

HISTOLOGICAL RESEARCH RESULTS OF SAMARIUM–COBALT MAGNETS SAMPLES

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This paper is a part of comprehensive initiative research project of the dental departments of the Higher State Educational Establishment of Ukraine «Ukrainian Medical Stomatological Academy»: «Improvement of orthopedic prevention methods and treatment of secondary edentulism, pathological abrasion, lesions of the periodontal tissues and TMJ diseases in adults on the background of somatic pathology» (state registration number 0111U004872).

Introduction. The need of population in complete removable dentures manufacturing is increasing while taking into account patients who do not use designs made for them. According to WHO data this group comprises from 20% to 26% of the total number of manufactured complete removable dentures. In 52% of such cases the patients complain about unsatisfactory prostheses fixation [2,3].

The problem of dentures fixing on toothless jaws has more than two centuries-old history. But it can't be considered completely solved. The new fixation methods of complete removable dentures are being developed continuously. The use of magnets for the dentures fixation has long been known [4,5,10].

Purposeful application of fixation methods with magnetic adhesion usage enables to achieve required prostheses resistance in orthopedic treatment of patients with teeth loss [6,7,8]. In 50-60 years of the last century magnetic alloys were proposed to apply for improvement of prostheses fixation, but the small coercive power and necessity for frequent magnetization were their disadvantages [1,9].

The aim of the study was to conduct the histological research of samarium-cobalt magnets samples to define the biocompatibility with the oral cavity tissues when fixing dentures.

Materials and methods. The magnets of samarium-cobalt type (Sm2Co17 XGS30) were the objects of the study included in sanitary-chemical and medicobiological researches.

The experiment was conducted on 10 white laboratory rats weighing 150-200 g. Under general anesthesia, in aseptic conditions the experimental samples of polymagnets were implanted subcutaneously to the dorsal area of the rats. Animals were given the overdose of ether on 7, 14 and 30 days after surgery. Sections with the thickness of 10-15 μ m, which were stained with hematoxylin and eosin were made for morphological analysis after standard histological processing (fixation in 10% formalin solution, dehydration in increasing concentrations of ethanol, pouring in paraffin) of

connective-tissue capsule that has formed around the implanted material.

The animal welfare and experiments were carried out in accordance with the provisions of «European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes» (Strasbourg, 1985), «General ethical principles of animal experimentation» adopted by the First National Congress on Bioethics (Kyiv, 2001).

The study results and their discussion. Macroscopically all samples around the connective tissue did not differ in color and structure from the tissues far from the site of implantation. Connective tissue capsule was easily detachable from the experimental samples through their smooth surface.

In 7 days after surgery the immature connective tissue capsule around the implanted sample was observed. The inner side of the capsule, which is in direct contact with the polymagnets samples was characterized by round cell infiltration (**Fig. 1**).

The main cellular elements of the capsule were leukocyte and lymphoid elements as well as macrophages, which were presented in moderate quantity. On the inside of the capsule the fibrin clots were revealed. The young forms of fibroblasts actively producing collagen began to appear at this stage of research. The microvasculature response to the experimental sample implantation was negligible, the single vessels of small diameter with normal microcirculation were observed.

In 14 days after surgery the mature and formed enough connective tissue capsule around the experimental sample was revealed (**Fig. 2**).

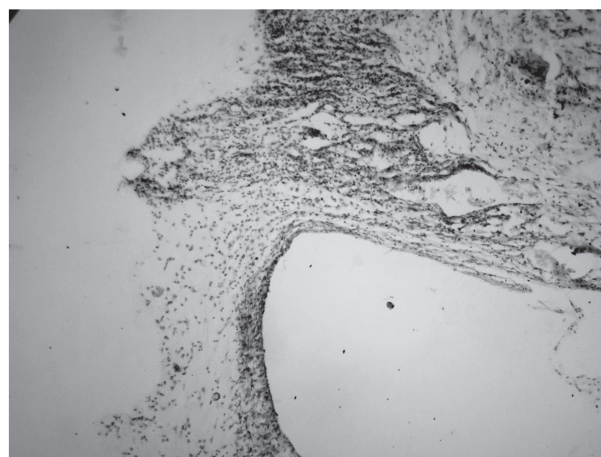


Fig. 1. Histological pattern around the implanted sample in 7 days after surgery. Hematoxylin and eosin X100 stain.

