

DENSITOMETRIC INDICATORS OF BONE TISSUE IN THE BONE-IMPLANT ZONE AT DIFFERENT PERIODS AFTER DENTAL IMPLANTATION

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ABSTRACT

In this scientific work degree of osteointegration at border bone - dental implant by a densitometry method in terms of 1, 3, 6 months was studied. The received results showed a positive tendency of dynamic increase in density of a neo formed bone on border implant — bone during various periods of research.

Key words: dental implant, osseointegration, densitometry, jaw bone.

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ДЕНСИТОМЕТРИЧЕСКИЕ ПОКАЗАТЕЛИ КОСТНОЙ ТКАНИ В ЗОНЕ КОНТАКТА КОСТЬ-ИМПЛАНТАТ В РАЗНЫЕ СРОКИ ПОСЛЕ ДЕНТАЛЬНОЙ ИМПЛАНТАЦИИ

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АННОТАЦИЯ

Проведено исследование степени остеоинтеграции на границе кость-дентальный имплантат методом денситометрии в сроки 1,3,6 месяцев. Полученные результаты показывают положительную динамику плотности новообразованной кости на границе кость-зубной имплантат.

Ключевые слова: дентальный имплантат, остеоинтеграция, денситометрия, челюстные кости.

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THE RELEVANCE OF RESEARCH

Currently, the use of dental implantation is especially relevant, as the most progressive method of eliminating dentition defects through permanent dental prosthetics. Its role in restoring the quality of life of patients is great. The

number of installed dental implants is growing, and the indications for dental implantation are expanding [1].

For the first time, for the development of this progressive branch of dentistry in Uzbekistan, a new design of a dental implant was

developed and a patent for a utility model was obtained (Utility Model Patent No. FAP 00819, Uzbekistan) [2]. In order to study the impact of the general and local reaction of the body to the inserted implant, to study the processes of osseointegration, experimental experiments were carried out on animals. Complete osseointegration of intraosseous implants is a fundamental condition for the long-term success of dental implant-supported prosthetics [3]. Reliable, quantitative assessment of the degree of osseointegration of intraosseous implants is crucial for choosing the design of the prosthesis, tactics for the functional loading of implants, and predicting the effectiveness of orthopaedic treatment.

It is known that quantitative analysis of x-ray images helps improve the quality and objectification of diagnostics. The studies performed using quantitative characteristics are superior in their information content to traditional X-ray examinations, not only at the stage of primary diagnosis. The principle of comparative assessment should be the leading one in determining the results and adequacy of the treatment at different stages of dynamic observation, in particular in diseases studying osseointegration processes.

In clinical practice, there are several possibilities for quantitative assessment of the degree of osseointegration and stability of implants [2]: clinical (percussion, manual control of implant stability); periotestometry; torque test using a torque wrench; frequency or magnetic resonance analysis; densitometric assessment of bone tissue density.

The last one, densitometry, is a diagnostic study that combines various methods of image acquisition and its quantitative analysis, the main task of which is to determine the mineral density of the bone tissue of an object.

Densitometric examination of radiographs makes it possible to expand the diagnostic capabilities of X-ray examination when studying the process of osseointegration of dental implants at various periods of observation.

PURPOSE

of our study was to study the density of newly formed bone tissue at the implant-bone interface by scientifically substantiating the method of

densitometric assessment of the optical density of bone tissue using X-ray images.

MATERIALS

An experimental study was carried out on 12 German Shepherd dogs, of both sexes, aged 2-3 years, weighing 25-30 kg. The studied dental implants were implanted into the jawbones of experimental animals.

METHODS

When analysing the data obtained, we used X-ray visualization, densitometric and statistical research methods.

X-ray examination was carried out using a Wireless device Portable X - ray Prox from DigiMed (South Korea) in the following periods: before implantation, during surgery, 1, 3 and 6 months after surgery.

The analysis of X-ray images in this work was carried out on a personal computer using the publicly available program "Image" J " (Wayne Rasband. National Institute of Health, USA. <http://rsb.info.nih.gov/ij/>). Radiographs were used to measure the density of newly formed bone tissue at the implant-bone interface.

