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D-PTFE Membranes for Ridge Preservation: a Randomized Controlled Trial

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Abstract

Background: Alveolar ridge preservation (ARP) is a method used to reduce the external resorption of the ridge and increase bone deposition in the post-extraction site. Recently, dense polytetrafluoroethylene (d-PTFE) membranes have been adopted for ARP. This research investigates the application of d-PTFE membranes for ARP.

Methods: The randomized clinical trial with parallel groups and 1:1 allocation comprised 40 patients requiring premolar or molar tooth extraction, equally divided into experimental and control groups. The surgical protocol included atraumatic tooth extraction in both groups, followed by unassisted socket healing in the control group and ARP with a d-PTFE barrier in the experimental group. Cone-beam computed tomography was used to evaluate the vertical resorption in the groups for 3 months.

Results: ARP with d-PTFE membranes successfully reduced the vertical post-extraction resorption. For the buccal plate, it was 1.05 ± 0.6 mm in the d-PTFE group and 3.47 ± 1.96 mm in the control group, while for the oral plate it was 1.08 ± 0.6 mm (d-PTFE) and 2.1 ± 1.1 mm (control). The determining factor for post-extraction resorption is socket management.

Conclusion: Socket sealing with d-PTFE membranes is an effective ARP method. However, it cannot completely compensate for the influence of the socket plate width on post-extraction resorption.

Keywords: alveolar ridge preservation; d-PTFE membranes; post-extraction resorption; guided regeneration; socket sealing

Introduction

The success of implant treatment is evaluated by its long-term aesthetics and functionality. Implant placement must be prosthetic-driven, with correct three-dimensional positioning to ensure optimal support and stability of the peri-implant tissues (1).

Alveolar ridge preservation (ARP) is a method used after tooth extraction to reduce external resorption of the ridge and increase bone deposition at the post-extraction site (2).

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There are different types of barrier membranes used for socket sealing and ARP, generally divided into two categories - resorbable and non-resorbable. Non-absorbable membranes are made of cellulose acetate or polytetrafluoroethylene (PTFE, Teflon). Titanium is also sometimes used to reinforce the structure of PTFE membranes (3).
Non-resorbable expanded PTFE (e-PTFE) membranes have been well-studied and adopted. They are biocompatible and preserve tissue integrity during implantation (4).
Their primary disadvantages are the need for a second surgical intervention for their removal and their frequent exposure, which leads to impaired healing and regeneration.
D-PTFE membranes are used to avoid some disadvantages of e-PTFE membranes, namely their rough surface that promotes bacterial adhesion, which necessitates primary closure to isolate them from the oral environment (5, 6), and the need for their surgical removal. Furthermore, the use of resorbable and e-PTFE membranes leads to a reduction of keratinized gingiva, while d-PTFE membranes eliminate this disadvantage (7). A high-density PTFE membrane was explicitly created for post-extraction ARP (8).

Aim

This research aims to investigate the application of d-PTFE membranes on the vertical post-extraction resorption at the premolar and molar sites for 3 months and whether this resorption depends on the plate width, jaw, tooth type, tooth diagnosis, and smoking.

Materials and Methods

The trial was conducted at the Medical University of Varna, Bulgaria. The period of the research was 27 June 2022 – 20 April 2023. Ethical approval (№ 118/ 23 June 2022) was obtained from the institutional Research Ethics Committee. It was conducted in accordance with the Declaration of Helsinki and the CONSORT Reporting Guidelines (9). The randomization in this trial was random. The lottery method was employed by selecting envelopes containing patients' names and treatment methods - ARP versus unassisted socket healing. A third party picked envelopes, defining the patients' sequence and method.

The flow chart of the study subjects is presented in Figure 1.