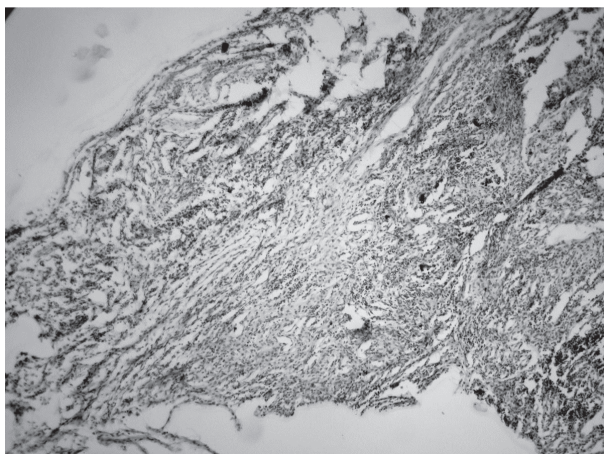


Fig. 2. Histological pattern around the implanted sample in 14 days after surgery. Hematoxylin and eosin X100 stain.

The main cellular elements of the capsule were fusiform fibroblasts that were in the bundles plane of mature collagenous fibers arranged along the implanted sample. It should be noted that there is little macrophage infiltration caused by protective organism response to the foreign body implantation. The connective tissue capsule contained single leukocytes and lymphoid elements on the separate sites. The microcirculatory response was negligible, as in the previous investigation period and was characterized by normal microcirculation of single blood vessels.

The thin and mature connective tissue capsule consisting of mature collagen fibers bundles oriented along the implanted sample and fusiform fibroblasts between them was observed in 30 days around the implanted sample (**Fig. 3**).

The little round cell infiltration, mainly of macrophage elements was revealed on the separate sites of connective tissue capsules. The intensity of the microcirculatory response was the same as in the previous experimental periods.

Conclusion. Thus, the implantation of experimental samples to the organisms of experimental animals

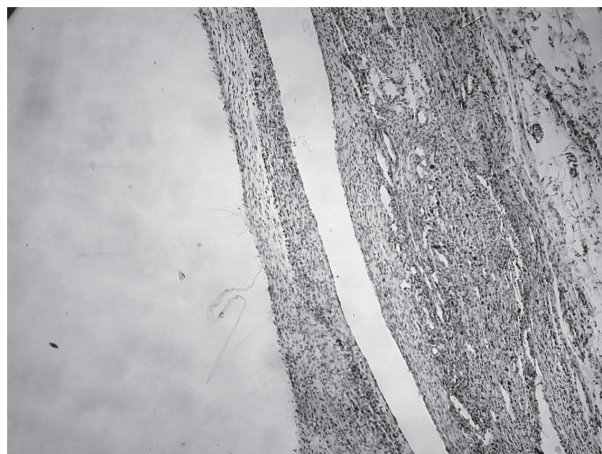


Fig. 3. Histological pattern around the implanted sample in 30 days after surgery. Hematoxylin and eosin X100 stain.

induced protective-compensatory cellular response of aseptic inflammation type, which was the normal physiological response of the organism to the foreign body presence. According to the morphological characteristics the signs of degenerative changes, tumors and tissue necrosis of connective tissue capsule and surrounding connective tissue around all implanted samples were not observed. Considering the low intensity of the connective tissue cellular response to the implantation of the experimental samples it can be concluded that the experimental samples are biocompatible with the tissues of experimental animals and may be widely used in medical practice after clinical investigations.

Conducted histological studies showed that the experimental polymagnets samples are biocompatible with the tissues of experimental animals and cause negligible reaction according to aseptic inflammation type in the site of their implantation.

Prospects for further research. The experimental study of the effects of samarium-cobalt magnets on the tooth tissues, namely the enamel and dentin with removable and fixed dental prosthetics are planned in future.