To assess the density of the newly formed bone, the difference between the average brightness value of the pixels in the area of the implant-bone boundary and the adjacent (healthy) bone area was measured. The results are displayed on the screen in the form of a histogram with average values. Since brightness depends not only on the density of the object, but also on the settings of the device, in order to avoid the influence of the settings on the indicator, X-ray images were obtained under a certain radiation dose, the same throughout the entire study period, and relative indicators were also calculated.

The results of the obtained data were statistically processed using the Microsoft Office Excel 2012 program. The arithmetic mean (M), the error of the arithmetic mean (m) and the confidence interval (CI) for the 95% confidence level ($\alpha \leq 0.05$) were calculated. Differences in means were considered significant if the confidence intervals did not overlap.

RESULTS

Dynamic monitoring of the state of bone

tissue regeneration in the implant area at various follow-up periods (1, 3, 6 months) showed that obvious, clearly detectable differences are observed at the end of 3 months. Stabilization of the process is recorded at the end of the 6th month.

Let's consider this trend in experimental dog No. 1. Dental implantation was performed in place of the missing first premolar on the upper jaw on the right.

As a result of X-ray studies, it was established that at the time of surgery, clear contours of the alveolar bone were noted (Fig. 1). The bone tissue around the surgical bed was without pathological changes. The radiological signs of the adjacent tooth are in good condition. The periodontal gap of the adjacent tooth is normal, indicating the absence of an inflammatory process in the bone tissue.

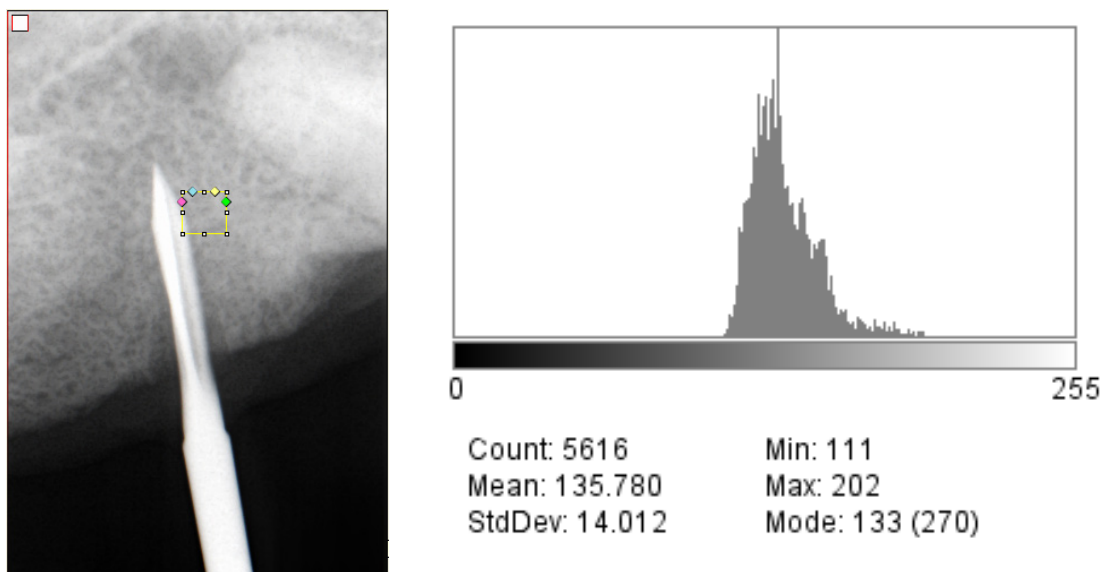


Fig. 1. During dental implantation

1 month after the operation, blurring of the contours at the implant-bone interface is noted. The newly formed tissue is visually homogeneous, and only in certain areas is the trabecular structure of the newly formed bone

tissue determined (Fig. 2).

