tissue regeneration, or both. Biologically active regenerative material that is proven to promote regeneration such as enamel matrix derivative (EMD) has also been extensively studied and used to promote regeneration. The guided tissue regeneration based on the idea of preventing the migration of the epithelial periodontal tissues into the osseous defect, allowing time for bone and other attachment tissues to heal. The clinical attachment level gained with bone grafts, guided tissue regeneration and enamel matrix derivative had showed significant differences compared with open flap debridement alone.[7]

Orthodontic treatment of elderly patient is different than that for children and adolescents. An expectation of a beautiful smile at the end of orthodontic treatment is a primary concern for all patients. Elderly patient who are susceptible to periodontal disease and have experienced advanced levels of bone loss and sometimes loss of dental units may be defined as periodontally compromised. These patients need to dealt separately because, they are prone to further bone loss; the reduced periodontium cannot sustain further loss without the potential loss of teeth; there is frequently as acquired malocclusion unique to this group; and the reduced periodontal support dictates altered treatment design, mechanics, and retention.[8]

**Case presentation**

A 55 year old female patient came with complaint of the front tooth that was jutting out. It started with a swelling and pus from the gum and the tooth became longer and moved from the original position. She had patent ductus arteriosus (PDA) when she was young and it had been surgically corrected when she was 19 years old. Otherwise, she had no other medical problems. Her missing teeth were extracted due to caries or periodontal disease. She was a retired teacher and had 3 children. She never smoked cigarettes.

She presented with moderate to severe periodontal disease with generalized 4 – 9mm probing pocket depths and gingival recession. The deepest periodontal pocket depths were noted on teeth 11 which was the complaint tooth and tooth 23. Tooth 11 was disto-labially protruded and extruded with grade 1 mobility, tooth 28 was having grade 2 mobility and had fractured cusp. There were no occlusal trauma or fremitus detected. Generalized abrasion cavities on buccal surfaces of the teeth were observed. The missing teeth were 38, 37, 36, 34, 44 and 48. Tooth 26 was over erupted due to missing opposing tooth(**Figure 1**).

***Investigations***

Orthopantomogram(**Figure 2**) showed horizontal bone loss on the maxilla which was generalized up to 2/3 of root length. On the mandible, it was generalized bone loss up to 1/3 of root length. Vertical bone loss can be observed on tooth 14(D), 11(D), 23(M), 22(D), 35(M) and 33(M). There was widening of periodontal ligament spaces on teeth 18, 14, 11, 23, 24, 35 and 33. No furcation involvement or periapical radiolucency on other teeth. The other findings included the overerupted tooth 26 and partially edentulous mandible.

Periapical radiograph of disto-labially protruded and extruded tooth 11 showed vertical bone loss of almost the whole length of the root; only the apical end of the root was still in bone(**Figure 3**). The tooth responded to. Tooth 11, 21, 23 and 35 responded positive to pulp sensibility tests (electric and cold).

***Diagnosis***

1) Generalized moderate to severe chronic periodontitis.
2) Pathological migration of tooth 11.
3) Caries on teeth 46 (D) and 18 (B).
4) Fracture cusp of tooth 18.
5) The buccal abrasion cavities on 16, 15, 14, 24, 25, 26, 35, 45 and 46.
6) The missing teeth were 38, 37, 36, 34, 44 and 48.

***Treatment options***

Tooth 11 with grade 1 mobility, extruded and disto-labially rotated:

i) Splinting and accept the malposition.
ii) Orthodontic realignment.
iii) Elective endodontic and crown restoration.

1) Replacement of lower missing teeth:
   i) Removable partial denture.
   ii) Implant supported bridge.
   iii) Single tooth supported implant for each missing teeth.

***Treatment plan***

1) Initial therapy:
   i) Oral hygiene instructions, scaling and prophylaxis.
   ii) Root planning of pockets ≥ 5mm.
   iii) Restorations of tooth 46 (D) and 18 (B).
   iv) Removable partial denture to replace lower missing teeth.
   v) Splinting of tooth 11.
1) Corrective therapy:
   i) Periodontal surgery.
   ii) Permanent removable partial denture for lower teeth.
2) Maintenance phase: Review 3 monthly and then re-evaluation at 6 monthly intervals.
3) Advanced therapy: Orthodontic realignment of upper teeth.

***Treatment summary***

1) Initial periodontal therapy.
   - Patient motivation.
   - Oral hygiene instruction.
   - Full mouth scaling and prophylaxis.
   - Root planning of sites with periodontal pockets ≥ 5mm.
   - Splinting of tooth 11.
2) Regenerative periodontal surgery on tooth 23.
3) Removable cobalt-chrome partial denture to replace lower missing teeth.
4) Orthodontic realignment of upper teeth.
5) Review and maintenance.

***Treatment progress***

1) Initial periodontal therapy

The initial periodontal therapy consisted of oral hygiene instructions, re-evaluation and scaling was done. Root debridement was then performed on sites with periodontal pockets of more than 5mm. Oral hygiene was monitored and kept at very good level by patient at home.