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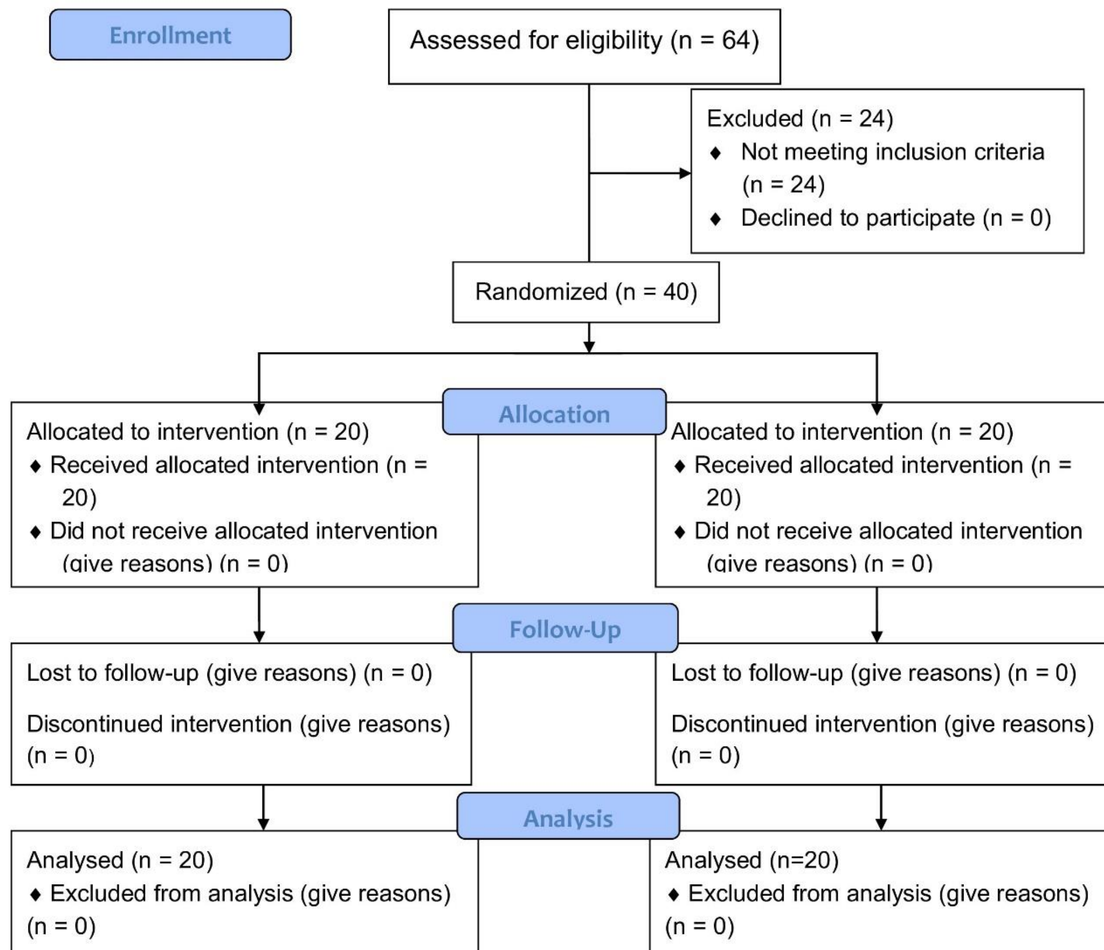

Figure 1. Flow Diagram of the Participants.

Forty patients, aged 26-65, who presented for the extraction of a single premolar/molar tooth, were enrolled in this study. The participants were allocated to either the experimental group (ARP) or the control group (spontaneous healing).

Patient recruitment

It was performed after a detailed analysis and assessment of the indications for treatment (18-56 years of age, good health, requiring premolar/molar extraction) and the lack of any contraindications for surgical treatment.

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Radiological Examination:

Each participant underwent the following radiological exams:

- preoperative orthopantomogram/periacpical X-ray;
- cone-beam computed tomography (CBCT) scans – one following the extraction, and another one after 3 months.

The following measurements were made on the first CBCT scan:

- buccal (A0) and lingual/palatal bone plate (B0) heights measured on a paraxial slice in the middle of the post-extraction socket from the tip of the plates to the ceiling of the mandibular canal for lower teeth and the lower border of the maxillary sinus for the maxillary premolars and molars respectively;
- width (thickness) of the buccal (Aw) and the lingual/palatal plate (Bw), measured 3 mm below the tips of the plates.

It should be noted that sockets with interradicular septa required two measurements (mesial and distal).

The measurements after 3 months included the plates' heights (A1 and B1, respectively) on the same paraxial section (Figure 2).