The apex of the alveolar bone has not yet been restored and has unclear contours. In this area, horizontal loss of bone tissue is observed. In connection with this, the height of the alveolar

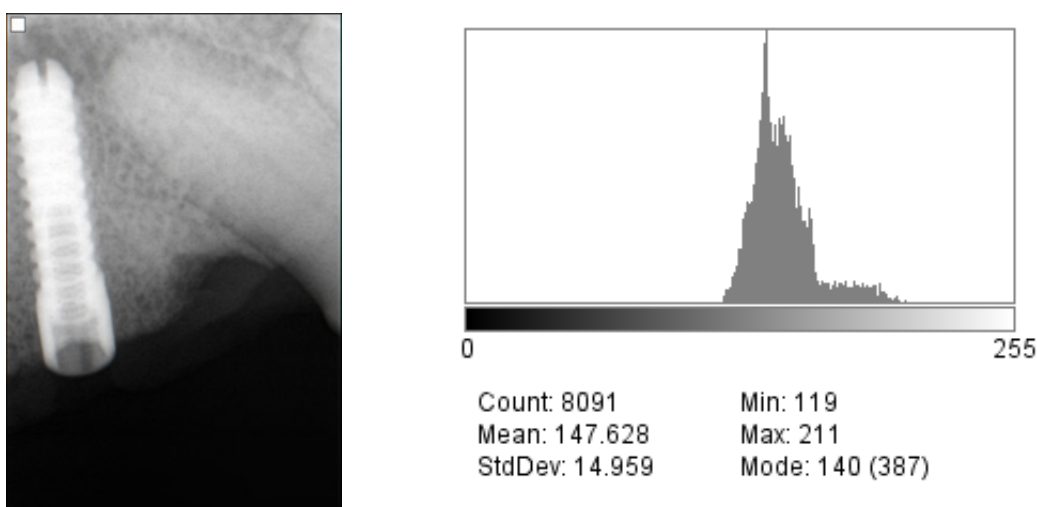


Fig. 2. 1 month after implantation

bone is reduced.

In experimental animal No. 1, at 3 months after surgery, the lumen is filled with newly formed bone tissue with a trabecular pattern at the implant-bone interface (Fig.3). The apex of the alveolar bone has not yet been restored, but is already acquiring a more even contour. Newly

formed bone textile It has mainly fine mesh trabecular structure a trabecular pattern is noted at the surgical site (Fig. 4).

The apex of the alveolar bone has not yet been restored, but is already acquiring a more even contour. The newly formed bone tissue along the entire length of the implant acquired