References

1. Джамус Белал Использование магнитных сил в ортодонтии: автореф. дис. на соискание научн. степени. канд. мед. наук: спец. 14.00.21-стоматология / Белал Джамус. – Кишинэу, 2004. – 20 с.
2. Згонник О.С. Нуждаемость в полном съемном протезировании населения города Полтавы и области / О.С. Згонник // Актуальні проблеми сучасної медицини: Вісник Укр. мед. стомат. акад. – 2003. – Т. 3. – Вип. 2 (6). – С. 24-26.
3. Король М.Д. Застосування самарій-кобальтових магнітів у знімному та незнімному зубному протезуванні. Огляд літератури / М.Д. Король, Д.М. Король, Н.В. Головкин [та ін.] // Новини стоматології. – 2008. – № 1 (54). – С. 53-55.
4. Летягина Р.А. Применение внутрикорневых фиксирующих устройств съемных зубных протезов / Р.А. Летягина, Ж.С. Бякова, А.Г. Рогожников, Е.В. Летягин // Зубной техник. – 2001. – № 2. – С. 40.
5. Марков Б.П. Фиксация протезов на беззубых челюстях / Б.П. Марков // Стоматологический вестник. – 2002. – № 2. – С. 44-55.
6. Ортопедическая стоматология: [руководство для врачей, студ. вузов и мед. училищ] / Н.Г. Аболмасов, Н.Н. Аболмасов, В.А. Бычков, А. Аль-Хаким. – М.: МЕД пресс-информ, 2002. – 576 с.
7. Патент № 2188603 RU МПК А61С13/235 «Устройство для магнитной фиксации съёмного зубного протеза» / С.В. Казаков, Г.Е. Кирко, И.М. Кирко, С.Г. Конюхова, А.Г. Рогожников. – Пермская государственная медицинская академия (RU). – № 2000109001/14; Заявл. 10.04.2000; Опубл. 10.09.2002; Бюл. № 36.
8. Рендо Б. Магнитная балочная конструкция от клыка до клыка: трамплин для перехода к несъемному протезированию на имплантатах / Б. Рендо, Р. Кальвани, Ф. Соллечито, С. Саба, В. Ток, Е. Финадеева // Новое в стоматологии. – 1997. – № 9. – С. 7-24.
9. Самарий-кобальтовый магнит – концентратор / www.imp.uran.ru.

10. Свирин Б.В. Получение функционального слепка с верхней и нижней челюстей после полной утраты зубов, обусловленной заболеваниями пародонта / Б.В. Свирин // Зубной техник. – 2003. – № 6. – С. 18.

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РЕЗУЛЬТАТИ ГІСТОЛОГІЧНИХ ДОСЛІДЖЕНЬ ЗРАЗКІВ САМАРІЙ–КОБАЛЬТОВИХ МАГНІТІВ

Король Д., Киндій Д., Король М., Козак Р., Скубій І.

Резюме. Метою дослідження було гістологічне вивчення зразків самарій–кобальтових магнітів з метою біосумісності з тканинами порожнини рота при фіксації знімних протезів. Об'єктами дослідження служили зразки магнітів типу самарій–кобальт ($\text{Sm}_2\text{Co}_{17}$ Xgs30), які піддавалися санітарно–хімічним і медико–біологічним дослідженням.

Експеримент проводився на 10 білих лабораторних щурах, вагою 150–200 г. Під наркозом, в умовах асептики, щурам субкутально в області спини імплантували дослідні зразки полімагніту. Тварин виводили з експерименту шляхом передозування ефіром на 7, 14 і 30 добу після операції. Для морфологічного аналізу після стандартної гістологічної обробки сполучнотканинної капсули, яка сформувалася довкола імплантованого матеріалу, були виготовлені зрізи товщиною 10–15 мкм, які забарвлювали гематоксиліном і еозином.

Проведені гістологічні дослідження показали, що дослідні зразки полімагнітів є біосумісними з тканинами експериментальних тварин і викликають незначну запальну реакцію за типом асептичного запалення у місці їх імплантації.

