

The Socket-Plug Technique and Materials Comparison in Atraumatic Extractions - A Multiple-Case Study

Chen-Che Hung*

Adjunct Assistant Instructor, Mediterranean Prosthodontic Institute, Castellon, Spain.

Private Practice, Kaohsiung City, Taiwan.

**Corresponding Author: Chen-Che Hung, Mediterranean Prosthodontic Institute, Castellon, Spain.*

DOI: <https://doi.org/10.58624/SVOADE.2023.04.0126>

Received: March 22, 2023 **Published:** April 03, 2023

Abstract

It is confirmed that tooth extraction with spontaneous healing may lead to degrees of alveolar bone resorption due to the bone remodelling phase. Reconstructive materials are proposed to insert into the socket during the extraction procedure preventing the loss of alveolar bone dimension. The "Socket Plug" technique is an alveolar ridge preservation (ARP) method saving both operational time and is easy to apply in clinical routines. The technique includes steps of atraumatic extraction, flapless design, biomaterial placement, and suturing. Four clinical cases are reported using the socket-plug technique placing hemostatic gelatin sponges as spontaneous healing and collagen plug in sockets as ARP with or without interradicular septum.

Keywords: atraumatic extraction, collagen plug, alveolar ridge preservation, ARP, gelatin sponge, oral surgery

Introduction

Tooth extraction is a common surgical procedure for the purpose of removing hopeless dentition. The spontaneous healing of extracted socket without any ridge preservation or augmentation may result in possible alveolar ridge resorption and inadequate hard and soft tissue envelope.^{1,2} Various alveolar ridge preservation (ARP) methods and materials are proposed to stabilize the volume of the alveolar bone,¹⁻⁴ or obtain ideal esthetics outcomes.⁵ A successful ARP indicates the extracted socket healed appropriately and the reconstruction of the grafting materials. Post-extraction healing begins with blood clot formation, leading to granulation tissue growth, epithelium attachment regain, osteoid calcification, and new bone regeneration.⁶ To achieve an ideal socket wound healing process and minimize the bone resorption caused by tooth extraction, the atraumatic extraction method is advised.^{4,7-9}

Socket-Plug Technique

The socket-plug technique is a conventional ARP method that simply inserts a socket-shaped collagen plug into the extracted socket.^{4,8} The aid of a collagen plug allows the alveolar ridge to preserve its original dimension and reduce the alveolar ridge resorption due to bone remodeling.^{4,10,11} The technique consists of 4 steps proposed by Kotsakis G et al,⁴ (1) Atraumatic Extraction, (2) Flapless Design, (3) Biomaterials placement, and (4) Suturing.

Step 1 - Atraumatic Extraction

Any surgical trauma should be reduced while performing a tooth extraction. The use of instruments such as desmotome and periotome could lower the risk of pain, analgesic consumption, gingival laceration, and damaging the periodontal tissue during the procedure.^{4,9,12} The residual inflammatory tissue should be curetted without any remains, preventing plug materials resorption and chances of delayed healing due to the low pH environment inside the socket.⁴ The technique benefits the healing of the wound and maintains alveolar bone for future implant insertion.¹³

Step 2 - Flapless Design

The flapless design of the extracted wound could preserve hard and soft tissue vertical dimensions in both spontaneous healing and combing ARP procedures.^{4,14} The patients responded with less post-operative pain and discomfort after the flapless surgery.¹⁴ And there are no significant differences between the flap and flapless procedures in histologic and histomorphometric analysis.¹⁵

Step 3 - Biomaterials

Placement Bone grafting materials such as autogenous grafts, allografts, xenografts, and synthetic grafts could be selected through their properties and characteristics.⁴ Morphologic plug materials like shaped collagen matrix, collagen sponge, and collagen plug embedded bone grafting are available to insert into the socket.

