

Densitometric study of extraction site healing in rats

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Abstract:

Aim: A complete knowledge of bone healing is a prerequisite to many decision makings in dentistry and is considered as a basic event in some research strategies. Any method that can accurately monitor the healing process is important to clinician providing the information required for further treatment planning. Our study shows a simple and reliable method to evaluate the events that occur during socket healing in rats.

Materials and Methods: Thirty five "Sprague - dawley" male rats were selected. All rats were anesthetized with intra peritoneal injection of Ketamin 10% and Xylazine 2% at the dose of 2 ml/kg on day 1. Mandibular left first molars were extracted with the use of very small excavator and hemostat forceps. At the same day, 7, 14, 21, 28, 45 and 60 days after extractions, five rats were sacrificed, the left mandibles were removed and placed into 10% Formaline. Muscles and gingival tissue were dissected away the following day and the mandible was placed on a radiographic film and the buccal views were taken. The radiographs were scanned and analyzed with Avend (program that designed in matlab 6.1).

Results: Increased density of the image of apical and crestal areas of the socket was observed on day 7. The maximum density of apical area was reached on day 28 and preceded towards crestal area on day 60. Density increasing in the crestal area is slower than apical area.

Conclusion: Densitometric evaluation of extraction socket healing using Avend program is useful and reliable to objectively assess bone formation and mineralization.

Key words: Densitometry, Animal study, Extraction Site, Healing

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Bone formation in the tooth socket is an important factor for dentists in designing treatment plan after extraction such as prosthetic, implant, etc. Healing process after tooth extraction was considered histological and radiographic aspects in human and animals. Histologic consideration in animals show tooth socket healing stages in animals is similar to human but these stages are faster in animals.¹

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Taking radiographs because of speed, repeatable measurements and noninvasive nature related to histologic consideration in clinical conditions is more preferable. Bone healing in radiographic aspect was determined as increasing bone radiopacity and to specify bone healing steps, variation of radiopacity in several radiographs must be studied. The radiopacity of different parts of tooth socket was compared with normal bone radiopacity. There are several methods for quantitative analysis of radiographs such as computerized densitometer, micro densitometry, scanning micro densitometry, which are used for diagnostic variation in jaw trabeculation design. They are not for evaluating healing region after tooth extraction.²⁻⁴ The purpose of this study is to evaluate bone healing of young rats' mandibular first molar extraction with a simple and repeatable radiographic method.

Materials and Methods:

Thirty five "Sprague - dawly" male rats were selected, with a mean weight of 120 gr. All rats on day 1 were anesthetized with intra peritoneal injection of Ketamin 10% and Xylazine 2% at the dose of 2 ml/kg. Mandibular left first molars were extracted with the use of very small excavator and hemostat forceps. One each stage; day 1, 7, 14, 21, 28, 45 and 60 days after extractions, five rats were scarified and the left mandibles were removed and placed into 10% Formaline. The muscle and gingival tissues were dissected away the following days then the mandible was placed on a radiographic film and the buccal view was taken. The radiographs were scanned and analyzed with Avend program that designed in matlab 6.1. After scanning, ⁵ crops in apical and crestal region of mesial and distal of tooth socket were done in Photoshop Ver.7. The software for statistical analyzing was SPSS ^{11.5}.

Results:

Increased density of the images of apical and crestal areas of the sockets was observed on day 7. The maximum density of apical area was reached on day 28. It was achieved on day 60 in the crestal area. So, increase of density in the crestal area is slower than apical area. From the 7th day to 60th, the average of bone density was increased and maximum average was seen in 28th day (Distal: 75.84 \pm 3.77, Mesial: 73.1 \pm 6.39), but from 28th to 60th day, the average showed very low variation. For crestal region the average of bone density was increased too.

In all days the average of bone density in apical was lighter than crestal. The maximum bone density in apical was seen in day 28 but in crestal region was seen in 60th day. (Table I)

Table 1: Densitometric findings in different locations during study

Days	Ap.Dis.#	Ap. Mes.	Cres. Dis.	Cres. Mes.
0	11.61	11.22	11.22	10.44
7	15.09	14.7	13.56	13.54
14	31.73	32.12	22.84	24.38
21	61.9	59.58	33.7	36.37
28	75.84	73.13	49.98	47.6
45	72.36	71.58	62.29	62.29
60	75.06	71.6	72.75	72.35

Ap.Dis. = Apical Distal; Ap. Mes.=Apical Mesial; Cres. Dis.= Crestal Distal; Cres. Mes.= Crestal Mesial

Discussion:

Histologic phases of the extracted tooth socket healing have been assessed extensively in human and different kind of animals, such as rats. ⁵⁻¹⁰

Proceduure of this healing are divided into three phases: ¹¹

1- First phase (1-5 days): During this phase clot of blood is organized completely and tooth socket is covered to some extent by epithelium.

2- Bone organization phase (5-20 days).

3- Remodeling phase: during this phase primary bone is matured and alveolar ridge reorganized.

Study and clinical follow of first phase is possible while second and third phase of bone healing could be assessed by histologic and radiographic methods. Bone organization at tooth socket is important both in dental clinical observation and in the use of dental implant at that site. ¹² At this study, bone organization was observed on 7th day at first. This organization is assessed by radiographic and observation of bone density increase.

Result of this study is in accordance with Smith that confirms new bone organization on 8th day. ⁷ At the other similar study, Boodner and his collaborators, reported first bone organization on 7th day. ¹ In addition, in the other comparison that was done during our study, crestal, apical area both showed new bone organization 7 days after extraction that is in accordance with

Boodner and collaborators.¹³ They discovered histologic new bone organization with a little difference on 5th day.

On the other hand, Huebsch reported bone organization histologically on 5th day but radiographic study showed this primary organization on 16th day.⁹ Tennenbaum and Shklow observed on the other study that tooth socket is filled with new bone during a week. Motti and Cabrini described on their observation, that socket's radiograph was opaque on 7th day.⁸

At radiographic studies, standard and reproducibility is necessary. Meanwhile objective parameters and reference points must be obtained to compare different radiographs of a tissue at different times with themselves, and with results of other studies.

According to Carvalhoo et al. they also confirm such capability at densitometry because densitometric and histologic results were comparable.¹¹

Fast increase amount of density at apical area as compared with crestal area could be as a result of anatomic form, because if we section half horizontally on socket, we will observed very smaller appearance that such section on half crestally because of this bone organization and mineralization of apical area happens fast.^{5, 13, 14}

Conclusion:

This densitometric study makes available numerical information from socket healing and reflect real phase of bone organization and healing. Utilizing computer programs that show accurately rate of radiographic density is a new method of densitometric study. Thus, studying effective factors in bone healing could find extensive results that can be used as a guide in other studies.

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