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Case Report

Alveolar ridge augmentation by open healing with high-density polytetrafluoroethylene membrane

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Abstract: Non resorbable polytetrafluoroethylene membranes find great use in everyday oral surgery treatments. We aimed to verify the performance of high-density polytetrafluoroethylene (hdPTFE) membrane in open healing after alveolar ridge augmentation at two patients. For that reason, we raised full thickness flap and grafted with different xenograft granules that were covered with resorbable collagen membrane. Then the grafted area was covered with high-density polytetrafluoroethylene membrane (permamem®) and stabilized with sutures by leaving it partially exposed. Six weeks after open healing, the permamem® was removed and successful post-operative healing with no complications were observed. The newly formed soft tissue grew under the membrane and completely covered the new alveolar ridge volume. There were no signs of dehiscence or infection, and the patients had no pain or discomfort, neither after suture nor the membrane removal. Also, there were no visible signs of bacterial plaque on the membrane after its placement and during removal. After eight months implants were successfully installed, and full mouth prosthetic reconstruction was following the osseointegration. In conclusion, the high-density polytetrafluoroethylene membrane efficiently supported open healing and led to successful alveolar ridge augmentation.

Keywords: alveolar ridge augmentation; high-density polytetrafluoroethylene membrane; open healing

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Introduction

Sufficient alveolar ridge height and width are important criteria before dental implant placement [1]. Therefore, there are many available augmentation techniques to compensate for bone deficiency [2]. Also, plenty of biomaterials with various physiochemical properties can be used to perform bone augmentation [3].

Xenograft granules and resorbable collagen membranes are the most used GBR biomaterials to improve the bone volume defects in defined alveolar regions [4], [5]. In some cases, such treatment can lead to soft tissue deficits and with that an impossibility to fully cover the grafted area. Especially in bigger bone defects, an additional soft tissue surgeries are required for primary wound closure [6]. Also, the lack of soft tissue represents a huge risk for dehiscence, infection, and a graft failure.

Gaining keratinized gingiva over the bone grafted area is a quite challenging task due to lack of initial vascularization [7]. The use a non-resorbable polytetrafluoroethylene membrane can be a minimally invasive solution in such situation and can be applied alone or in combination with bone graft particles [8]. They enable new bone formation by bone graft stabilization and minimize the ridge collapse, as well as the soft tissue ingrowth [9], [10]. Especially the high-density polytetrafluoroethylene membrane (permamem®) seems to be highly effective in open-healing socket preservation

procedure [10]. It has also been successfully applied in alveolar ridge preservation without any grafting material use and only by intentional exposure after sutures stabilization [11]. However, in these studies, the membrane was removed only after four weeks, and it is no surprise that patients sometimes are unable to show up at the agreed meeting.

The aim of these clinical cases was to retrospectively analyze the open healing effect with high-density polytetrafluoroethylene (hdPTFE) in alveolar ridge augmentation of two patients. We achieved that by a minimally invasive approach after horizontal ridge augmentation with different xenograft granules and resorbable collagen membrane covered with hdPTFE membrane. Even though the hdPTFE membrane was removed after six weeks, still a successful gain of soft tissue without any negative effects were observed.

