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Research Article

Can the Age Affect the Regenerations Carried Out With Dental Graft?

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Abstract

Introduction: The tooth extraction is followed by marked osseous changes of the residual alveolar ridge including severe bone alterations both in height and width. For this reason has been developed the Alveolar Ridge Preservation (ARP). It is important for the dental surgeon to know how the alveolar crest changes when a ARP is performed. The metabolism affects bone repair reaction. To prevent alveolar ridge dimensional changes, since numerous graft materials have been suggested. In the last years, a growing interest in teeth material, due to his bone similarity, has been observed as a valuable alternative to synthetic biomaterials.

Aim: We want to assess if the age affects the regenerations ARP using dental graft.

Material and Methods: In this study 115 histologies from different patients (59 Male and 56 female) were analyzed splitting in six different age range: 20-30, 30-40, 40-50, 50-60, 60-70, over 70. The statistical analysis was effectuated using a P-value analyzing the differences between each age each other and cumulative.

Results: The statistical differences are not relevant even if the sample's number is limited only in two groups the differences are slightly above the significant value. The differences between the average value is not significative P <0,05.

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Conclusion: Any differences is evident between different ages.

Keywords

Bone Structure; Scar; Tooth Transformer; Bone Grafting

Introduction

Tooth extraction always implies the alveolar bone resorption, due to remodelling process of the tooth socket. In general terms, as reported in Literature, the amount of bone resorption following tooth extraction is 1.76 + 2.03 vertically and 3.87 horizontally, on average [1].

The scientific literature proved that the process of the alveolar socket remodelling reaches the highest rate during the first year after extraction, but it also leads to a visible decrease of soft tissue trophism, that is directly related to bone reduction [2].

Several techniques were proposed in order to maintain the bone volume and reduce bone resorption [3,4].

Bone structure and mass are maintained by the equilibrium of bone absorption and formation. The aging can change this equilibrium and the bone resorption exceeds bone apposition. This disease is increasingly seen in aging societies [5].

One of the risk factors for regenerations therapies and implant therapy is poor bone quality. Bone generally has effective capacity to heal and due to continuous remodelling of bone throughout adult life, healing often occurs with no scar [6].

Bone grafting is one of the most common procedures used to treat complex bone fractures, which are hard to heal otherwise. Current grafts include autografts and allografts [7]. Human dentin matrix can be successfully used for bone grafting procedure. It is well known that dentin grafts can induce osteoblasts proliferation. An innovative preparation method, using the dedicated automated device Tooth Transformer, which is able to transform autologous teeth in suitable grafting material, has been recently introduced [8].

Aim of Study

The aim of this study is to analyze the results of 115 ARP therapy made using the dentin graft from tooth transformer device subdivided by aging to understand if the age can change the quality of the new bone or the possibility to produce the enough quantity of bone.

Materials and Methods

Between April 2019 and March 2022, subject were recruited from patients which need tooth extraction in the upper and lower maxillae. The study was performed following the standard protocol for socket preservation and implant placement without adopting any experimental procedure. All data were anonymized. The present study was carried out following the principles embodied in the Helsinki Declaration, in its latter form [9].

On March 21st 2019, the University of Chieti Ethics Committee authorized the clinical study protocol on a human model registered under the number: 638-21/3/19.

Inclusion and Exclusion Criteria

The histomorphometric analysis was performed on samples selected according to the following inclusion criteria:

- Subjects who underwent surgical intervention for tooth removal and alveolar socket preservation by using only tooth-derived bone substitute (Tooth Transformer®-Tooth Transformer SRL, Milan, Italy)
- Subjects who underwent implant placement in the same site of socket preservation
- Subjects who did not present any systemic diseases and conditions that could cause an impairment of the bone metabolism
- Cases referring to pregnant or lactating women were excluded

Surgical Protocol

All the surgeries were performed by trained expert clinicians, with more than 10 years of clinical training in the field. Briefly, the preparation of the tooth-derived substitute material followed the procedure here described. First, the extracted tooth was accurately cleaned from residual calculus and thoroughly polished by using a diamond drill (ref. 6855 - Dentsply Maillefer, Ballaigues, Switzerland) with abundant saline solution irrigation. The procedure required the complete remotion of any root filling material from the selected tooth. Afterwards, the tooth was cut in small pieces and the fragments were placed in the mill (Tooth Transformer ® - Tooth Transformer srl, Milan, Italy) previously prepared, following the procedure described in previously published studies [8].

After 25 minutes, the material was ready to be placed in the recipient area, prepared by performing cortical perforations with a 1.5-2 mm spiral drill, to enhance the bone healing process [10].

Once grafted, the defect was covered with a resorbable membrane (Osseo guard-Zimmer Biomet, Palm Beach Gardens -USA).

Dental implants were placed in the grafted area after a healing period that ranged between 3 to 12 months. For the preparation of implant site, a 3 mm trephine bur (Meisinger, Neuss, Germany) was used under copious irrigation with saline solution associated or not with other specific drills, following the standard protocol. Implants were positioned with different torque values. The healing period was not shorter than 3 months.

