Clinical and radiographic study in extraction sockets using an impermeable barrier

Estudo clínico e radiográfico em alvéolos pós exodontia com barreira impermeável

Estudio clínico-radiográfico en alveolos de extracción mediante barrera impermeable

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ABSTRACT
Evaluate the width and height dimension in dental human sockets covered by an impermeable barrier for a guided bone regeneration technique. Sixteen tooth extractions were performed, divided into two groups: a) Study group (n = 10), with polypropylene barrier; b) Control group (n = 6), without polypropylene barrier. The alveoli of both groups were filled with only blood coat. The evaluation was clinical to measure width, and radiographic for height. Evaluations were done immediately after tooth extraction and four months later. The mean reduction in width was lower in the study group ($p < 0.05$, bi-flow test), while in height there was no difference between groups ($p > 0.05$, bi-flow test). The width loss was lower in the barrier group, but there was no difference between groups in height loss.

KEYWORDS: Tooth socket. Surgery, oral. Bone regeneration.

RESUMO

Avaliar as dimensões de alvéolos dentários humanos, em altura e largura, nos quais foi usada uma barreira impermeável de polipropileno na técnica de regeneração óssea guiada. Dezesseis extrações dentárias foram realizadas e divididas em dois grupos: a) Grupo de estudo (n = 10), com barreira de polipropileno b) Grupo controle (n = 6), sem barreira de polipropileno. Os alvéolos de ambos os grupos foram preenchidos apenas com o coágulo sanguíneo. A avaliação da largura foi clínica, enquanto a da altura foi através de radiografia. As avaliações foram feitas imediatamente após a extração dentária e quatro meses depois. A média da redução da largura foi significativamente menor no grupo de estudo ($p < 0.05$, bi-flow teste), enquanto não houve diferença significativa na altura alveolar entre os grupos ($p > 0.05$, bi-flow teste). A perda de largura, quatro meses após a cirurgia, foi menor no grupo de dentes em que foi usada a barreira, entretanto não houve diferença entre os grupos em relação à perda de altura alveolar.

PALAVRAS-CHAVE: Alvéolo dental. Cirurgia bucal. Regeneração óssea.

RESUMEN

Evaluar la dimensión de ancho y alto en alveolos humanos dentales cubiertos por una barrera impermeable para una técnica de regeneración ósea guiada. Se realizaron dieciséis extracciones dentales, divididas en dos grupos: a) Grupo de estudio (n = 10), con barrera de polipropileno; b) Grupo control (n = 6), sin barrera de polipropileno. Los alvéolos de ambos grupos estaban llenos solo de sangre. La evaluación fue clínica para medir el ancho y radiográfica para la altura. Las evaluaciones se realizaron inmediatamente después de la extracción del diente y cuatro meses después. La reducción media en el ancho fue menor en el grupo de estudio ($p < 0.05$, prueba de doble flujo), mientras que en la altura no hubo diferencia entre los grupos ($p > 0.05$, prueba de doble flujo). La pérdida de ancho fue menor en el grupo de barrera, pero no hubo diferencia entre los grupos en la pérdida de altura.

PALABRAS CLAVE: Alveolo dental. Cirurgía bucal. Regeneración ósea.

INTRODUCTION

In general, bone healing after tooth extraction by second intention ends at around eight weeks[1]. During the healing process of the socket, there is reduction of the alveolar ridge[2]. However, the following bone remodeling is variable among patients[3], since several factors may contribute to the speed and severity of resorption[4]. This is usually higher in the first three months and is more pronounced on the oral surface of molar teeth[5-7]. When there is loss of the alveolar wall during tooth extraction or due to previous periodontal disease, reduction of the alveolar ridge can be aggravated[3]. The guided bone regeneration technique (GBR) is a surgical intervention that utilizes membrane barriers with or without the use of bone grafts or surrogates[8-10]. The basic principle of this technique is to reduce the proliferation of epithelial and connective cells in the bone defect, and to promote the migration of osteogenic cells and the osteogenesis process, as well as to maintain socket space and provide stability to the fibrin clot[8,11-13].

In general, the materials used as membranes are porous and have specific indications of use (for example, absence of exposure to the oral environment, prolonged healing periods and a second surgery for removal); in addition, they have significant morbidity, especially when associated with other materials of bone filling[8,10-11,14-15]. Non-resorbable barriers exposed to the oral environment have also been used, which can be removed without a second surgical procedure[16]. This latter type of membrane is particularly indicated when tissue suturing can cause great strain on the flaps[9].