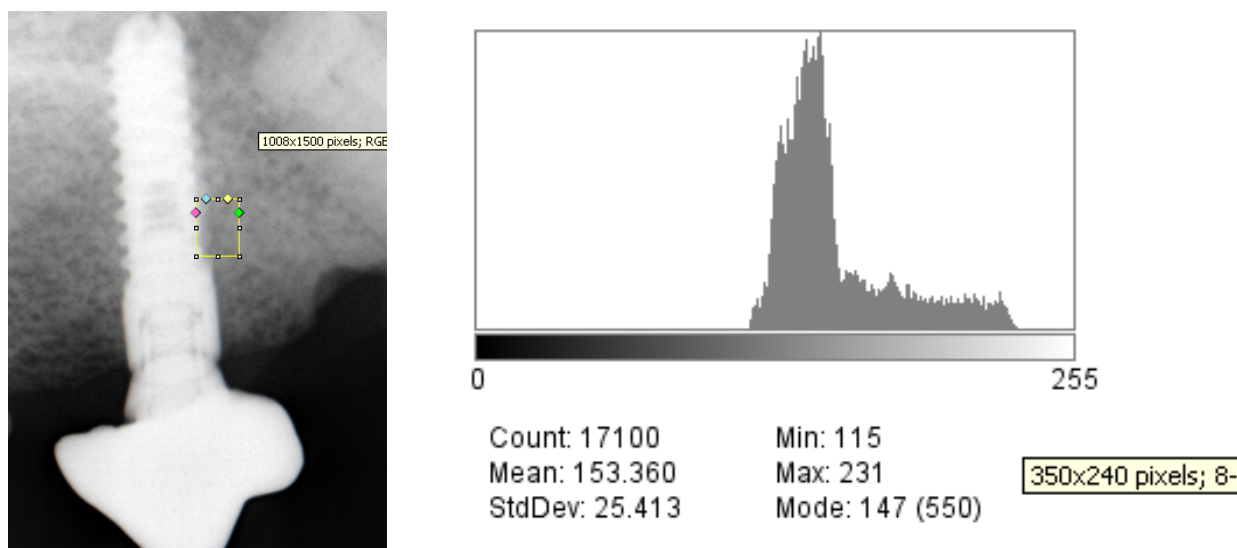


Fig. 3. 3 months after implantation

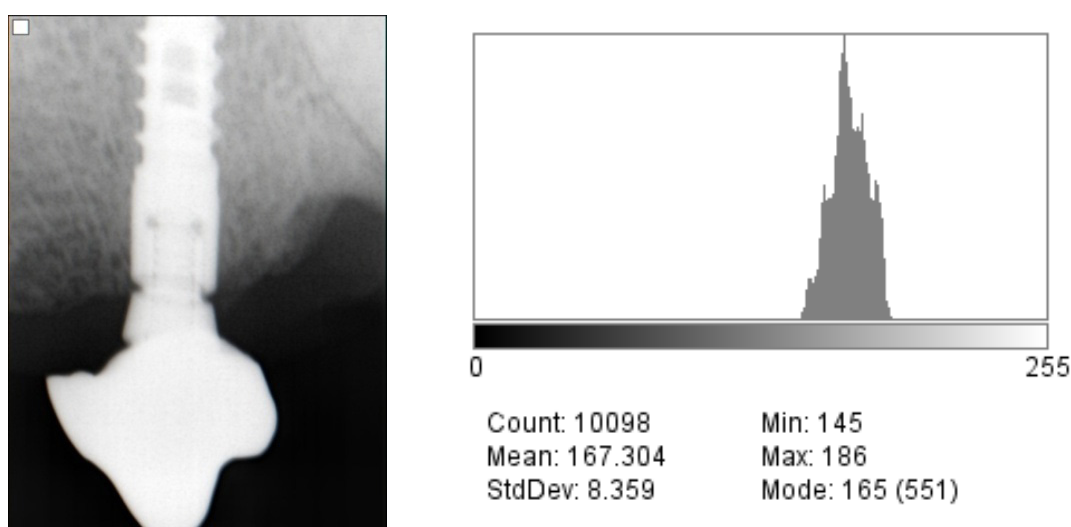


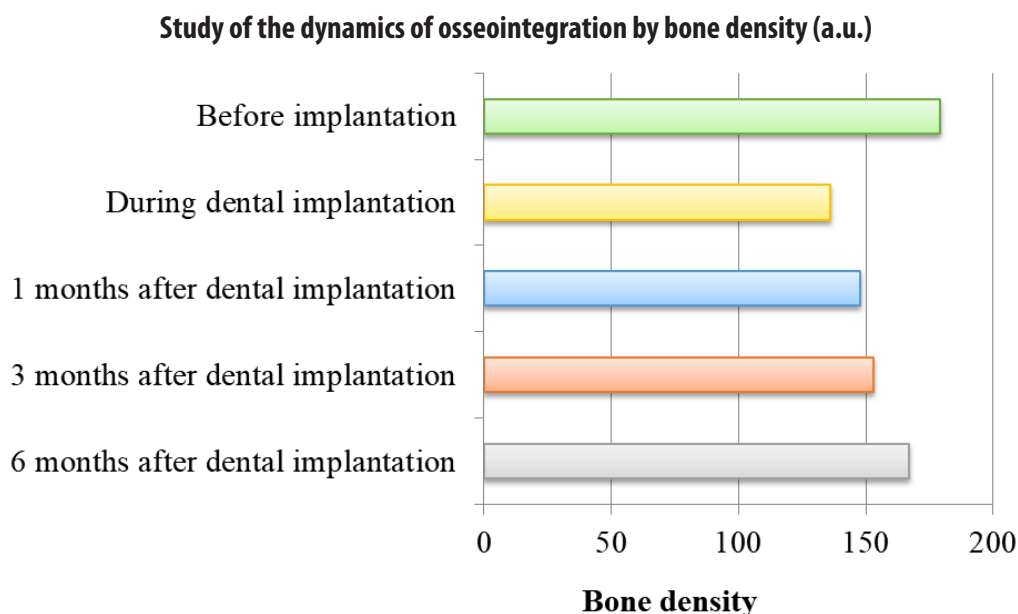
Fig. 4. 6 months after dental implantation