Histological Technique

The specimens were decalcified and the paraffin-embedded and cut. Samples were fixed in buffered formalin for 7 days. Decalcification was carried out with disodium EDTA pH 7 until total decalcification, the endpoint was determined physically. Specimens were then dehydrated in ethanol of rising concentration from 70% to 100%, cleared with xylene, and embedded in paraffin; all the chemical use were manufactured from Carlo Erba reagents. Paraffin slides were obtained with a Lecia RM2245 rotatory microtome and placed on superfrost microscope glass slides e mounted with Biomout HM bio-optica. The histological images obtained from the transmitted light microscope (Olympus, Shinjuku, Tokyo, Japan) were digitized through a digital camera and analyzed by means of an image analysis software IAS 2000 (QEA, Billerica, MA, USA).

A percentage of mineralized volume with exclusion of medullary tissues (BV%), a percentage of the remaining graft, excluding bone and marrow (residual graft TT %) and a vital bone percentage excluding the medulla and residual graft (Vital Bone (VB)%) were detected.

Statistical Methods

Data statistical analysis was carried out to obtain average.

Values and to compare the behavior of the six groups. Outcome measures of the exploratory study were analyzed with a t-test for paired samples for pre-post differences with time as the factor using. Statistical Package for Social Sciences (SPSS for Windows, Version 11.5, Chicago, IL, USA) software, to detect significant differences between pre-test and post-test scores Table 1.

The level of significance was $P < 0.05$.

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Analyze:
p>0.05 No statistical significance value
p<0.05 The hypothesis is wrong
p-value (significance level)

	Age	Numerousness	Average VB%	P-value Significance level
Average VB% 35,841	Group 1 (20-30)	4	45,803	0,131898306
	Group 2 (30-40)	10	27,788	0,236302859
	Group 3 (40-50)	31	30,487	0,30069756
	Group 4 (50-60)	26	36,207	0,465552483
	Group 5 (60-70)	31	33,380	0,896458442
	Group 6 (up to 70)	13	41,382	0,093218453

Table 1: Statistical differences between the groups.

Results

A total of 115 biopsies belonging from 115 patient (59 males and 56 females) were retrieved and analyzed.

The mean healing time was 5 months. The Table 2 show the numbers of subjects and the percentage of new bone produced after 5 months of healing time to the ARP procedure.

The subjects were subdivided in 6 groups by age.

Age	Male	Female	% of New Bone
27,75	2	2	45,8+-19,07
37,3	5	5	27,7+-12,74
46.3	15	16	30,4+-16,11
53,7	12	14	36,2+-14,6
65,8	20	11	33,8+-14,75
76,1	5	8	41,3+-14,2
	59	56	35,841+-6,77

Table 2: Number of subjects and new bone percentage.

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Discussion

Bone of deproteinized bovine origin or alloplastic materials are used as graft very often [11]. These materials have the characteristic of maintaining space and are embedded in the bone matrix in formation. The newly formed bone tissue will consist mainly of residues of the graft material and a small percentage of new bone. The use of tooth particulates, even after root canal treatment, offers the advantage of possessing osteoinductive molecules, like BMP-2 that are present in the dentin [12]. The use of the tooth graft is evaluated as an autologous graft, but some doubt remains about the use of teeth with root canal therapies.

Elderly patients are often the target population for implant therapy. Such patients are more likely to have systemic diseases. Therefore, the effects of systemic diseases are an important issue that needs to be clarified to achieve good outcomes from implant therapy [13].

Moreover osteoporosis and osteopenia affect the survival rate of implants. They examined 746 women (3,224 implants), who were at least 50 years old at the time of implant placement. Their statistical analysis showed that patients diagnosed with osteoporosis or osteopenia were not significantly more likely to develop implant failure compared with those without such a diagnosis. Therefore, they concluded that a diagnosis of osteoporosis and osteopenia did not contribute to an increased risk of implant failure.

Histological analyses of the excised tissues suggest that all implants were infiltrated with host cells despite the age differences among the recipients [14].

Age of the recipients had a strong influence on the rate and the amount of bone formation. As evident by the radiographic and histochemical analyses, 6-month-old mice showed delayed bone regeneration, while the 14-month-old mice exhibited a compromised tissue repair ability with no significant increase in calcification observed between 2 to 8 weeks. These findings are in agreement with the clinical observations that the ability of the bone tissue repair declines with age *in-vivo*, we found that old donor cells were able to regenerate new bone in the critical-size defect model in both young and old animal hosts as efficiently as young [15-17]. However, bone regenerative capacity was reduced in old animal hosts compared to young animal hosts [18].

With aging, the proliferative and functional abilities of macrophages and MSCs are impaired because of a combination of intrinsic and environmental factors.

At the same time, aging negatively impacts MSC proliferation and differentiation, further impeding the bone-healing process [19]. From this point we would like to investigate if the aging could influence the regeneration process using a tooth derivative graft.

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Conclusion

Despite the differences in age statistically no significant changes in the P-value is observed Several studies will be useful to know the real impact of this innovative technology on dental and maxillo-facial hard tissue regeneration therapy; however, the very promising results of our study show a high percentage of new vital bone around the residual graft material, suggesting that the autogenous demineralized tooth graft obtained by the TT Transformer medical device can be considered a feasible alternative to biomaterials currently used in human alveolar socket preservation procedures to promote bone healing in intraoral defects.

Conflict of Interest

The authors declare no conflict of interest.

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