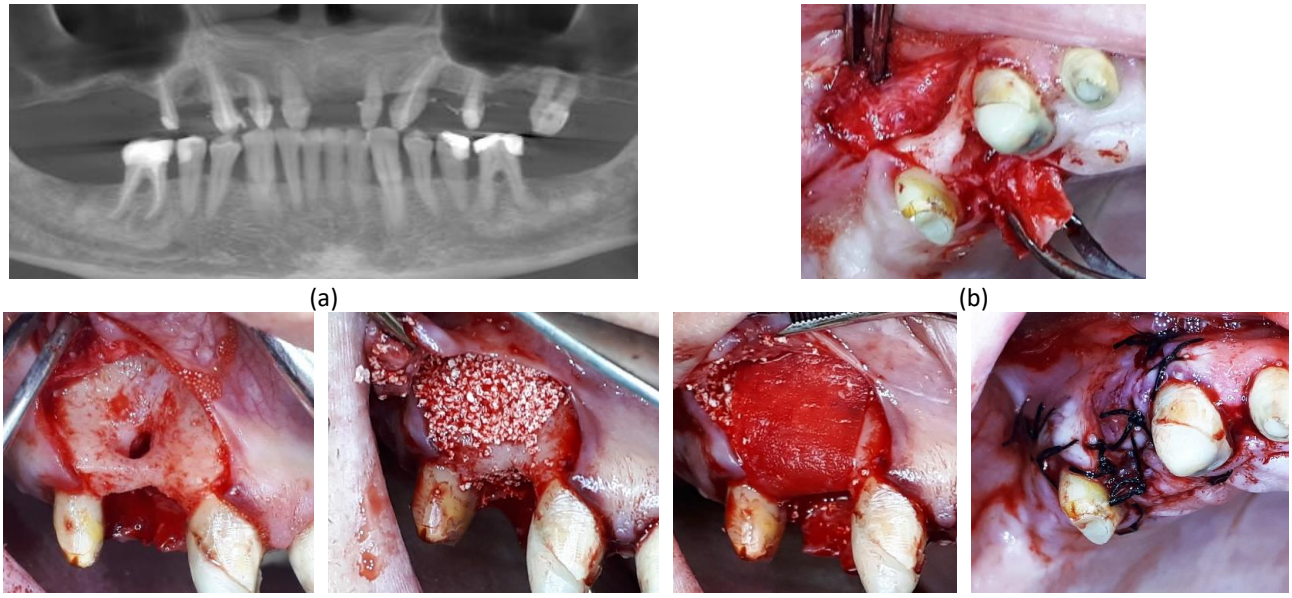
Materials and Methods

Case 1

The patient was a 55-year-old male in generally good health condition, smoker with more than 10 cigarettes per day for over 20 years and suffered from periodontitis stage three. He lost the tooth #14 due to endo-perio problems one year earlier, which caused deep and irregular horizontal and vertical defects in the alveolar ridge (Figure 1a). Therefore, the patient requested to recover the function and aesthetics of the premolar region by an implant and via minimally invasive approach.

The diagnostics was performed by detailed clinical examination and CBCT, which revealed additional bone defect about 3 mm above the cortex of processus alveolaris. This defect had a complete bony tunnel form with a diameter of around 4 ± 0,5 mm in a vestibule-oral direction. In order to achieve satisfactory bone quantity and quality for an implant use during the second stage surgery, it was decided to augment with xenograft granules and resorbable collagen membrane. However, the lacking soft tissue for coverage of the grafted area was still an issue. For that reason, it was decided to use minimally invasive approach by placing hdPTFE membrane over the grafted area, while leaving it exposed during open healing.

The surgical procedure was performed by raising a full thickness flap with a horizontal cut in the middle of the alveolar processus (Figure 1b). Also, additional relaxing cuts enabled wide wound exposure to apply and adjust bigger volume of the bone grafting material. Then an open curettage of the neighboring teeth was performed, as the fistulous bony canal of about 3 mm above the ridge margin was also cleaned by curettes and Er:YAG laser (LiteTouch™ Syneron, Israel) with ST mode 300mJ/17Hz, 1.5mm tip and HT mode 100mJ/20Hz CH tip (Figure 1c). Consequently, the defect was grafted with xenograft granules (Bio-Oss®, 0,25-1mm, Geistlich Pharma AG, Switzerland) and followed by coverage with resorbable collagen membrane (Bio-Gide Perio®, 16x22 mm, Geistlich Pharma AG, Switzerland) (Figure 1d, 1e). Once the collagen membrane was adapted, it was then covered with non-resorbable hdPTFE membrane (permamem®, 15x20 mm, botiss biomaterials GmbH, Germany). Finally, the hdPTFE membrane was sutured with 5-0 non-resorbable suture (Silkam 5-0, BBraun, Aesculap,Germany) by using mattress and normal suturing technique. Once the hdPTFE membrane was properly stabilized, it was then left partially exposed in order to support the open wound healing (Figure 1f). The patient was instructed to take antibiotics (Clindamycin 300 mg, every 8 hours) for 7 days and to rinse with chlorhexidine solution (Perio+ plus Protect, 0.12, Curaprox, Switzerland) twice a day for 2 weeks. After seven days, the sutures were removed and the hdPTFE membrane was left exposed during the following five weeks.