Step 4 - Suturing

Proper suturing techniques and materials could be selected and used to prevent the washout of the biomaterials, induce blood clot formation, stabilize platelet aggregation and hold the flap or tissue edges until the wound has healed.^{4,16} Conventional crossed mattress (cris-cross) suturing is common used to stabilize the grafting materials in ARP. A novel technique "Hidden X" suturing is also applied where primary closure is not intended.¹⁷

For proper post-extraction spontaneous healing without ARP, hemostatic agents such as gelatin sponge, bone wax, and oxidized regenerated cellulose are used to control hemorrhage and bacterial infection.¹⁸⁻²⁰ Wound healing with gelatin sponge is reported with an excellent soft tissue healing capability and suggested to be used in routine clinical practice.²⁰

Clinical Reports

4 clinical cases were presented in Grand Hyatt Dental Clinic, Kaohsiung City, Taiwan with a request for posterior molars extraction. None of the cases have any pain or infection on a surgical day and no systematic diseases were related. Four clinical cases are reported following the steps of the socket-plug technique. Two of the cases used hemostatic gelatin sponges for spontaneous healing, including one with interradicular septum and one without it inside the socket. The other two used collagen plug materials as an ARP method for the socket with or without the interradicular septum. Primary and short-term healing are recorded.

Case 1 - Upper Right 3rd Molar Extraction without Interradicular Septum - Spontaneous Healing

A 22-year-old male sought upper right 3rd molar extraction due to malposition and unfavorable oral hygiene care (Fig 1A). No signs of infection nor pain were presented. The 3rd molar was detached from periodontal tissue using desmotome and periotome (Desmotome/ Periotome, HELMUT ZEPF MEDIZINTECHNIK GMBH, Seitingen-Oberflacht, Germany) (Fig 1B, 1C). Once the tooth was loosened from attached tissue fibres, the fused root was luxated and extracted using a curved elevator (X-LUXATOOL Curved Elevator 2.5mm, HELMUT ZEPF MEDIZINTECHNIK GMBH, Seitingen-Oberflacht, Germany) (Fig 1D). The residual granulated tissue was curetted and removed from the socket. The wound was irrigated with normal saline and two gelatin sponges (ROEKO Gelatamp 14 x 7 x 7 mm, Coltène/Whaledent AG, Altstätten, Switzerland) were placed into the socket (Fig 1E). The wound healing was recorded after 7 days (Fig 1F). Gingival tissue infiltrated into the socket and maxillary tuberosity bone resorbed.

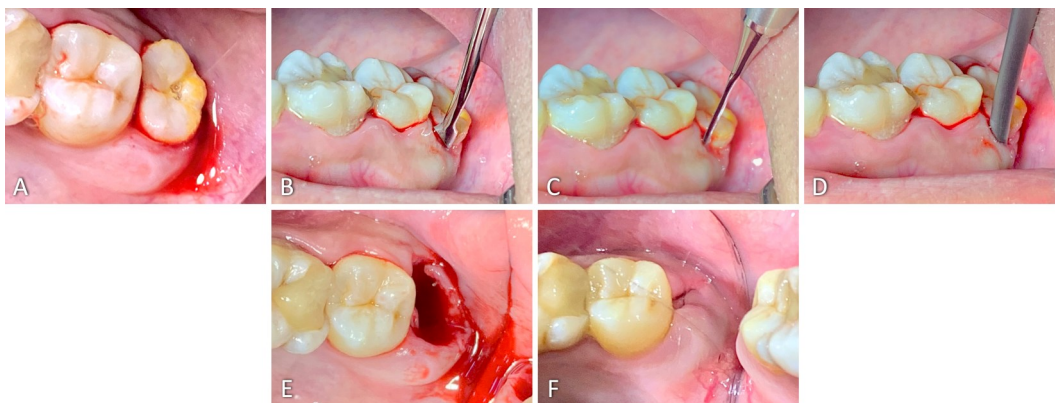


Figure 1: Upper right 3rd molar extraction without interradicular septum. (A): Upper right 3rd molar malposition. (B): Desmotome is used to detach buccal gingival tissue. (C): Periotome is used to release adjacent tissue attachment and periodontal ligament (PDL) of the tooth. (D): 2.5 mm curved elevator is used to luxate and extract the one-root molar. (E): 2 Gelatamp sponges were inserted without suturing. (F): 7 days F/U record.