Impermeable membrane exposed to the oral cavity can also been used in GBR, without primary closure of the flaps; it can be removed in a short period of time without the need for a second surgery[17-20]. Therefore, the objective of this study was to evaluate, clinically and radiographically, bone healing after tooth extraction followed by guided bone regeneration using an impermeable polypropylene barrier, which was exposed to the oral environment. This study group was compared with a control group, which did not use a barrier and whose healing occurred by the conventional second intention process.

MATERIAL AND METHODS

Fourteen patients underwent extraction of 16 teeth. The teeth were divided into two groups: a) Study group (n = 10), where the socket was filled with a blood clot covered with an impermeable polypropylene barrier (Bone Heal®, São Paulo, Brazil) and b) Control group (n = 6), wherein the socket filled with the blood clot was allowed to heal by conventional second intention.

Inclusion criteria: Incisors, canines and premolars with periodontal disease, root fracture or deep decay, and maintenance of adjacent teeth to the tooth extraction area. Exclusion criteria: edema due to acute tooth infection, smoking more than 10 cigarettes per day, chronic systemic diseases and pregnancy. All patients received previous periodontal treatment and also oral hygiene orientation. Periods of evaluation: immediately after tooth extraction, seven days and 120 days after surgery. Evaluation tools: digital caliper (Digimess, São Paulo, Brazil) and digital radiography. Dental procedures: the teeth molding was performed with alginate; so, one temporary prosthesis and one surgical guide in acetate, covering the occlusal surfaces to the middle third of the teeth, were then made. In the vestibular and palatine faces of the teeth, marks were made that served as reference for the measurement with the caliper (Figure 1). Radiographic examination was conducted as follows: Single 0.5-second exposure using Kodak d-speed films and 70x spectro-ray dental machines with 70 kVp and 10 ma work records. Processing was performed in standard solution, the time-temperature method was approximately 27.5°. To ensure the reproducibility of the images with maximum fidelity a silicon coupling device was made to the radiographic positioner guided by dental intercuspation (Figure 2). The radiographs were scanned with a resolution of 300 dpi (Digimazer software for linear measurement between two data points). Fixed reference lines were drawn between the root apex and between adjacent tooth cusps and the measurements obtained at height between the reference lines to the bone crest remaining at two points (mesial / distal) at the radiopaque site (Figures 3 and 4).

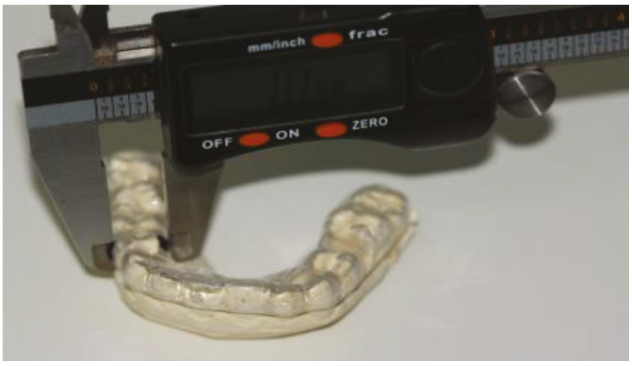

Figure 1 - It shows the digital caliper used to measure the socket width and the surgical guide of acetate covering the occlusion surfaces of the teeth.

Figure 2 - The device silicon guide in position to do the radiography.

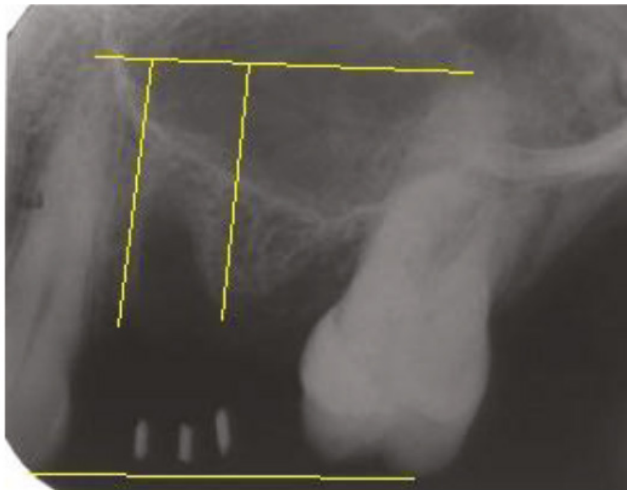

Figure 3 - The fixed reference lines were drawn between the roots apexes of adjacent teeth and the remaining bone crest at two radiopaque points (mesial/distal).