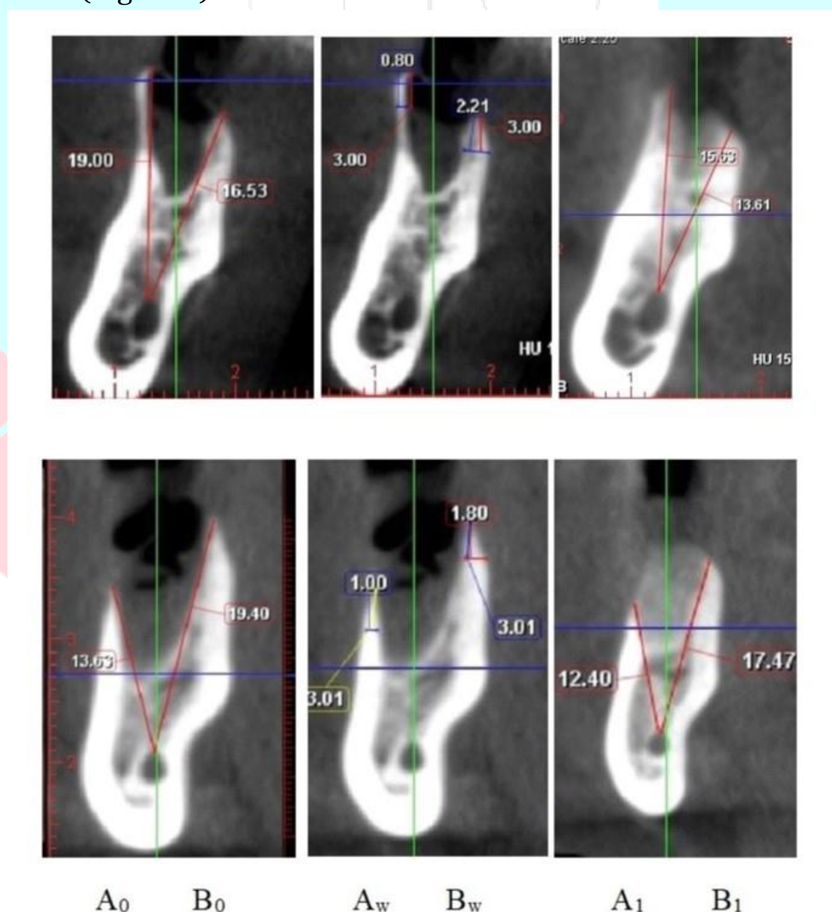

Figure 2. Measurements of the bone plates. First CBCT scan: A0 – buccal height; B0 – palatal/lingual height; Aw – buccal width; Bw – palatal/lingual width; second CBCT scan: A1 – buccal height; B1 - palatal/lingual height.

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Surgical Steps

Following an atraumatic extraction, the sockets were left to spontaneous healing (control) or sealed with a membrane (experimental group). For the latter, the gingival margin at the postextraction site was retracted using a periosteal elevator, creating space beneath the periosteum for the membrane. A periodontal probe was used to measure the size of the socket orifice, and then the membrane was trimmed and tucked 3-5 mm subperiosteally and under the interproximal dental papillae, but distant to the neighboring teeth. Crossed mattress sutures and/or single sutures with 5/0 monofilament polyamide were used for fixation (Fig. 3). Thus, the membrane was left partially exposed. It was important not to fold the membrane and preserve its integrity.

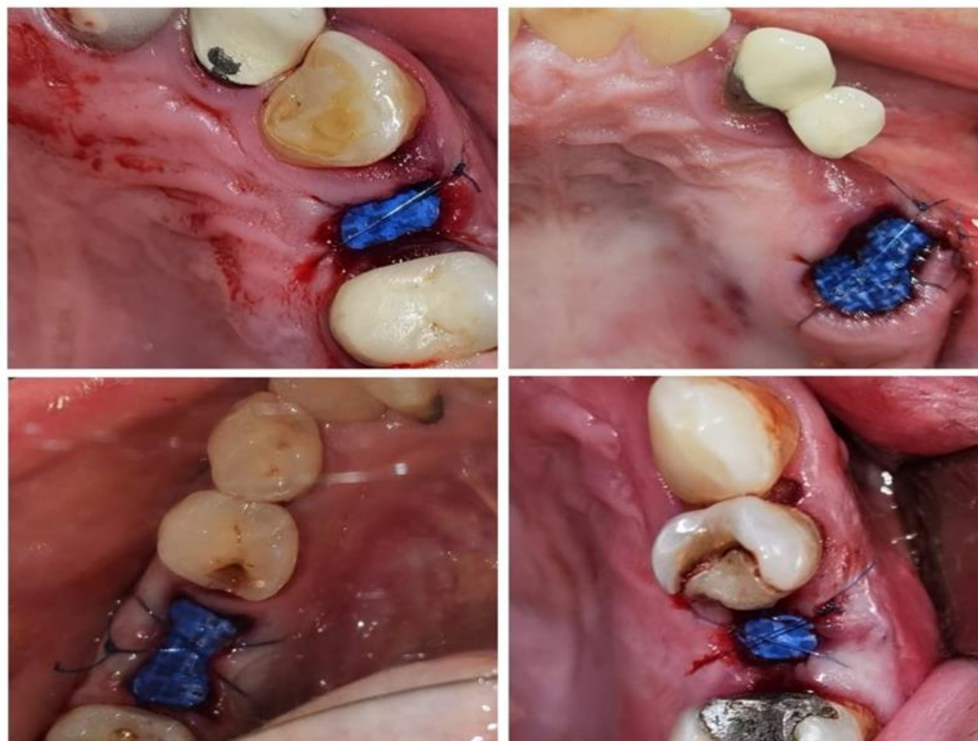

Figure 3. Postextraction sockets in the ARP group.

In 4 weeks, the membrane was removed with a hemostatic forceps or tweezers. Complete tissue epithelization occurred in a month.