Case 2 - Lower Right 1st Molar Extraction with Interradicular Septum - Spontaneous Healing

A 66-year-old female felt her lower right posterior tooth cracked while biting and thought the tooth was mobilized (Fig 2A). No signs of infection nor pain were presented. The 1st molar was detached from periodontal tissue using desmotome and periosteal elevator (Fig 2B, 2C). The molar was luxated using a curved elevator (Fig 2D) and then odontectomy was performed to separate the mesial and distal roots of the first molar (Fig 2E) to preserve interradicular septum (Fig 2F). Two gelatin sponges (ROEKO Gelatamp 14 x 7 x 7 mm, Coltène/Whaledent AG, Altstätten, Switzerland) were placed into the remaining mesial and distal sockets after the removal of residual granulated tissue and proper irrigation (Fig 2G). The post-extraction site was sutured with 4-0 silk conventional crossed mattress suturing to hold the collagen. The suture was removed and the wound healing was recorded after 10 days (Fig 2H). The buccal bone wall of the socket resorbed and the volume of the alveolar bone decreased.

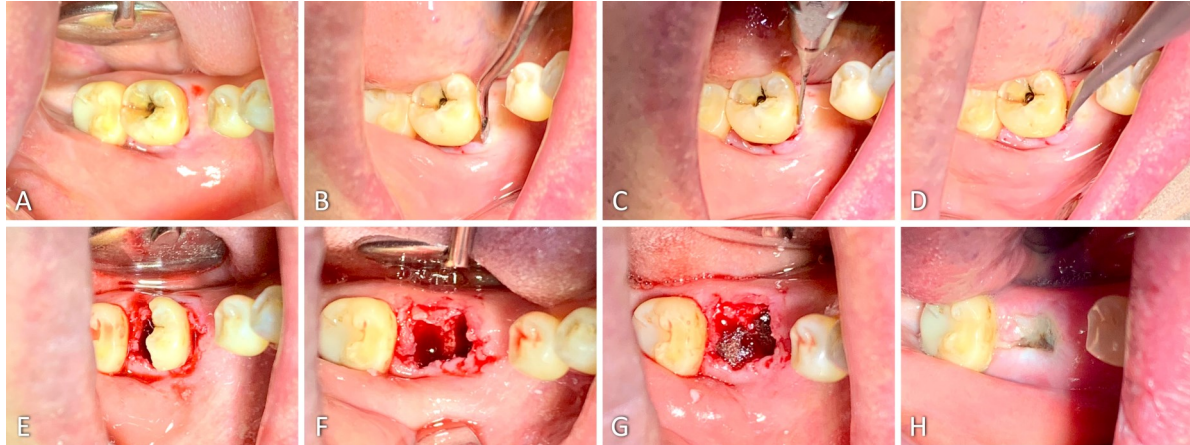


Figure 2: Lower right 1st molar extraction with interradicular septum. (A): Lower right 1st molar with cavitation and gingival recession. A vertical fracture line was discovered on the mesial root surface (B): Desmotome is used to detach buccal gingival tissue. (C): Periosteal elevator is used to release adjacent tissue attachment and PDL of the tooth. (D): 2.5 mm curved elevator is used for tooth luxation. (E): Odontectomy separated the molar into 2 pieces to prevent root fracture during the procedure and preserve the remaining interradicular septum. (F): Tooth extracted and the presence of the interradicular septum. (G): 1 Gelatamp sponge was inserted in each socket (in total 2) and sutured with 4-0 silk conventional crossed mattress suturing. (H): Suturing removal and 10 days F/U record.

Case 3 - Upper Right 3rd Molar Extraction without Interradicular Septum - Socket-Plug Technique

A 36-year-old female fractured her upper right molar while eating. No signs of infection nor pain were presented. A vertical fracture line was presented (Fig 3A). The 3rd molar was detached from periodontal tissue using desmotome and periosteal elevator (Fig 3B, 3C). Two fragments of the molar were luxated and extracted using a curved elevator (Fig 3D). Collagen plug wound dressing (HealiAid® ø 10 x 20 mm, MAXIGEN BIOTECH INC, Taoyuan City, Taiwan) was inserted once the socket was curetted and irrigated properly (Fig 3E). The wound healing was recorded after 7 days (Fig 3F). The gingival tissue attached around the socket and new growth of epithelium presented. The collagen preserved the volume of the alveolar bone.

