decade and muscle mass around 10% per decade after the age of 50 years, and specific force typically 20-40% lower in 70 and -years old compared young adults.

Suggested mechanisms:

- Less force per cross bridge? Non-functional proteins?
- Less myosin – fewer cross bridges?
- More intramuscular fat (IMAT) – less contractile proteins
- Impaired muscle activation?
  - Suboptimal recruitment of motor units?
  - Suboptimal discharge rates?

Contributing factors:

- Impaired mitochondrial function
- Impaired protein quality control
- Increased oxidative stress
- Increased inflammation

Discussion points: Aging vs. inactivity

Question # 2 (10 points). Gøran Paulsen

Force-velocity profile and performance

You aim to test the effectiveness of training based on force-velocity profiling. Describe a study to investigate this. You are not limited by resources, so you can choose whatever tests you find appropriate. You should briefly explain the study design, participants, and methods and equipment used for the measurements.

Sensor guide:

The concept of force-velocity profiling should briefly be explained. A randomized controlled trial design should be chosen to ensure the reliability and validity of the study outcomes. The participants should be described, e.g., male soccer players. The study should be done off season to avoid a high demand/load on the participants. The result of the pre-test profiling should be kept concealed from the participants so they could be divided into four groups: 1) Optimized training according to the profile, 2) non-optimized, well-balance training, 3) opposite training, and 4) a control group that continue with the regular training. By this design a potential placebo effect could be measured. Soccer players need both sprinting and jumping abilities, so both a vertical and a horizontal force-velocity test could be included. These tests should be briefly explained – including the equipment (force plate, timing gates, etc.). Body composition and other sport specific performance tests could be included as well, such as different jump tests (SJ, CMJ and jump and reach) and an agility test.

Question # 3 (10 points). Hannah Rice

Running Economy

Identify biomechanical factors that can influence running economy. Explain how the variables can be measured and possible mechanisms for how they may influence running economy (i.e. how could they influence running economy).

Sensor guide:

Based on the information presented in the lecture, you should show an understanding of the key variables relevant to running economy. These could include variables related to ground reaction force, spatial-temporal variables and kinematics, and the factors can include intrinsic and extrinsic factors (training status, running shoes etc.). The measured variables should be explained in terms of the equipment that can be used to collect it, how it is processed, and what it tells us.

A feasible explanation for how a change in the biomechanical variable may lead to altered running economy is required.

Question # 4 (10 points). Live Luteberget

Match Analysis in team sports

1. There are several other contextual factors that can influence the outcome of a match analysis. List three (3) factors that has been shown to influence outcomes of physical variables in match analysis.
2. Provide an overview of what match analysis entails in the context of team sports.
3. Explain how a strategic application of match analysis can lead to improvements in overall team performance.

Sensor guide:

1) Answers should include at least three of the following factors: environmental conditions (e.g., weather, altitude), match location (home vs. away), and the stage of the competition (e.g., early season vs. playoffs), quality of opposition, match status, match half.
2) A comprehensive answer should define match analysis as the systematic observation and evaluation of actions and behaviors during a game to improve team performance. It should mention the use of technology and data analysis to assess technical, tactical, and physical aspects of play.
3) Answers should detail how match analysis can identify strengths and weaknesses, inform tactical decisions, and tailor training to specific needs, as well as its contribution to formulating game strategies and adjustments during matches.

In general:

Responses are evaluated based on their depth of understanding and the accuracy of the information. The inclusion of relevant examples or case studies, and the ability to convey how theoretical concepts are applied practically is also evaluated.

Question # 5 (10 points). Matthias Gilgien

Performance analysis in racing sports

Compare distance swimming in an indoor pool with alpine ski racing. In both sports time from start to finish is the performance criteria.

1. Take a kinematic perspective on the sports and describe how speed and pathlength play a role for performance time from start to finish.
2. Take a kinetic perspective on the sports and describe the different types of forces that are regulating speed in the different phases of the competition.
3. Describe how the kinematics of the sports can be measured. What are the methods you know are used and explain why they are used. What is the strength of the measurement methods that are used in training and competition to measure kinematics in these sports.
4. What are typical performance metrics that you can measure continuously during a competition and what are these used for?

Sensor guide:

Compare distance swimming in an indoor pool with alpine ski racing. In both sports time from start to finish is the performance criteria.

1. Take a kinematic perspective on the sports and describe how speed and pathlength play a role for performance time from start to finish.

- ➔ Swimming: speed
- ➔ Skiing speed and pathlength

2. Take a kinetic perspective on the sports and describe the different types of forces that are regulating speed in the different phases of the competition.
   - ➔ Swimming: push off start block (GRF), water resistance (drag and lift), gravity during swimming, push off in turning (GRF)
   - ➔ Skiing: gravity, air resistance, ski snow friction
3. Describe how the kinematics of the sports can be measured. What are the methods you know are used and explain why they are used. What is the strength of the measurement methods that are used in training and competition to measure kinematics in these sports.
   - ➔ Alpine skiing:
   i. Swimming: camera, computer vision tracking or manual, reflective marker, underwater over water cameras, stitched together (restricted volume, indoor, electromagnetics disturbtion by water → optical system)
   - ➔ Skiing: GNSS, video (large volume, point mass is sufficient, safety), GNSS/GPSlarge range, parameter specific sufficient accuracy (speed, path, position, forces), non-invasive

   ii.
4. What are typical performance metrics that you can measure continuously during a competition and what are these used for?
   - ➔ Time differences: find where the source of time occur /pinpoint the time points to find the reasons for differences
   - ➔ Explanation variables for time differences:
     - Level1: speed, path length
     - Level 2: forces (+in swimming stroke rate)
     - Level 3: technique

Question # 6 (10 points). Olivier Seynnes

Muscle mechanics

1. A scientist measures the maximal voluntary knee extension moment at 6 different joint angles. What muscle property can be obtained from such a test?

2. What information can be obtained by measuring muscle architecture at rest, before and after a training intervention?

3. Which methods can be used to estimate instantaneous muscle work (force x shortening) and power (force x shortening velocity) production? Referring to the phenomenon of architecture gear ratio, explain why measuring instantaneous changes in the whole muscle length cannot be used reliably for these purposes.

Sensor guide:

1. Such measurements can be used to estimate the muscle force - length relationship, the maximal force potential at a range of lengths. This question is linked to learning objective "To be able to explain how the concept of force potential can be used to estimate force production during movement from a practical perspective".

2. The expected answer should list the variables defining muscle architecture (fibre/fascicle length and pennation angle/physiological cross-sectional area) and their significance for maximal force production (force potential). It should explain that such measurements can be used interpret training adaptations. The question refers to the learning objective "To be able to explain the links between muscle architecture - including size - and potential force production" and was addressed in several parts of the lecture.

3. The expected answer should propose ultrasound measurements of fascicle behaviour and force calculations (for example from inverse dynamics). It should explain that tracking changes in the whole muscle length is not appropriate as it does not take the rotation of fibres into account and does not reflect the actual shortening of sarcomeres. This answer should be supported by a a definition of the architecture gear ratio. This question is linked to learning objectives "To be able to explain how the concept of force potential can be used to estimate force production during movement from a practical perspective" and "To be able to describe the concept of architecture architecture gear ratio".