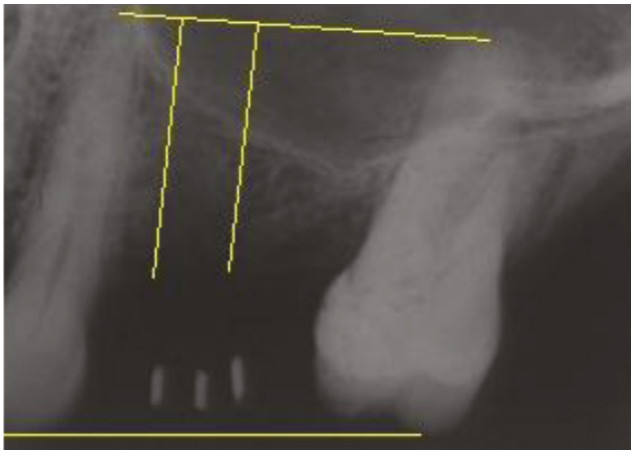

Figure 4 - Measurement of socket dimension 120 days later.

The surgical procedures were performed under local anesthesia (mepivacaine hydrochloride with epinephrine at concentrations of 36 mg and 18 µg, in a 1.8 mL carpule syringe) and with an atraumatic technique to preserve as many bone walls as possible (Figure 5). The tooth alveolus was filled exclusively with blood clot and no bone graft was used. Surgical flaps were of total thickness on all surfaces (vestibular, lingual or palatal) and healing was by second intention. When the barrier was used, it covered the clot, and was left exposed to the oral cavity. The suture was performed with silk thread (Johnson & Johnson, São Paulo, Brazil) and aimed to keep the barrier in place, without intending the flaps. When the membrane was not used, the suture was performed on the clot. The suture and barrier were removed on the seventh day after surgery (Figures 6 and 7).

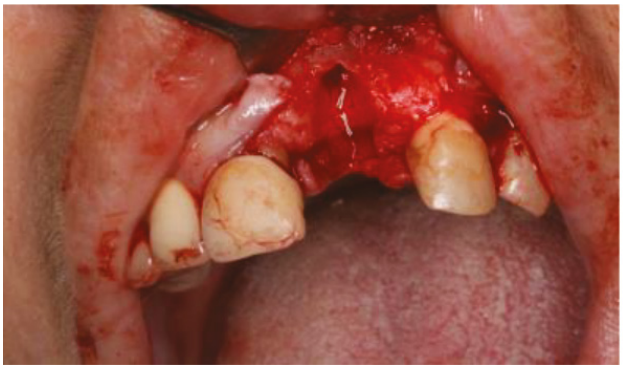

Figure 5 - Aspect of the socket after the exodontia; it is possible to see the loss of the vestibular alveolar bone wall.

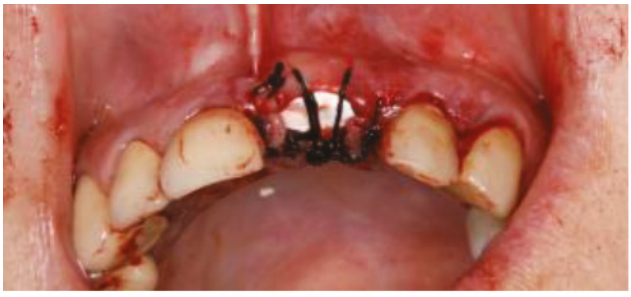

Figure 6 - At the end of the procedure: the prolypropylene barrier in position and exposed to the oral environment.

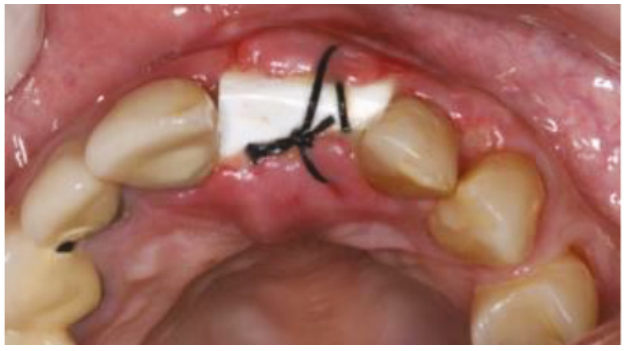

Figure 7 - Seven-day follow up when the suture and the propypropylene barrier were removed.