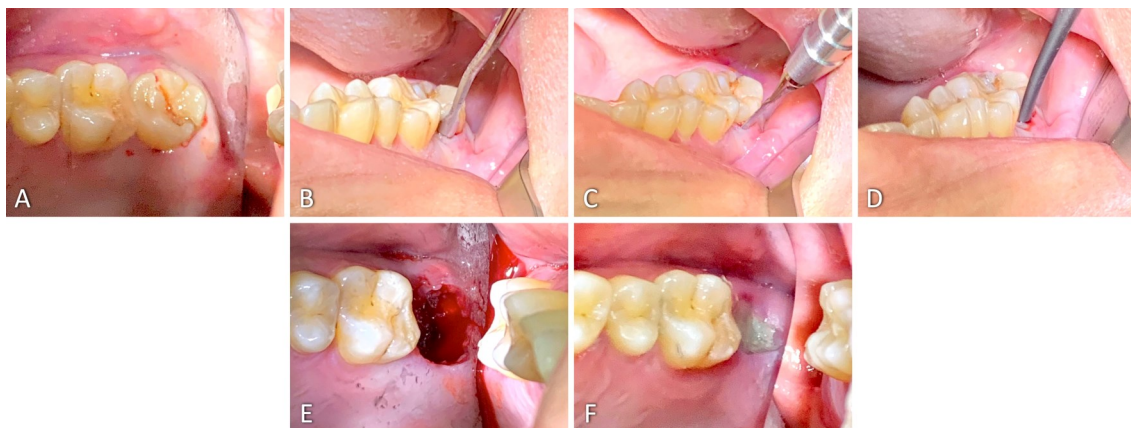


Figure 3: Upper right 3rd molar extraction without interradicular septum. (A): Upper right 3rd molar with visible vertical fracture line. (B): Desmotome is used to detach buccal gingival tissue. (C): Periostome is used to release adjacent tissue attachment and PDL of the tooth. (D): 2.5 mm curved elevator is used to luxate and extract the molar. (E): HealiAid® collagen plug insertion without suturing. (F): 7 days F/U record.

Case 4 - Upper Right 1st Molar Extraction with Interradicular Septum - Socket-Plug Technique

A 40-year-old female cracked her upper right posterior tooth while biting. A vertical fracture line and heavy tooth bruxism was presented on the coronal portion (Fig 4A). The 1st molar luxated and extracted with desmotome, periostome, and curved elevator. Interradicular septum was preserved and the socket was curetted and irrigated (Fig 4B). Collagen plug wound dressing (Horien® Gennu-Plug \varnothing 8.3mm x 20mm, HORIEN Biochemical Technology Co. Ltd, Taichung City, Taiwan) was divided into two smaller plugs and placed separately into the socket (Fig 4C). The socket is sutured with 4-0 silk conventional crossed mattress suturing to hold the collagen (Fig 4D). The suture was removed and the wound healing was recorded after 7 days (Fig 4E). The buccal bone wall contour remained and preserved the volume of the alveolar bone. New epithelium was formed around the socket.