Ключові слова: самарій–кобальтові магніти, імплантація, гістологічні дослідження.

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РЕЗУЛЬТАТЫ ГИСТОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ ОБРАЗЦОВ САМАРИЙ–КОБАЛЬТОВЫХ МАГНИТОВ

Король Д., Киндий Д., Король М., Козак Р., Скубий И.

Резюме. Целью исследования явилось гистологическое изучение образцов самарий–кобальтовых магнитов с целью биосовместимости с тканями полости рта при фиксации съёмных протезов. Объектами исследования служили образцы магнитов типа самарий–кобальт ($\text{Sm}_2\text{Co}_{17}$ XGS30), которые подвергались санитарно–химическим и медико–биологическим исследованиям.

Эксперимент проводился на 10 белых лабораторных крысах, весом 150–200 г. Под наркозом, в условиях асептики, крысам субкутально в области спины имплантировали опытные образцы полимагнита. Животных выводили из эксперимента путем передозировки эфиром на 7, 14 и 30 сутки после операции. Для морфологического анализа после стандартной гистологической обработки соединительнотканной капсулы, которая сформировалась вокруг имплантированного материала, были изготовлены срезы толщиной 10–15 мкм, которые окрашивали гематоксилином и еозином.

Проведенные гистологические исследования показали, что опытные образцы полимагнитов являются биосовместимыми с тканями экспериментальных животных и вызывают незначительную воспалительную реакцию по типу асептического воспаления в месте их имплантации.

Ключевые слова: самарий–кобальтовые магниты, имплантация, гистологические исследования.

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HISTOLOGICAL RESEARCH RESULTS OF SAMARIUM–COBALT MAGNETS SAMPLES

Korol D., Kindij D., Korol M., Kozak R., Skubij I.

Abstract. The problem of dentures fixing on toothless jaws has more than two centuries-old history. But it can't be considered completely solved. The new fixation methods of complete removable dentures are being developed continuously. The use of magnets for the dentures fixation has long been known.

Purposeful application of fixation methods with magnetic adhesion usage enables to achieve required prostheses resistance in orthopedic treatment of patients with teeth loss. In 50–60 years of the last century magnetic alloys were proposed to apply for improvement of prostheses fixation, but the small coercitive power and necessity for frequent magnetization were their disadvantages.

The aim of the study was the histological investigation of samarium–cobalt magnets samples on biocompatibility with the oral cavity tissues when fixing dentures. The magnet samples of samarium–cobalt type ($\text{Sm}_2\text{Co}_{17}$ XGS30) included to sanitary–chemical and medico–biological researches were the objects of the study.

The experiment was conducted on 10 white laboratory rats weighing 150–200 g. Under general anesthesia, in aseptic conditions the experimental samples of polymagnets were implanted subcutaneously to the dorsal area of the rats. Animals were given the overdose of ether on 7, 14 and 30 days after surgery. Sections with the thickness of 10–15 μm , which were stained with hematoxylin and eosin were made for morphological analysis after standard histological processing of connective tissue capsule that had formed around the implanted material.

Macroscopically all samples around the connective tissue did not differ in color and structure from the tissues far from the site of implantation. Connective tissue capsule was easily detachable from the experimental samples through their smooth surface.

Thus, the implantation of experimental samples to the organisms of experimental animals induced protective–compensatory cellular response of aseptic inflammation type, which was the normal physiological response of the organism to the foreign body presence. According to the morphological characteristics the signs of degenerative

changes, tumors and tissue necrosis of connective tissue capsule and surrounding connective tissue around all implanted samples were not observed.

Considering the low intensity of the connective tissue cellular response to the implantation of the experimental samples it can be concluded that the experimental samples are biocompatible with the tissues of experimental animals and may be widely used in medical practice after clinical investigations.

Conducted histological studies showed that the experimental polymagnets samples are biocompatible with the tissues of experimental animals and cause negligible reaction according to aseptic inflammation type in the site of their implantation.

Keywords: samarium–cobalt magnets, implants, histological examinations.

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