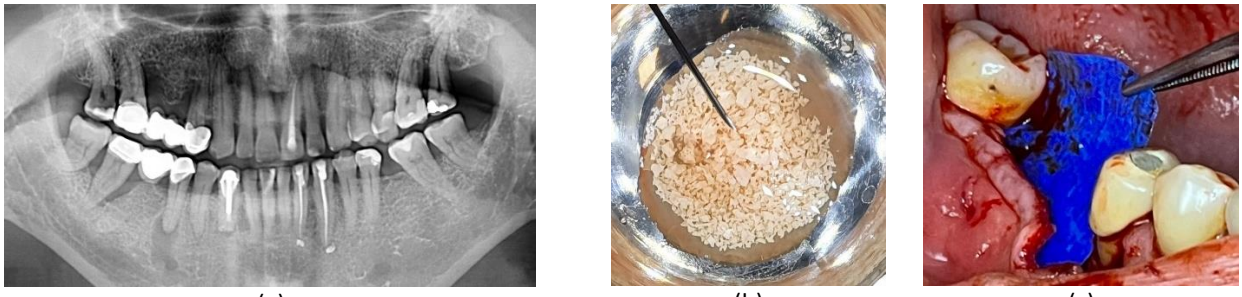


(a) (b) (c) (d) (e) (f)

Figure 1. Alveolar ridge augmentation at tooth #14: (a) Initial situation; (b) Raising of full thickness flap; (c) Area preparation after relaxing cuts and curettage; (d) Grafting with xenograft granules; (e) Coverage with resorbable collagen membrane; (f) Partially exposed permamem® after suturing.

Case 2

The second patient presented himself with significant bone defects on the upper jaw (right maxilla) and lower jaw (right mandibule) (Figure 2a). Teeth #17 and #47 were hopeless, which is why they required extraction. Also, surgical reconstructive therapy of periodontal intrabony defects on teeth #18, 15, 45 and 48 was required. Therefore, horizontal augmentation of the narrow alveolar processus in the upper right first molar and lower right first molar regions, as well as ridge preservation of the extracted alveola #17 and #47 was performed. In order to compare the results with the previous patient, the defect was grafted with another xenograft granules (cerabone®, 0,5-1mm, botiss biomaterials GmnH, Germany) (Figure 2b) and followed by coverage with another resorbable collagen membrane (collprotect®, 20x30 mm, botiss biomaterials GmnH, Germany). Consequently, the collagen membrane was covered with the same non-resorbable hdPTFE membrane (permamem®, 20x30 mm, botiss biomaterials GmbH, Germany) (Figure 2c).



(a) (b) (c)

Figure 2. Ridge preservation after extraction of teeth #17 and #47: (a) Initial situation; (b) Hydrating the xenograft granules with saline solution; (c) Covering with permamem® before suturing.

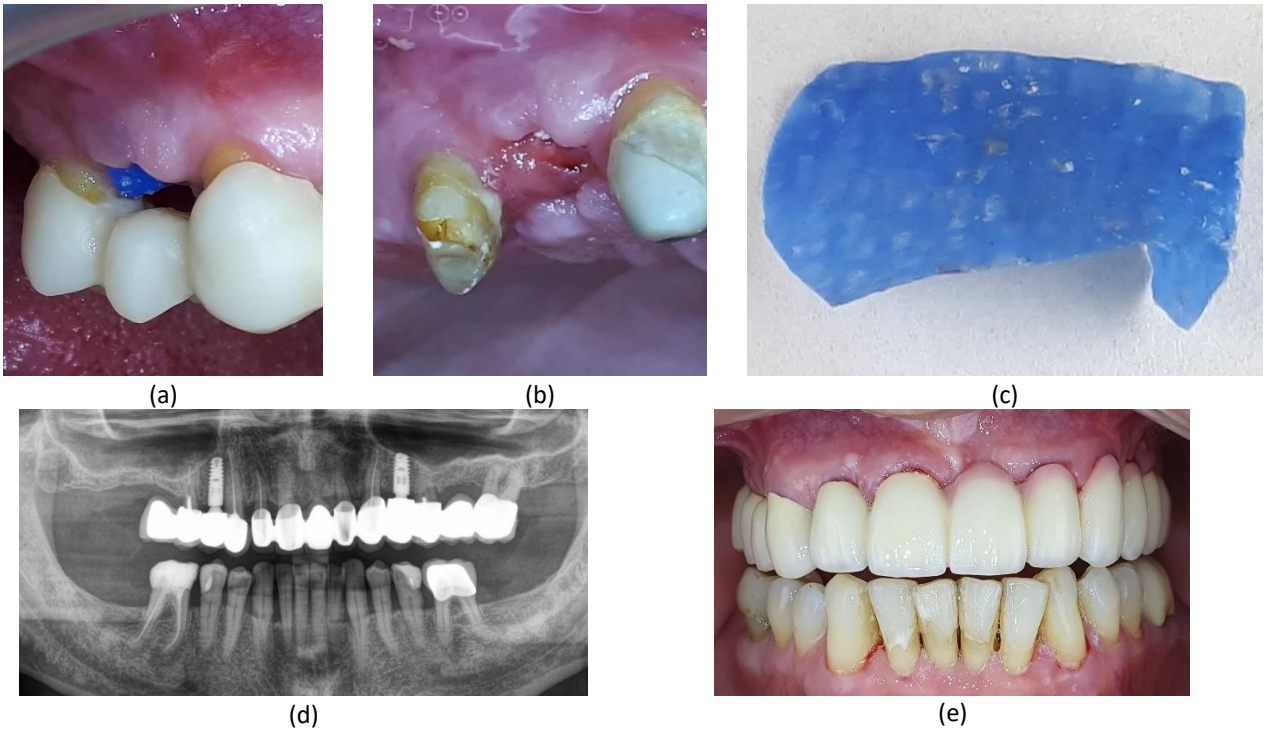
The hdPTFE membrane was also sutured with 5-0 non-resorbable suture (Silkam 5-0, BBraun, Aesculap,Germany) by using mattress and normal suturing technique. After the hdPTFE membrane was stabilized in same way as with the patient 1, it was then intentionally left partially exposed to support the open wound healing. This patient was also instructed to