Statistical Analysis

The results were evaluated using measures of descriptive statistics (mean and standard deviation (SD), median and interquartile range (IQR), and range). Parametric and non-parametric tests were used for hypothesis testing. Statistical significance was assessed using a p-value threshold of <0.05.

Results

The comparison between the measurements in the experimental group demonstrated statistically significant bone loss (Table 1).

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Table 1. The heights of the socket walls on the extraction day and after 3 months in the ARP group.

Measurement	N	Mean	SD	Mean diff.	95% CI		t	P
					Lower	Upper		
A_0	24	10.75	3.45	1.05*	0.79	1.32	8.37	<0.0001
A_1		9.70	3.29					
B_0	24	12.69	3.48	1.08**	0.83	1.33	8.99	<0.0001
B_1		11.61	3.52					

***A0-A1 - vertical buccal loss; ** B0-B1 – vertical palatal/lingual loss**

Data analysis did not demonstrate a statistically significant difference in the vertical bone loss of the plates according to the observed categories – jaw, tooth type and diagnosis, and smoking habit (Tables 2 and 3).

Table 2. Vertical buccal loss (A0-A1) in the ARP group.

Category	N	Mean	SD	t	p
Upper jaw	9	1.06	0.62	0.03	0.980
Lower jaw	15	1.05	0.64		
Premolars	7	0.92	0.68	-0.69	0.496
Molars	17	1.11	0.60		
Advanced periodontitis	14	1.12	0.69	0.60	0.555
Periapical periodontitis/cyst	10	0.96	0.52		
Smokers	14	0.99	0.50	-0.64	0.530
Non-smokers	10	1.15	0.77		

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Table 3. Vertical resorption of palatal/lingual bone plate (B0-B1) in the experimental group.

Category	N	Mean	SD	Median	IQR	Mann–Whitney U test	p
Upper jaw	9	1.02	0.54	1.27	0.90	75.500	0.682
Lower jaw	15	1.11	0.63	1.26	1.21		
Premolars	7	1.06	0.57	1.27	0.99	58.500	0.951
Molars	17	1.08	0.61	1.26	0.94		
Advanced periodontitis	14	0.99	0.60	1.27	1.10	83.000	0.472
Periapical periodontitis/cyst	10	1.20	0.58	1.33	0.99		
Smokers	14	1.18	0.52	1.27	0.78	54.500	0.371
Non-smokers	10	0.94	0.67	0.97	1.22		

The difference (0.03 mm) between the buccal and oral vertical losses in the ARP group was statistically significant ($p = 0.503$).

A statistically significant correlation (Pearson's $r = -0.41$, $P = 0.048$) was established between the buccal wall width and its vertical loss for 3 months, while for the oral wall the correlation was insignificant (Spearman's $r = -0.24$, $P = 0.256$).

The comparison between the measurements in the control group demonstrates statistically significant vertical loss – 3.47 ± 1.96 mm ($t = 8.7$, $p < 0.0001$) for the buccal wall and 2.08 ± 1.10 mm ($t = 9.3$, $p < 0.0001$) for the oral wall (Table 4).

Table 4. The heights of buccal and palatal/lingual plates on the extraction day and after 3 months in the control group.

Measurement	N	Mean	SD	Mean diff.	95% CI		t	P
					Lower	Upper		
A_0	24	13.40	4.54	3.47	2.64	4.29	8.66	<0.0001
A_1		9.94	4.24					
B_0	24	13.54	4.63	2.08	1.62	2.55	9.27	<0.0001
B_1		11.46	4.51					

*A_0-A_1; ** B_0-B_1

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Data analysis demonstrated a significant vertical loss of the buccal bone plate only according to the diagnosis (t = 2.10, p = 0.047) (Tables 5 and 6).

Table 5. Vertical buccal loss (A_0-A_1) in the control group.

Category	N	Mean	SD	t	p
Upper jaw	11	2.92	1.52	0.26	0.796
Lower jaw	13	3.92	2.22		
Premolars	8	3.60	2.03	0.23	0.822
Molars	16	3.40	1.99		
Advanced periodontitis	16	4.02	2.08	2.10	0.047
Periapical periodontitis/cyst	8	2.36	1.11		
Smokers	15	3.74	2.19	0.89	0.386
Non-smokers	9	3.01	1.50		

Table 6. Vertical buccal loss (B0-B1) in the control group.

Category	N	Mean	SD	t	p
Upper jaw	11	2.07	1.07	-0.04	0.97
Lower jaw	13	2.09	1.17		
Premolars	8	1.96	1.36	-0.37	0.71
Molars	16	2.14	0.99		
Advanced periodontitis	16	2.14	1.14	0.38	0.71
Periapical periodontitis/cyst	18	1.96	1.09		
Smokers	15	2.25	1.12	0.94	0.36
Non-smokers	19	1.81	1.07		

There was a significant difference between the vertical loss of the walls in this group (t = 3.0, p =0.005) with mean difference of 1.39 mm.

