

Course title: Metals and alloys as biomaterials

Department: Department of fixed prosthodontics

Address: Gundulićeva 5

Total ECTS points: 3

Course leader: Associate Professor Andreja Carek

Course associates: Associate Professor Ljerka Slokar Benić

Teaching plan

	No. classes
Lecture	
Seminar	7
Practical	8
Total	15

1 class = 45 minutes

Course description:

The science of dental metals and alloys includes studies on the composition, properties, processing and their influence on the environment with which they are in contact. Planning types and forms of metals and alloys as a constituent of the structural part of compensation of the tooth or more teeth depended on the development of industry and technological processes. The industry used alloys (eg. steel) have found application in the development of denture base, at first by cold working, or by manually shaping and hardening. Tagart's invention apparatus for casting in 1907 was a turning point in the design and application of metal for restorative-reconstructive procedures in the oral cavity.

First used metal in the mouth was gold. Chemical never clean, very soft and extendible, originally was formed by forging and bending as fixation tape, or as a cohesive gold indenter into the cavity of the tooth. It was a precursor of filling or inlay. Similarly, the injection of crushed glass in the tooth start the application of ceramics.

Gold is too soft, platinum is too hard, silver is chemically reactive. These are all reasons for blending two or more metals to obtain a mixture with optimal properties for use in biological media. Thus, the alloys, ie. a mixtures of metal and metal or metal and non-metals was achieved. Alloys are commonly produced by addition of alloying elements, by which the alloy is appointed, to the molten core component or constituent.

Mutual chemical tendency of individual elements is different. There are elements that are inclined to one another in liquid and solid state. Some elements exhibit a partial or no tendency in the solid state. Depending on mutual inclinations components in an alloy, the microstructure and properties of alloys are changed. According to the composition of the crystal lattice, homogeneous, inhomogeneous and heterogeneous structure and mechanical mixtures are distinguished.

The mixture of compounds can be obtained by sintering and by compressing metal powders under pressure and elevated temperature respectively. By sintering the homogeneous composition of the mixture is obtained which is more appropriate to call alloy.

Alloys with respect to the number of components can be binary, ternary or multicomponent. They are solids at room temperature with the glossy surface, crystalline structure and are castable in a certain time period, ie, within a casting range.

As the dental industry offers a vast number of alloys of different composition, for easy selection alloys are systematized according to weight or atomic proportion of the main stand (composition), by purpose and the mechanical properties. According to the component's electropotential, alloys are divided into precious and non-precious alloys. While the precious alloys must be a certain percentage of base components, primarily due to the improvement in mechanical properties, non-precious alloys generally do not contain precious components. Non-precious alloys are often called basic or alternative alloy. This being assessed as a replacement alloy for the high-gold alloy.

Metals and alloys which they will enter into a biological medium must have a positive therapeutic effect. Dental alloys are on the list of medicines and are subject to the law on drugs.

Learning outcomes:

1. The student will be able to describe, define and select the type of metals and alloys as biomaterials for dental use.
2. The student will be able to analyze and relate the relationship between microstructure and material properties.
3. The student will recognize, express and identify the mechanical properties of metals and alloys as biomaterials.
4. The student will be able to organize and conduct laboratory tests in dental practice.
5. The student will be able to explain the basic principles and procedures for obtaining biomaterials for dental use.

Course content

Lecture

	Lecture topics	Number of classes/hours
1.	-	-
2.	-	-
3.	-	-
4.	-	-
5.	-	-
6.	-	-
7.	-	-
8.	-	-
9.	-	-
10.	-	-

1 sat = 45 minuta

Seminari

	Seminar topics	Number of classes/hours
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1.	Introduction to dental metals and alloys; Systematization of alloys	1
2.	Linkage of the structure and properties of metals and alloys as biomaterials	1
3.	Heat treatment of alloys (recrystallization, homogenization and precipitation of alloy)	1
4.	Biocompatibility and corrosion of dental metals and alloys	1
5.	Technologies of joining for identical and/or different metals and alloys; Lasers in dental prosthetics	1
6.	Welded joints errors	1
7.	Metal (Al, Zr) as a compound of ceramic material	1
8.	-	-
9.	-	-
10.	-	-