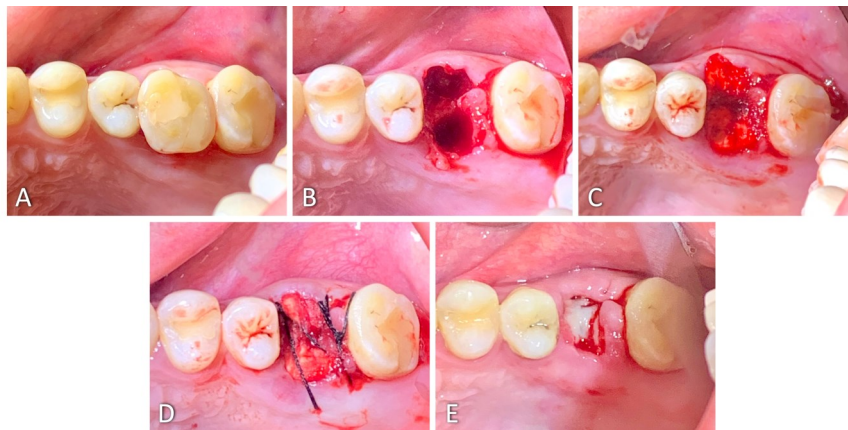


Figure 4: Upper right 1st molar extraction with interradicular septum. (A): Upper right 1st molar with large amount composite restoration and vertical fracture line presented on the coronal portion. (B): Tooth extracted socket with preservation of interradicular septum. (C): Horien® Gennu-Plug collagen plug insertion. (D): Conventional crossed mattress suturing sealed the wound socket. (E): Suturing removal and 7 days F/U record.

Discussion

ARP is believed as a gold standard for post-extraction management. The purpose of the technique is to prevent undesirable alveolar bone resorption. In 2012, Hämmerle et al reported a horizontal reduction in width of 3.8 mm and a vertical reduction in height of 1.24 mm within 6 months after tooth extraction.¹ Ridge preservation is the management of maintaining the ridge profile while ridge augmentation is aiming at enlarging the ridge profile.¹ Barone et al reported a clinical study comparing spontaneous healing and ridge preservation with secondary soft tissue healing in 2013.³ The spontaneous healing group showed horizontal bone resorption of at least 3.6 mm in general and approximately 2 mm in vertical bone resorption compared to the ARP group with 1.6 mm horizontal reduction and 0.3 to 0.9 mm vertical reduction after 4 months.³ In 2015, Araújo et al presented a similar study and showed a 25% bone height reduction in spontaneous healing sockets and 3% in extracted sockets grafted with Bio-Oss® Collagen.¹⁰ Covani et al showed a significant alveolar bone collapse in natural-healing sockets compared to the group placing collagen plugs with less dimensional resorption of the bone in 2022.¹¹

Atraumatic extraction allows for preserving the most amount of uninfected gingival tissue and alveolar bone in the procedure. In 2015, Sharma et al suggested periostome as an aid for tooth luxation that could decrease post-extraction pain, operation time, and complication rate.¹² Other instrumental methods including using physics forceps and piezotome for the extraction are also reported.^{9,13} Interradicular septum is presented in the tooth with multiple roots especially posterior dentitions and is suggested to preserve for better wound healing and immediate implant placement.²¹⁻²³ As the interradicular septum remains, the post-extraction site is divided into two smaller sockets and the morphologic shape favors the wound healing process.

Various collagen plug materials including pure collagen matrix and collagen-embedded grafting materials are available to use in ARP and are proclaimed to have better results compared to no coverage of post extraction sockets.^{10,24} Collagen-embedded grafting materials are claimed to be effective in the socket plug technique.^{10,25-27} In 2011, Kim et al reported the usage of collagen sponge with xenograft could prevent horizontal resorption of the alveolar ridge.²⁵ In 2016, Feng et al reported using mineralized collagen has better bone formation for a post-extraction site than using blended hydroxyapatite/ collagen.²⁶ Morelli et al investigated three-dimensional volume changes of extracted sockets filled with deproteinized bovine bone and collagen matrix and reported the reduction of buccal soft tissue loss after 6 months.²⁷

However, the properties of collagen matrix and grafting materials may affect the histological analysis of healed alveolar ridge. In 2003, Carmagnola et al investigated 3 different post-extraction socket groups by placing Bio-Gide® membrane, filling with Bio-Oss® particles, and spontaneous healing.²⁸ The group using Bio-Gide® and spontaneous healing showed a higher amount of lamellar bone growth and no connective tissue infiltration at the site. Bio-Gide® group reached 46% of bone marrow and 12.9% woven bone growth while the group filled with Bio-Oss® particles had the least growth of bony structure 26.0% lamellar bone and 8.4% woven bone. Connective tissue infiltration was presented and particles of xenograft remained around 21.1% in the group as a foreign body in the post-extraction site.²⁸ In 2013, Alkan et al reported higher new bone formation in extracted sockets filled with enamel matrix derivatives (EMD) compared to the sockets filled with Bio-Oss® Collagen.²⁹ The study evaluated the ISQ values after placing dental implants at these sites. EMD sites showed higher value in the first and third months but no significant difference in Bio-Oss® Collagen group.²⁹ In 2022, Gabay et al compared histological and dimension changes of the alveolar ridge following tooth extraction when using deproteinized bovine bone mineral containing collagen materials (DBBM-C).³⁰ The use of DBBM-C resulted in a small reduction of alveolar bone resorption of the site but it showed 33.79% vital bone and 12.9 residual graft while the spontaneous healing presented 51.44% vital bone in histomorphometric analysis.³⁰