The correlation between buccal wall width and its vertical loss for the observed period was statistically insignificant (Pearson's r = - 0.358, P = 0.086), while for the oral wall it was statistically insignificant (Pearson's r = -0.287, P = 0.175).

A statistically significant difference of 2.4 mm (t = -5.7, p<0.0001) in buccal resorption was found between the two groups with it being more evident in the control cases (Table 7).

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Table 7. Vertical buccal loss in the two groups.

A_0-A_1, mm	N	Mean	SD	Mean diff.*	95% CI Lower	95% CI Upper	t	p
Experimental group	24	1.05	0.62	-2.42	-3.27	-1.55	-5.74	<0.0001
Control group	24	3.47	1.96					

*((A0-A1) control) – ((A0-A1) ARP)

The comparison of A0-A1 in plates with Aw ≤2 mm between the two groups demonstrated a statistically significant difference (p=0.032) (Table 8).

Table 8. Vertical buccal loss in the groups in cases with plate width ≤2 mm.

A_0-A_1 in plates with Aw ≤2 mm	N	Mean	SD	Median	IQR	Range	Min	Max	Mann-Whitney U test	p
Experimental group	5	1.79	0.78	2.14	1.02	1.81	0.64	2.45	65.500	0.032
Control group	16	3.84	2.09	3.46	3.09	7.22	1.18	8.40		

The difference in the bone loss between the groups in width > 2 mm was also significant (t = -3.4, p=0.010) (Table 9).

Table 9. Vertical buccal loss in the in cases with plate width >2 mm.

A_0-A_1 in plates with Aw >2 mm	N	Mean	SD	Mean diff.	95% CI Lower	95% CI Upper	t	P
Experimental group	19	0.86	0.40	-1.87	-3.14	-0.59	-3.41	0.010
Control group	8	2.73	1.53					

A statistically significant difference of 1.00 mm (p = 0.001) in the vertical bone resorption of the palatal/lingual plate for 3 months was found between the experimental and the control group with it being more evident in the control cases (Table 10).

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Table 10. Vertical oral loss in the groups.

B_0-B_1, mm	N	Mean	SD	Median	IQR	Mann–Whitney U test	P
Experimental group	24	1.08	0.59	1.27	0.97	443.500	0.001
Control group	24	2.08	1.10	1.93	1.33		

Discussion

A significant vertical loss was registered in the d-PTFE group. For the buccal plate, it measured 1.05 ± 0.62 mm, and for the oral, 1.08 ± 0.59 mm. These values corresponded to the reports by Sabe-Alarabab et al. (10) and Papi et al. (11), who observed mean vertical resorption 3-4 months after ARP with d-PTFE membranes.

The differences in the vertical loss of the plates regarding any of the evaluated categories were insignificant. These results partially overlap those reported by Hoffman et al. (6). They found that age, gender, and smoking do not influence the parameters studied. On the other hand, the jaw region and socket shape influenced bone resorption.

Data analysis showed that the walls resorbed evenly with the applied method, although more pronounced buccal resorption was previously reported (12-14). This resorption pattern can be explained by the concept of the alveolar bone proper (bundle bone) by Araujo and Lindhe (15). In contrast to those reports, equal vertical resorption for both plates and even more pronounced palatal/oral loss have also been previously registered (16-18).

The correlation between the buccal and oral vertical losses in this group was statistically insignificant, which means that the resorption of one plate did not affect that of the other.

A significant correlation was observed between the width of the buccal plate measured immediately after extraction and subsequent vertical loss, suggesting that thinner walls are associated with greater vertical loss. These findings align with those from numerous studies (19-21), unlike those reported by Mandarino et al. (22), who found no relationship between platelet width and vertical loss, and Cardaropoli et al. (23), who observed such a correlation in unassisted healing but not in the ARP group.

Regarding the oral wall, the correlation was statistically insignificant, but with the same tendency as the buccal plate.

Although a significant difference in buccal width was reported based on the jaw (mean difference 1.36 mm), this did not result in a difference in buccal resorption in either jaw (mean difference –0.01 mm; p = 0.980).

Since plate width/thickness has been reported as a key factor influencing vertical resorption, this indicates there may be a width value (or range) beyond which no significant difference in resorption occurs. The average plate widths for both upper and lower jaws were over 2 mm, suggesting that if a critical threshold exists, it is not above this value.