1 sat = 45 minuta

Vježbe

	practicals topics	Number of classes/hours
1.	Representation of metals and their selections for alloys making (University of Zagreb Faculty of Metallurgy)	1
2.	Representation of making procedures for alloys, sintered products and CAD/CAM blocks (University of Zagreb Faculty of Metallurgy)	1
3.	Laboratory fabrication of metals and alloys (casting, sintering, CAD/CAM technique) making (University of Zagreb Faculty of Metallurgy)	1
4.	Physical properties and biocompatibility of metals and alloys in dental medicine	1
5.	Application of gold alloys in dentistry	1
6.	Application of CoCr and AgPd alloys in dentistry	1
7.	Application of titanium and titanium alloys in dentistry	1
8.	Finishing treatments of fixed-prosthetic metallic base	1
9.	-	-
10.	-	-

1 class = 45 minutes

Literature:

2017. Mehulic K. I sur. Dentalni materijali. Medicinska naklada d.o.o. 352 str. Carek Andreja. Metali i legure u dentalnoj medicini: 162-185.

2020. Ketij Mehulić. Dentalna medicina-vodić za praktičare. Medicinska naklada d.o.o. 493 str. Carek Andreja. Planiranje fiksoprotetičke terapije i dijagnostički pristup, 249-265.

2019. Vanja Vučićević Boras. Hitna stanja u dentalnoj medicini. Naklada Slap: Zagreb. 156 str. Carek Andreja. Pregled pacijenta s hitnim stanjem: 13-28.

2005. Živko-Babić J. Jerolimov V. Metali u stomatološkoj protetici., Školska knjiga; Zagreb.

2012. Kenneth J. Anusavice. Phillips' Science of Dental Materials 12th Edition

2013. J. Anthony von Fraunhofer. Dental Materials at a Glance. 2th edition.

2002. R.E. Smallman, R.J. Bishop. Modern Physical Metallurgy and Materials Engineering. 6th Edition

2009. William J. O'Brien. Dental Materials and their selection. 4th edition.

CV (*curriculum vitae*) and bibliography of course leader:

Associate Professor Andreja Carek, DMD, MSc, PhD, graduated from the School of Dental Medicine in Zagreb, Croatia, in 2002. In 2003, she passed the state exam and obtained a license for independent work. In 2004, she began to specialize in prosthodontics and in 2007 she became a specialist in Dental Prosthetics. After receiving her Master of Science degree in 2005 and PhD in 2009 she became a senior assistant at the Department of Prosthodontics of the School of Dental Medicine in Zagreb. In 2008, she received the Dean's award for the best teacher at the School of Dental Medicine in Zagreb. Since 2011, Andreja Carek is Assistant Professor and has been a course instructor in the "Treatment planning and diagnostic approach in Fixed Prosthodontics" further education program at the Zagreb Dental School. In 2012, she was appointed head of the postgraduate professional study course "Treatment planning and diagnostic approach in the aesthetic zone" and head of the postgraduate scientific study course "Metals and alloys as biomaterials". In 2018, she became head of the undergraduate students course "EndoProsthodontics". The same year she was announced as a member of the board for Postgraduate studies and for International cooperation at School of Dental Medicine in Zagreb. Since 2020, she is assoc. professor at Dpt. of Fixed Prosthodontics and in 2021, she became head of the undergraduate students course "Fixed Prosthodontics I".

Andreja Carek is the author of the chapter "Metals and alloys in dental medicine" of the University

book "Dental materials", the author of the chapter "Examination of an emergency patient" of the textbook of the University book "Emergencies", author of the chapter "Planning of fixed prosthetic therapy and diagnostic approach" of the University book "Dental medicine - Guide for practitioners", author of the chapters "Impressions in fixed prosthetics" and "Post and Core" of the University book "Preclinical and Laboratory Fixed Prosthodontics". She is an author and co-author of many scientific papers and she has actively participated in numerous international conferences. She is a lecturer and training course instructor (KOL) at international meetings for 3M and Colgate. She is a **Secretary of the Croatian Society for Prosthetic Dentistry**, member of the European Prosthodontics Society, FDI, IADR, ICP, Croatian Society of Dental Implantology, Croatian Medical Association and the Croatian Dental Chamber.

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