a trabecular structure, completely identical to the surrounding bone tissue. Horizontal loss of alveolar bone is not visually observed.

A similar study was conducted on the remaining 11 dogs, during which a direct relationship between the increase in bone density around the dental implant and the time elapsed since surgery was observed.

Strengthening osteoreparative processes in the surgical field is reflected in the average increase in X-ray bone density and a lesser degree of loss of alveolar bone tissue. Positive dynamics of osseointegration processes is achieved by the 6th month, marked by the density of the regenerate at the implant-bone interface close to the original indicator (Diagram 1).

Diagram 1



The X-ray data we obtained indicate the presence of bone tissue in the area of surgical intervention in the third month of the study. This is consistent with the data of Robustova T.G. (2005), which reports the presence of finely looped bone already 2-3 months after the operation. Although the density of the newly formed bone during this period is less than the control value, according to Kulakov A.A. (2004) after 6 months it approaches that of its own bone.

Thus, based on the results of X-ray examination and densitometry, we can state the positive dynamics of osseointegration processes using a domestic dental implant.

CONCLUSIONS

The study showed a positive trend in the dynamic increase in the density of newly formed bone at the implant-bone interface during different periods of the study. To determine the dynamics of the bone tissue regeneration process, we recommend performing an X-ray examination with computer analysis of X-ray images.

To objectively assess the degree of bone loss and the density of newly formed bone in the socket, we recommend using the ImageJ program (Wayne Rasband. National Institute of Health, USA. <http://rsb.info.nih.gov/ij/>).

ETHICAL STATEMENT AND CONSENT TO PARTICIPATION

The study was conducted in accordance with the local ethical committee.

CONFLICT OF INTERESTS

The authors declare the absence of obvious and potential conflicts of interest related to the publication of this article.

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AVAILABILITY OF DATA AND MATERIALS

All data generated or analysed during this study are included in this published article.

AUTHORS' CONTRIBUTIONS

All authors contributed to the design and interpretation of the study and to further drafts. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All applicable international, national and/or institutional ethical guidelines have been followed.

CONSENT FOR PUBLICATION

Not applicable.

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КОНФЛИКТ ИНТЕРЕСОВ

Авторы заявляют, что данная работа, её тема, предмет и содержание не затрагивают конкурирующих интересов.

ИСТОЧНИКИ ФИНАНСИРОВАНИЯ

Авторы заявляют об отсутствии финансирования при проведении исследования.

ДОСТУПНОСТЬ ДАННЫХ И МАТЕРИАЛОВ

Все данные, полученные или проанализированные в ходе этого исследования, включены в настоящую опубликованную статью.

ВКЛАД ОТДЕЛЬНЫХ АВТОРОВ

Все авторы внесли свой вклад в подготовку исследования и толкование его результатов, а также в подготовку последующих редакций. Все авторы прочитали и одобрили итоговый вариант рукописи.

ЭТИЧЕСКОЕ ОДОБРЕНИЕ И СОГЛАСИЕ НА УЧАСТИЕ

Были соблюдены все применимые международные, национальные и/или институциональные руководящие этические принципы.

СОГЛАСИЕ НА ПУБЛИКАЦИЮ

Не применимо.

ПРИМЕЧАНИЕ ИЗДАТЕЛЯ

Журнал *"Интегративная стоматология и челюстно-лицевая хирургия"* сохраняет нейтралитет в отношении юрисдикционных претензий по опубликованным картам и указаниям институциональной принадлежности.

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