Postoperative recommendations: 2 g of amoxicillin was prescribed 1 hour before surgery and 500mg every 8 hours after, for 7 days, or clindamycin 300 mg every 8 hours, in case of allergy to amoxicillin; acetaminophen 750 mg was prescribed if necessary; mouthwashes with chlorhexidine 0.12% twice daily for one week; drink cold liquid or pasty diet were indicated for the first postoperative day; use of cold compress on the face in the first three hours, avoid physical exertion and exposure to the sun on the first day. Follow up of 120 days: A new periapical RX and clinical measurements were performed using the acetate guide and the caliper. At this stage, the implants were placed surgically into the bone (Figures 8 and 9).

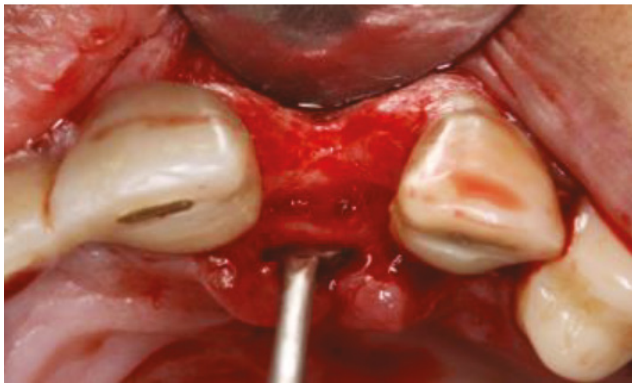

Figure 8 - Appearance of the alveolar bone at 120 days of surgery of the control group.

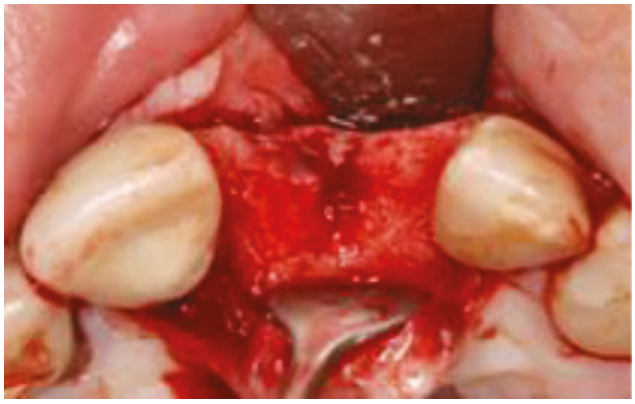

Figure 9 - Appearance of the alveolar bone at 120 days of surgery of the study group.

This study was approved by the ethics committee of the university and the patients gave their signed consent to participate in it.

Statistical analysis. The sociodemographic characteristics (ages, gender and extracted teeth) were initially compared between the groups. Then, the means, standard deviations and intervals for the quantitative variables and frequencies and percentages for the ordinal or nominative variables were performed. To analyze the data obtained on the height dimension variation, through the clinical measurement, and the size of the height, by means of linear radiographic measurements, the t test was performed with equal variances, comparing the two periods evaluated: immediately after extraction of the tooth and four months after. $P < 0.05$ was considered as statistically significant.

RESULTS

Regarding the width of the bony ridge, there was loss in both groups, at 120 days of surgery. The reduction was 2.6 mm (34.9%) in the control group and 1.14 mm (14.65%) in the study group. There was a significant difference between the groups, since the greatest loss of width occurred in the control group (p bi-caudal = 0.008). The results are presented in Tables 1 and 3. In relation to the reduction of alveolar bone height at 120 days, there was no statistically significant difference between the two groups (p bi-caudal > 0.05): reduction of the height of the mesial ridge in the test group was 0.73 mm and in the distal crest 0.49 mm. In the control group the reduction was 0.47 mm of the mesial crest and 0.43 mm in the distal crest. All results are described in Tables 2 and 3.

Table 1 - Comparison of weight loss (mm) between both groups.