take antibiotics (Clindamycin 300 mg, every 8 hours) for 7 days and to rinse with chlorhexidine solution (Perio+ plus Protect, 0.12, Curaprox, Switzerland) twice a day for 2 weeks. Seven days later, the sutures were removed and the hdPTFE membrane was again left exposed during the following five weeks.

Results

Case 1

The post-surgical healing was uneventful, and no complications were observed (Figure 3a). After six weeks post-operatively, the hdPTFE membrane was very easily removed and a stable clinical situation was observed. Here the newly formed soft tissue that grew under the hdPTFE membrane, had completely covered the new alveolar ridge volume without any dehiscence or signs of infection (Figure 3b). The patient expressed a high level of satisfaction without having any pain. He had no discomfort at the grafted area, neither after suture nor the hdPTFE membrane removal. In addition, there were hardly any signs of bacterial plaque formation on the hdPTFE membrane even six weeks after its placement and during removal (Figure 3c). Eight months after grafting, the patient had satisfactory stable and newly formed bone, which allowed installation of two implants on position #14 (Ankylos c/x A 11, Dentsply Sirona, Germany) and #24 (Ankylos c/x B 9.5, Dentsply Sirona, Germany). Six months after osseointegration, a full mouth prosthetic reconstruction was accomplished (Figure 3d, 3e). Then the patient was in a maintenance phase for three and a half years after periodontal therapy with augmentation and two years after finished prosthetics, without any complications and adverse effects.



(a) (b) (c)

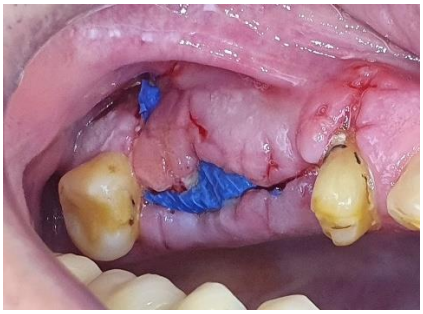
(d) (e)

Figure 3. Six weeks post-operatively: (a) Uneventful soft tissue healing; (b) permamem® removal as new healthy soft tissue grew under the membrane; (c) Hardly any signs of bacterial plaque formation over the membrane; (d) (e) Full mouth prosthetic reconstruction, as implants were placed at eight months after grafting, followed by six months osseointegration.

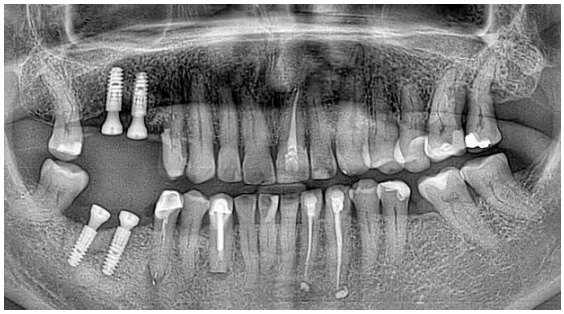
Case 2

Successfully soft tissue healing was achieved, without any complications and no bacterial plaque formation was observed on the hdPTFE membrane at six weeks after its placement (Figure 4a). Once the membrane was removed, just like in