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Study heterogeneity may be due to the existence of a "critical value" for the width. This means that below this value, resorption occurs to a greater extent and more rapidly. According to the literature, this "critical threshold" may be 1 mm or 2 mm.
Remodeling processes after tooth extraction result in clinically detectable bone loss at premolar and molar sites, with up to 50% width loss in the first year (15).
The only statistically significant difference among the observed categories was in buccal plate height regarding the jaw type.
Statistically significant differences in oral plate height were found by jaw and smoking status. The vertical resorption in both plates was highly significant both statistically and clinically.
The difference in how the two plates resorbed aligned with the studies of Araujo and Lindhe (2005) (15).
The only statistically significant difference in vertical resorption among the observed categories was in the buccal plate based on diagnosis, with a mean difference of 1.66 mm. The mean vertical loss in cases of advanced periodontitis was 4.02 ± 2.08 mm, while in cases of chronic periapical periodontitis/cyst, it was 2.36 ± 1.12 mm.
In this study, the mean vertical resorption in the lower jaw was 3.93 ± 2.22 mm, and in the upper jaw, 2.92 ± 2.52 mm. The mean difference was clinically significant and aligns with the results of other authors (24, 25) that post-extraction resorption is more pronounced in the lower jaw than in the upper jaw, and in the buccal plate than in the lingual.
The resorption in the control group was uneven and more severe buccally.
It should be noted that the mean difference between the buccal and oral plate widths, measured immediately after the extraction, was 1.3 mm (mean buccal width ≤ 2 mm and mean oral width > 2 mm).
It was previously reported that a buccal width less than 2 mm is linked to increased postextraction bone loss (26-28). However, the minimum buccal plate width required to prevent vertical bone resorption has not yet been determined.
According to some reports (29), a mean buccal loss of 7.5 mm at a wall width of ≤ 1 mm can be expected after 8 weeks, while for walls thicker than >1 mm, the mean vertical loss was 1 mm.
By fluorescent labeling, it was found that the alveolar crest resorption depends on the buccal bone width. This relationship is nonlinear with a threshold of 2 mm. The dependence is twice as strong for buccal bone < 2 mm. Therefore, the buccal bone width must be at least 2 mm to avoid pronounced bone resorption (27).
However, there was no statistically significant correlation between the initial wall width and vertical resorption at 3 months in this group. This indicates that crest width is not the sole factor influencing more pronounced vertical resorption. It occurs more often in the buccal plate than in the palatal/lingual plate, but resorption in both is significant.
Walker et al. (30) observed a vertical buccal loss of 2.60 ± 2.06 mm at the molar sites three months post-extraction. Barone et al. (31) reported buccal and oral loss of 2 ± 0.7 mm.
The study results indicated that ARP with d-PTFE membranes successfully reduced vertical post-extraction resorption.
Greater resorption can be expected in cases with thin socket plates, consisting mainly of bundle bone – a thin (0.2-0.4 mm) lamellar tooth-dependent bone structure (21,31,32).

A threshold of 2 mm has been reported as “critical” for significant post-extraction resorption (15, 27, 28), while others suggest that this “critical threshold" is 1 mm, and in such cases, the resorption increases twofold (23, 33) or even threefold (34).
Some authors suggest that non-resorbable bone substitutes can compensate for the resorption of thin buccal walls (≤ 1 mm) (34-36).
In this study, we investigated the suggested threshold of 2 mm, as there were insufficient cases with socket walls less than 1 mm in both groups.
Data analysis demonstrated that vertical loss in the control group was significantly greater, regardless of wall thickness (≤ 2 or > 2 mm). These results suggest that ARP is beneficial even in cases with thick socket walls.
The buccal width can serve as a valuable prognostic marker for post-extraction resorption (21, 22). The results of this study demonstrate that ARP with d-PTFE membranes can significantly mitigate the effect of plate width as a resorption risk factor, but does not completely neutralize it.
The study results did not provide convincing evidence for the influence of the investigated categories (jaw, tooth type, diagnosis, and smoking) on vertical ridge resorption.
In the present study, the widths of the bone plates and their vertical resorption after 3 months were similar in smokers and non-smokers.
This study has some limitations, such as a short evaluation period, which is insufficient to assess delayed and late implantation, and it did not assess the influence of the 1 mm buccal plate thickness threshold and its subsequent vertical resorption. However, the small number of cases with buccal width ≤ 1 mm did not allow for such analysis. Further randomized clinical trials are necessary to evaluate the application of d-PTFE membranes for ARP. It should be further investigated whether a “critical width” exists and its exact correlation with the vertical loss.

Conclusion

The ARP method used in this study successfully reduced the degree of post-extraction vertical bone resorption. However, it did not completely compensate for the role of buccal plate width (thickness) in bone loss. We found no significant difference in vertical ridge resorption by jaw, tooth type, tooth diagnosis, or smoking status during the postoperative 3-month period.