In 1992, Finn et al reported gelatin sponge is an effective hemostatic agent and capable of osseous regeneration.¹⁸ Nevertheless, there are no significant bone formation in studies of Singh et al in 2015,¹⁹ Thuruthel et al in 2023,²⁰ and this multiple-case study.

Conclusion

Alveolar ridge resorption can be reduced by appropriate ARP techniques. The socket-plug technique is a conventional ARP and easy to manipulate without further flap design and procedure. Within the limits of the study, collagen plug materials have better results in preserving the alveolar ridge compared to spontaneous healing after the tooth extraction. Hemostatic gelatin sponge could maintain wound healing but there is no significant result in ridge preservation. Inter-radicular septum affects the reconstructive progress and the volume of the alveolar ridge. Once the septum is showed, it should be preserved via the atraumatic extraction method to obtain the best ARP outcomes.

Conflict of Interest

The author declares no conflict of interest either directly or indirectly, in the materials or information listed in the article.

References

1. Hammerle CH, Araujo MG, Simion M, et al: Evidence-based knowledge on the biology and treatment of extraction sockets. *Clin Oral Implants Res* 2012;23 Suppl 5:80-82.
2. Steigmann L, Di Gianfilippo R, Steigmann M, et al: Classification Based on Extraction Socket Buccal Bone Morphology and Related Treatment Decision Tree. *Materials (Basel)* 2022;15.
3. Barone A, Ricci M, Tonelli P, et al: Tissue changes of extraction sockets in humans: a comparison of spontaneous healing vs. ridge preservation with secondary soft tissue healing. *Clin Oral Implants Res* 2013; 24:1231-1237.
4. Kotsakis G, Chrepa V, Marcou N, et al: Flapless alveolar ridge preservation utilizing the "socket-plug" technique: clinical technique and review of the literature. *J Oral Implantol* 2014;40:690-698.
5. Lopez-Pacheco A, Soto-Penalosa D, Gomez M, et al: Socket seal surgery techniques in the esthetic zone: a systematic review with meta-analysis and trial sequential analysis of randomized clinical trials. *Int J Implant Dent* 2021;7:13
6. Amler MH, Johnson PL, Salman I: Histological and histochemical investigation of human alveolar socket healing in undisturbed extraction wounds. *J Am Dent Assoc* 1960;61:32-44.