patient 1, a newly formed soft tissue completely covered the new alveolar ridge volume without any dehiscence. This patient also expressed a high level of satisfaction without any pain or discomfort after suture and hdPTFE membrane removal. The patient had sufficient stable and newly formed bone to accept implants eight months after grafting. For that reason, four implants were inserted at position #15, #16, #47 (Ankylos c/x A 9.5, Dentsply Sirona, Germany) and #46 (Ankylos c/x A 11, Dentsply Sirona, Germany). Three months after implants osseointegration, a full mouth prosthetic reconstruction was accomplished (Figure 4b, 4c). Then the patient was in maintenance phase for fifteen months after periodontal therapy with augmentation and three months after finished prosthetics, as no complications and adverse effect were seen.



(a)



(b)

(c)

Figure 4. Open healing with hdPTFE membrane: (a) Six weeks post-operatively, no bacterial plaque formation was observed over permamem®; (b) (c) Full mouth prosthetic reconstruction, as implants were placed at eight months after grafting, followed by three months osseointegration.

Discussion

The presented clinical cases illustrate a successful alveolar ridge augmentation by using open healing with high-density polytetrafluoroethylene membrane, even though different xenograft particles and collagen barrier membranes were used. Here a coverage of the bone graft with simultaneous thickening of the marginal tissue via minimal invasive approach was achieved. This enabled successful implants placement and full mouth prosthetic reconstruction.

Bone defects in defined regions of the alveolar processus can be augmented with xenograft granules and covered resorbable collagen membrane in order to improve the bone volume [4], [5]. However, that can lead to huge soft tissue deficits and impossibility to fully cover the grafted area. More specifically, bigger bone defects often need additional soft tissue surgeries in order to achieve a primary closure [6]. Consequently, the lack of soft tissue often leads to dehiscence which can then result into infection and a graft failure.

Finding a method to gain keratinized gingiva over the bone graft without and any additional soft tissue surgery can be quite challenging [7]. Also, it is important to reduce the patient's inconvenience while causing less morbidity and costs. One simple and easy solution in such situations is to use a non-resorbable hdPTFE membrane. In fact, it is the simplest

minimally invasive option for patient's comfort, also to reduce the risk for complications and to achieve predictable results.

The use of non-resorbable-polytetrafluoroethylene barriers for guided tissue regeneration alone or in combination with various bone graft particles have already been described [8], [12]–[15]. They have already proven to be highly effective in new bone formation by stabilizing the underlying bone graft, minimizing the ridge collapse risk and soft tissue ingrowth [9], [10]. More specifically, the hdPTFE membrane used in our case already enabled such open-healing socket preservation in 44 patients [10]. It also proved to be effective in alveolar ridge preservation without any use of biomaterial to graft the socket and only by intentional exposure with sutures stabilization [11]. However, according to the manufacturer recommendation, permamem® was removed after four weeks in both these studies [10], [11]. On contrast, due to patient late show up in our cases, we removed it after six weeks (Figure 2).

Still, successful post-operative healing and no complications were observed in both patients (Figure 3a, 4a). Once the hdPTFE membrane was removed a stable clinical situation was obvious. More specifically, the newly formed soft tissue grew under the permamem® completely covered the new alveolar ridge volume, and no dehiscence or signs of infection were seen (Figure 3b). Even though different xenograft particles and collagen barrier membranes were used in both patients, still a stable clinical outcome was well maintained during the following eight months and before the implants were installed. Most importantly, the patients expressed a high level of satisfaction, without having any pain or infection, also no discomfort at the grafted area, neither after suture as well as the membrane removal. Also, there were hardly any visible signs of bacterial plaque even at six weeks after the permamem® placement and during removal (Figure 3c, 4a). Finally, both patients received implants at eight months after grafting, followed by full mouth prosthetic reconstruction after osseointegration (Figure 3d, 3e, 4b, 4c)

Conclusions

We concluded that the use of hdPTFE membrane led to successful alveolar ridge augmentation by open healing even though different xenograft particles and collagen barrier membranes were used. Successful post-operative healing with no complications were observed, as the newly formed soft tissue grew under the permamem® and completely covered the new alveolar ridge volume, without any dehiscence or signs of infection. The patients were highly satisfied, had no pain or discomfort, neither after suture nor the membrane removal. There were no visible signs of bacterial plaque on the permamem® at six weeks after its placement and during removal. The patients received implants at eight months after grafting, followed by full mouth prosthetic reconstruction after osseointegration Additional patients need to be treated to verify our current results.

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