Course Schedule Orthodontic Biomechanics & Metallurgy

Teacher / instructor

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Aim of the course

The course is designed to provide basic and applied knowledge of 1) orthodontic biomechanics and clinical applications, and 2) orthodontic materials, their structure, physical properties and ways of production.

Ad 1) Basic orthodontic biomechanical principles will be illustrated through clinical cases.

Ad 2) Special focus is put here on metals and alloys, which are relevant for use in orthodontics. Furthermore, the mechanical properties of different types of orthodontic wires as well as the interaction between wires and brackets are discussed and the influence of the choice of alloy, wire cross-section and geometry of the appliance on the delivered force system is studied by means of computer simulation. Finally, the course will provide clinical examples of how the knowledge of metallurgy is applied in orthodontic practice and can help in treatment planning.

After finishing the course the participants should be able to understand the differences between the numerous orthodontic wires, which are currently available on the market and which wires are appropriate to be used for a given patient at a particular phase of treatment. Furthermore, a participant should be able to understand and appreciate papers on the topics of biomechanics and metallurgy within the scientific orthodontic literature.

NB: Participants are kindly asked to bring the next materials:

1. Hardwire cutters/distal end cutters
2. Young or 139 pliers
3. 5 preformed ideal arches in SS, TMA and NiTi in 0.019x0.025 or alternatively 0.018x0.025 or 0.017x0.025, but the same dimension for all types of wires.
4. Braided wire, for example 0.019x0.025 D-rect, 5 pieces, like above. If the same dimension as chosen above is available, it would be perfect.
5. 15x15 cm straight pieces of both 0.017x0.025 TMA and 0.017x0.025 SS or alternative another rectangular dimension, but the same dimension for both types of wires.

References:

PROFFIT WR, FIELDS Jr HW, BRENT L.SARVER DM. Contemporary Orthodontics. 6th edition. Chapter 8, 9 and 10. Elsevier Health Sciences; 2018.

VERSTRYNGE A, VAN HUMBEECK J,WILLEMS G. In-vitro evaluation of the material characteristics of stainless steel and beta-titanium orthodontic wires. Am J Orthod Dentofacial Orthop 2006;130: 460-470.

WHITLEY JQ, KUSY RP. Influence of interbracket distances on the resistance to sliding of orthodontic appliances. Am J Orthod Dentofacial Orthop 2007;132:360-372.

THURSDAY, MARCH 5TH

10.00-10.15: **Word of welcome & introduction to the course**

10.15-11.15: **Basic orthodontic biomechanics: Forces, moments & movements** (MD)
Principles of orthodontic loading and the associated tooth movements.

11.15-11.30: **Coffee break**

11.30-12.30: **Clinical orthodontic biomechanics: Orthodontic force systems** (MGL)
Force systems generated by orthodontic appliances; mechanically determined and undetermined configurations.

12.30-13.30: **Lunch break**

13.30-14.30: **Solid mechanics: Stresses & strains Visco-elasticity** (MD)
Introduction to solid mechanics. What is the relationship between load and deformation? How can mechanical properties like stiffness and strength be measured? What do these properties mean in orthodontic practice?

14.30-15.30: **What are metals? Structure and physical properties of metals** (MD)
Introduction to metals and alloys, their structure and physical properties. There will be special focus on those metals, which are relevant for orthodontic use.

15.30-16.15: **Properties of orthodontic alloys I: steel, CoCr & titanium** (MD)
An overview of the ”classical” orthodontic wires.

16.15-16.30: **Coffee break**

16.30-17.15: **Properties of orthodontic alloys II: nickel-titanium** (MD)
An overview of the superelastic and thermo-active orthodontic wires.

17.15-18.00: **Applied metallurgy and biomechanics in clinical practice I** (MGL)

FRIDAY, MARCH 6TH

09.00-09.45: **Applied metallurgy and biomechanics in clinical practice II** (MGL)

09.45-10.30: **Friction & resistance to sliding** (MD)
The interaction between orthodontic wire and bracket. Resistance to sliding consisting of friction, binding and notching.

10.30-11.00: **Coffee break**

11.00-11.45: **Biomechanics of TPA** (MGL)

11.45-12.30: **Closing loops and space closure** (MGL)

12.30-13.30: **Lunch break**

13.30-15.15: **Practical exercise I: Loop program**
A computer program (*Loop, Halazonetis*) will be introduced to simulate force systems, generated by orthodontic wires bent in a loop. By choosing different

materials, wire geometries or loop designs one can analyze how much the force system will change.

Practical exercise II: Loop program
Continuation of the previous session.

15.15-15.30: **Coffee break**

15.30-16.15: **Test**

16.15-17.00: **Evaluation & closure**