	Surgery mm ± sd	120 days mm ± sd	p*
Control group	7.45 ± 1.19	4.85 ± 0.90	< 0.05
Study group	7.78 ± 1.69	6.64 ± 1.24	< 0.05

*p bi caudal

Table 2 - Comparison of height loss (mm) between both groups.

	Mesial wall surgery mm ± sd	Mesial wall 120 days mm ± sd	p*	Distal wall surgery mm ± sd	Distal wall 120 days mm ± sd	p*
Control group	11.54 ± 4.16	11.06 ± 4.0	> 0.05	11.95 ± 3.35	11.51 ± 3.21	> 0.05
Study group	11.30 ± 3.01	10.56 ± 3.13	> 0.05	11.41 ± 2.12	10.92 ± 2.29	> 0.05

*p bi caudal

Table 3 - Comparison of weight and height losses (mm) between both groups 120 days after surgery.

	Control group	Study group	p*
Weight loss	-2.6 ± 0.82	-1.14 ± 1.55	0.008
Mesial wall mm±sd	0.47	0.73	> 0.05
Distal wall mm±sd	0.43	0.49	> 0.05

*p bi caudal

DISCUSSION

This study showed that bone loss in width at 120 days of extraction was about 2.4 times lower in the study group (p = 000). This result can be considered satisfactory, since several studies have shown that loss of alveolar width is generally greater than loss in height even after guided bone regeneration[21-26]. In addition, we must consider that some of the alveoli in this study lost part of the vestibular alveolar wall during tooth extraction, but this loss was not documented in the study. Therefore, in addition to reducing alveolar loss, in comparison to the control group, the use of the barrier provided a good maintenance or recovery of the alveolar width. This gain in width is important for future site placement of implants.

Regarding bone loss at height, there was no significant difference between the two groups (p > 0.05). These results are not different from those obtained in other studies[21-23], although the methodologies used for the measurement are not homogeneous.

The method used in this study to measure alveolar bone loss after tooth extraction was based on similar radiographic studies[7] and on direct measurements of the alveolar crest already described in the scientific literature[21,27]. The option for the four-month evaluation used in our study was based on studies that demonstrated that most alveolar resorption, both in height and width, occurs between three and four months after exodontia[6-7].

Although most studies using the GBR technique have used porous membranes, it has been demonstrated in experimental studies that impermeable membranes also allow the formation of new bone compared to the expanded tetrafluoroethylene membrane[28]. More recently, several case reports have suggested that the polypropylene impermeable membrane can also be used in GBR with favorable results, especially after extraction in which there is vestibular alveolar bone loss[17-18], indicating that it is possible to preserve or recover bone loss especially in width, allowing the placement of implants. Another study with impermeable polypropylene barriers showed that the formation of new bone around osseointegrated implants can be achieved using only the blood clot covered by the membrane and that the process does not differ when the space around the implants is filled with autogenous bone graft, covered by the same type of barrier[20].

The polypropylene barrier used in this study, besides being biocompatible, is also easy to handle and has adequate rigidity to remain in position at the tooth extraction site without being deformed. At the same time, the possibility of being removed in a short time and being exposed to the oral environment decreases the morbidity of this type of technique, mainly because it uses only the blood clot as a filling material for the socket. The results obtained in this preliminary study may be considered similar to other studies using biomaterials, although the techniques for evaluating the reduction of alveolar bone loss are quite heterogeneous.

Among the limitations of this study, we can mention the lack of measurement of the bone defects of the buccal walls in both groups, which could contribute to a better knowledge of the preservation or bone gain achieved at four months, especially in width. However, although there was no difference in height in relation to the control group, this study points to the efficacy of the membrane used. Although height loss was not statistically different from the control group, we considered that, in general, because it was smaller, it did not prevent the subsequent placement of implants. Another important question concerns the removal of the membrane after one week of its placement, this study shows that this is feasible, however prospective studies need to be performed compared to other periods to see if there is difference in lost bone volume. Studies with tetrafluoroethylene membranes exposed to the buccal medium were more frequently used for GBR in fresh alveoli[29-30], although the barrier removal time was higher than that used in the present study.

CONCLUSION

According to the methodology applied in this study, we observed that the alveolar bone loss in width was lower in the sockets where the polypropylene membrane was used in comparison with those who did not receive the same. There was no difference with the control group regarding alveolar height loss.

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