References

1. Buser, D.; Martin, W.; Belser, U.C. Optimizing esthetics for implant restorations in the anterior maxilla: Anatomic and surgical considerations. Int J Oral Maxillofac Implants 2004, 19, 43–61.
2. Horváth, A.; Mardas, N.; Mezzomo, L.A.; Needleman, I.G.; Donos, N. Alveolar ridge preservation: A systematic review. Clin Oral Investig 2013, 17, 341–363.
3. Kalsi, A.S.; Kalsi, J.S.; Bassi, S. Alveolar ridge preservation: Why, when and how. Br Dent J 2019, 227, 264–274.
4. Mizraji, G.; Davidzohn, A.; Gursoy, M.; Gursoy, U.K.; Shapira, L.; Wilensky, A. Membrane barriers for guided bone regeneration: An overview of available biomaterials. Periodontol 2000 2023, 93, 56–76.
5. Barber, H.D.; Lignelli, J.; Smith, B.M.; Bartee, B.K. Using a dense PTFE membrane without primary closure to achieve bone and tissue regeneration. J Oral Maxillofac Surg 2007, 65, 748–752.

DOI: 10.18044/MEDINFORM.2026131.2350 ISSUE 1, 2026

6. Hoffmann, O.; Bartee, B.K.; Beaumont, C.; Kasaj, A.; Deli, G.; Zafiropoulos, G.G. Alveolar bone preservation in extraction sockets using non-resorbable dPTFE membranes: A retrospective non-randomized study. J Periodontol 2008, 79, 1355–1369.
7. Bartee, B.K. Extraction site reconstruction for alveolar ridge preservation. Part 2: Membrane-assisted surgical technique. J Oral Implantol 2001, 27, 194–197.
8. Tomlin, E.M.; Nelson, S.J.; Rossmann, J.A. Ridge preservation for implant therapy: A review of the literature. Open Dent J 2014, 8, 66–76.
9. Schulz, K.F.; Altman, D.G.; Moher, D.; CONSORT Group. CONSORT 2010 Statement: Updated guidelines for reporting parallel group randomised trials. BMC Med 2010, 8, 18. https://doi.org/10.1186/1741-7015-8-18
10. Sabe-Alarab, M.; Al-Essa, H.; Jaber, F.; Shomal, Y.; Kharfan, J. Alveolar ridge preservation with d-PTFE membrane: A randomized controlled trial. Int J Recent Sci Res 2019, 10, 34658–34664.
11. Papi, P.; Di Murro, B.; Tromba, M.; Passarelli, P.C.; D'Addona, A.; Pompa, G. The use of a non-absorbable membrane as an occlusive barrier for alveolar ridge preservation: A one-year follow-up prospective cohort study. Antibiotics 2020, 9, 110.
12. Al Hugail, A.M.; Mealey, B.L.; Walker, C.; Al Harthi, S.; Duong, M.; Noujeim, M.; Lasho, D.J.; Prihoda, T.J.; Huynh-Ba, G. Evaluation of healing at molar extraction sites with ridge preservation using a non-resorbable dense polytetrafluoroethylene membrane: A four-arm prospective cohort study. Clin Exp Dent Res 2021, 7, 1103–1111.
13. Araújo, M.G.; da Silva, J.C.; de Mendonça, A.F.; Lindhe, J. Ridge alterations following grafting of fresh extraction sockets in man: A randomized clinical trial. Clin Oral Implants Res 2015, 26, 407–412.
14. Barone, A.; Aldini, N.N.; Fini, M.; Giardino, R.; Calvo-Guirado, J.L.; Covani, U. Xenograft versus extraction alone for ridge preservation after tooth removal: A clinical and histomorphometric study. J Periodontol 2008, 79, 1370–1377.
15. Araújo, M.G.; Lindhe, J. Dimensional ridge alterations following tooth extraction: An experimental study in the dog. J Clin Periodontol 2005, 32, 212–218.
16. van der Weijden, F.; Dell'Acqua, F.; Slot, D.E. Alveolar bone dimensional changes of post-extraction sockets in humans: A systematic review. J Clin Periodontol 2009, 36, 1048–1058.
17. Binkhorst, T.S.; Tawse-Smith, A.; Goh, R.; Nogueira, G.R.; Atieh, M. Tomographic evaluation of alveolar ridge preservation using bone substitutes and collagen membranes: A retrospective pilot study. Dent J 2023, 11, 58.
18. Abdelhafez, R.S.; Alhabashneh, R.; Khader, Y.; Hijazi, M.; Jarah, M. Dimensional changes in alveolar ridge following extraction of teeth in the maxillary premolar area in subjects with thick and thin gingival biotypes: A pilot study. Int J Periodontics Restorative Dent 2016, 36, 431–436.
19. Avila-Ortiz, G.; Gubler, M.; Romero-Bustillos, M.; Nicholas, C.L.; Zimmerman, M.B.; Barwacz, C.A. Efficacy of alveolar ridge preservation: A randomized controlled trial. J Dent Res 2020, 99, 402–409.
20. Chappuis, V.; Araújo, M.G.; Buser, D. Clinical relevance of dimensional bone and soft tissue alterations post-extraction in esthetic sites. Periodontol 2000 2017, 73, 73–83.
21. Couso-Queiruga, E.; Stuhr, S.; Tattan, M.; Chambrone, L.; Avila-Ortiz, G. Post-extraction dimensional changes: A systematic review and meta-analysis. J Clin Periodontol 2021, 48, 126–144.
22. Mandarino, D.; Luz, D.; Moraschini, V.; Rodrigues, D.M.; Barboza, E.S.P. Alveolar ridge preservation using a non-resorbable membrane: Randomized clinical trial with biomolecular analysis. Int J Oral Maxillofac Surg 2018, 47, 1465–1473.
23. Cardaropoli, D.; Tamagnone, L.; Roffredo, A.; Gaveglio, L. Relationship between the buccal bone plate thickness and the healing of post-extraction sockets with/without ridge preservation. Int J Periodontics Restorative Dent 2014, 34, 211–217.