7. Oghli AA, Steveling H: Ridge preservation following tooth extraction: a comparison between atraumatic extraction and socket seal surgery. *Quintessence Int* 2010;41:605-609.
8. Kotsakis G, Markou N, Chrepa V, et al: Alveolar ridge preservation utilizing the socket plug technique. *Int J Oral Implantol Clin Res* 2012;3:24-30.
9. Alraqibah MA, Rao JKD, Alharbi BM: Periotome versus piezotome as an aid for atraumatic extraction: a randomized controlled trial. *J Korean Assoc Oral Maxillofac Surg* 2022;48:356-362.
10. Araujo MG, da Silva JCC, de Mendonca AF, et al: Ridge alterations following grafting of fresh extraction sockets in man. A randomized clinical trial. *Clin Oral Implants Res* 2015;26:407-412.
11. Covani U, Giammarinaro E, Panetta D, et al: Alveolar Bone Remodeling with or without Collagen Filling of the Extraction Socket: A High-Resolution X-ray Tomography Animal Study. *J Clin Med* 2022;11.
12. Sharma SD, Vidya B, Alexander M, et al: Periotome as an Aid to Atraumatic Extraction: A Comparative Double Blind Randomized Controlled Trial. *J Maxillofac Oral Surg* 2015;14:611-615.
13. Misch CE, Perez HM: Atraumatic extractions: a biomechanical rationale. *Dent Today* 2008;27:98, 100-101.
14. Atieh MA, Alfardan L, Alsabeeha NHM: Flapped versus flapless alveolar ridge preservation: a systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2022;51:133-142.
15. Barone A, Borgia V, Covani U, et al: Flap versus flapless procedure for ridge preservation in alveolar extraction sockets: a histological evaluation in a randomized clinical trial. *Clin Oral Implants Res* 2015;26:806-813.
16. Silverstein LH, Kurtzman GM: A review of dental suturing for optimal soft-tissue management. *Compend Contin Educ Dent* 2005;26:163-166, 169-170; quiz 171, 209.
17. Park JC, Koo KT, Lim HC: The hidden X suture: a technical note on a novel suture technique for alveolar ridge preservation. *J Periodontal Implant Sci* 2016;46:415-425.
18. Finn MD, Schow SR, Schneiderman ED: Osseous regeneration in the presence of four common hemostatic agents. *J Oral Maxillofac Surg* 1992;50:608-612.
19. Singh M, Bhate K, Kulkarni D, et al: The effect of alloplastic bone graft and absorbable gelatin sponge in prevention of periodontal defects on the distal aspect of mandibular second molars, after surgical removal of impacted mandibular third molar: a comparative prospective study. *J Maxillofac Oral Surg* 2015;14:101-106.
20. Thuruthel MJ, Surej Kumar LK, Kurien NM, et al: Efficacy of gelatamp in controlling the postoperative sequelae following mandibular posterior teeth extraction - A split-mouth study. *J Oral Biol Craniofac Res* 2023;13:96-103.
21. Anitua E, Orive G: A new approach for atraumatic implant explantation and immediate implant installation. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2012;113:e19-25.
22. Sayed AJ, Shaikh SS, Shaikh SY, et al: Inter radicular bone dimensions in primary stability of immediate molar implants - A cone beam computed tomography retrospective analysis. *Saudi Dent J* 2021;33:1091-1097.
23. Milenkovic J, Vasiljevic M, Jovicic N, et al: Criteria for the Classification of the Interradicular Septum Shape in Maxillary Molars with Clinical Importance for Prosthetic-Driven Immediate Implant Placement. *Diagnostics (Basel)* 2022;12.
24. Del Fabbro M, Tommasato G, Pesce P, et al: Sealing materials for post-extraction site: a systematic review and network meta-analysis. *Clin Oral Investig* 2022;26:1137-1154.
25. Kim YK, Yun PY, Lee HJ, et al: Ridge preservation of the molar extraction socket using collagen sponge and xenogenic bone grafts. *Implant Dent* 2011;20:267-272.
26. Feng L, Zhang L, Cui Y, et al: Clinical evaluations of mineralized collagen in the extraction sites preservation. *Regen Biomater* 2016;3:41-48.
27. Morelli T, Zhang S, Monaghan E, et al: Three-Dimensional Volumetric Changes After Socket Augmentation with Deproteinized Bovine Bone and Collagen Matrix. *Int J Oral Maxillofac Implants* 2020;35:566-575.
28. Carmagnola D, Adriaens P, Berglundh T: Healing of human extraction sockets filled with Bio-Oss. *Clin Oral Implants Res* 2003;14:137-143.

29. Alkan EA, Parlar A, Yildirim B, et al: Histological comparison of healing following tooth extraction with ridge preservation using enamel matrix derivatives versus Bio-Oss Collagen: a pilot study. *Int J Oral Maxillofac Surg* 2013;42:1522-1528.

30. Gabay E, Katorza A, Zigdon-Giladi H, et al: Histological and dimensional changes of the alveolar ridge following tooth extraction when using collagen matrix and collagen-embedded xenogenic bone substitute: A randomized clinical trial. *Clin Implant Dent Relat Res* 2022;24:382-390.

Citation: Hung CC. The Socket-Plug Technique and Materials Comparison in Atraumatic Extractions - A Multiple-Case Study. *SVOA Dentistry* 2023, 4:2, 45-51.

Copyright: © 2023 All rights reserved by Hung CC., et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.