DOI: 10.18044/MEDINFORM.2026131.2350 ISSUE 1, 2026

24. Zhao, L.; Wei, Y.; Xu, T.; Zhang, B.; Hu, W.; Chung, K.H. Changes in alveolar process dimensions following extraction of molars with advanced periodontal disease: A clinical pilot study. Clin Oral Implants Res 2019, 30, 324–335.
25. Ten Heggeler, J.M.; Slot, D.E.; Van der Weijden, G.A. Effect of socket preservation therapies following tooth extraction in non-molar regions in humans: A systematic review. Clin Oral Implants Res 2011, 22, 779–788.
26. Chen, S.T.; Darby, I.B.; Reynolds, E.C. A prospective clinical study of non-submerged immediate implants: Clinical outcomes and esthetic results. Clin Oral Implants Res 2007, 18, 552–562.
27. Qahash, M.; Susin, C.; Polimeni, G.; Hall, J.; Wikesjö, U.M. Bone healing dynamics at buccal peri-implant sites. Clin Oral Implants Res 2008, 19, 166–172.
28. Spray, J.R.; Black, C.G.; Morris, H.F.; Ochi, S. The influence of bone thickness on facial marginal bone response: Stage 1 placement through stage 2 uncovering. Ann Periodontol 2000, 5, 119–128.
29. Chappuis, V.; Engel, O.; Reyes, M.; Shahim, K.; Nolte, L.P.; Buser, D. Ridge alterations post-extraction in the esthetic zone: A 3D analysis with CBCT. J Dent Res 2013, 92, 195S–201S.
30. Walker, C.J.; Prihoda, T.J.; Mealey, B.L.; Lasho, D.J.; Noujeim, M.; Huynh-Ba, G. Evaluation of healing at molar extraction sites with and without ridge preservation: A randomized controlled clinical trial. J Periodontol 2017, 88, 241–249.
31. Barone, A.; Toti, P.; Quaranta, A.; Alfonsi, F.; Cucchi, A.; Negri, B.; Di Felice, R.; Marchionni, S.; Calvo-Guirado, J.L.; Covani, U.; Nannmark, U. Clinical and histological changes after ridge preservation with two xenografts: Preliminary results from a multicentre randomized controlled clinical trial. J Clin Periodontol 2017, 44, 204–214.
32. Araújo, M.G.; Silva, C.O.; Misawa, M.; Sukekava, F. Alveolar socket healing: What can we learn? Periodontol 2000 2015, 68, 122–134.
33. Cardaropoli, D.; Tamagnone, L.; Roffredo, A.; Gaveglio, L. Evaluation of dental implants placed in preserved and non-preserved post-extraction ridges: A 12-month post-loading study. Int J Periodontics Restorative Dent 2015, 35, 677–685.
34. Tomasi, C.; Donati, M.; Cecchinato, D.; Szathvary, I.; Corrà, E.; Lindhe, J. Effect of socket grafting with deproteinized bone mineral: An RCT on dimensional alterations after 6 months. Clin Oral Implants Res 2018, 29, 435–442.
35. Ku, J.K.; Hong, I.; Lee, B.K.; Yun, P.Y.; Lee, J.K. Dental alloplastic bone substitutes currently available in Korea. J Korean Assoc Oral Maxillofac Surg 2019, 45, 51–67.
36. Mahesh, L.; Venkataraman, N.; Shukla, S.; Prasad, H.; Kotsakis, G.A. Alveolar ridge preservation with the socket-plug technique utilizing an alloplastic putty bone substitute or a particulate xenograft: A histological pilot study. J Oral Implantol 2015, 41, 178–183.

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