Teeth 46 and 18 that were carious had been restored. However tooth 18 was affected by acute periapical periodontitis and had to be extracted considering the tooth had no restorative importance and also because of the severe pain. During the course of the treatment, tooth 16 was causing discomfort to the patient and was diagnosed with cracked tooth syndrome. The existing occlusal amalgam restoration and the fracture line extending distally from the occlusal amalgam restoration into the dentine below the contact point were removed and finally restored with composite resin (**Figure 4**). The buccal abrasion cavities on 16, 15, 14, 24, 25, 26, 35, 45 and 46 were restored with glass ionomer cement (GIC).

Tooth 11 that was extruded and rotated disto-labially due to severe loss of periodontal support was splinted to adjacent sound and firm teeth using twist-flex orthodontic wire stabilized with composite resin (**Figure 5**). The purpose was to stabilize the tooth from occlusal trauma and also to prevent further extrusion.

Patient was then reviewed and had maintained optimum plaque control. Lower removable cobalt-chrome partial denture was then constructed and issued for the patient to improve mastication and prevent over- eruption of upper teeth.

2) Corrective phase

Periodontal pockets of more than 7mm on tooth 23 which was not reduced after non surgical periodontal therapy was treated with open flap debridement and combined with regenerative procedures using demineralized freeze-dried bovine bone mineral-OsteoLemb and resorbable collagen membrane-LyoLemb, derived from bovine pericardium produced locally (Bank Tissue - HUSM). Pre-operative picture of the surgical site and radiograph can be observed on **figure6**.

***Regenerative procedure on tooth 23*** **(Figure 7)**

Procedures were explained to patient including post-operative complications to be expected such as pain, swelling, mild bleeding and possibility of gingival recession to be more prominent after surgery. Patient agreed and understood; and gave consent for treatment. Patient was given local anesthetic infiltration of 2% Mepivacaine HCL with 1:100,000 adrenaline on buccal and palatal gingiva of tooth 23 (1 and ½ catridges).

Extraoral and intraoral surgical site was disinfected with 0.2% chlorhexidine gluconate, and patient was draped. Using no. 15c blade, sulcular incision was performed, buccally and palatally from distal of to 23 to mesial of 24. Modified papilla preservation technique was applied by performing the releasing incision palatally and raised with the buccal flap. Buccal and palatal full thickness flap was raised with periosteal elevator. 2 wall vertical bone defect was noted on mesial of tooth 23 measuring 12mm deep. Granulation tissue was curetted. Scaling and root planing was done on the root surfaces. Then the surgical site was irrigated with normal saline.

Template was then measured for the correct size of resorbable membrane to cover the defect. Bone perforations were done using slow-speed round bur to induce bleeding. Blood was aspirated to mix with xenograft-bovine bone granules (Bank Tisu - HUSM) and mixed with blood and placed in the vertical defect, slightly overfilled. The bone graft was subsequently covered with resorbable collagen membrane (bovine pericardium-Lyolemb, Bank tisu - HUSM) and stabilized with resorbable suture (Safil 4/0). The flaps were approximated and reposition to cover the membrane over the bone graft, and placed at the original position. The flap was stabilized with modified vertical mattress suture using resorbable sutures (Safil 4/0). Hyaluronic acid (Gengigel) was applied over the incision area and periodontal dressing placed (Coe-pak). Patient was instructed not to brush the surgical area for a week and only to use chlorhexidine mouthwash 0.2%, twice daily using 15ml, for 30 seconds. The medications prescribed were tablet metronidazole 400mg three times daily for 7 days, and tablet paracetamol 1000mg three times daily for 3 days.

Review was performed weekly for two weeks. Sutures were removed after a week. Patient was then reviewed once a month for oral hygiene reinforcement and scaling.

The site was observed for 6 months before reassessment of pocket depths, gingival recessions and radiographic examination were done. There was additional gain of attachment of 2mm on mesio-buccal and 4mm on mesio-palatal despite some gingival recession (**Table 1**). Radiographic comparison showed evidence of hard tissue gained, which can be observed in **figure 8**.

Tooth 11 was evaluated after splinting and non-surgical periodontal therapy and periodontal pocket depth had reduced. It was observed from periapical radiograph that additional bone was gained (**Figures 9**).

Patient's periodontal condition was stable. The intraoral pictures of the patient at completion of periodontal treatment were shown in **figure 10**.

***Orthodontic treatment***

Pre treatment model photographs (**Figure 11**), orthopantomogram (**Figure 12**), lateral cephalogram and tracing (**Figure 12**) were done as a part of investigation. The orthodontic fixed appliance was bonded on the upper teeth on a 3/6 sectional basis using 0.022 MBT Preadjusted Edgewise Appliance with a very light continuous force at the age of 58.The maxillary teeth were leveled with continuous archwires, restarting with 0.012-inch nickel-titanium and working up to 0.017- × 0.025-inch stainless steel. In order to maintain the existing gingival height and contour, it was decided to align tooth 11 and 23 with a very light continuous force until the proper finishing. During the active orthodontic treatment, the patient was remotivated and periodontally maintained by the dental hygienist on a monthly basis.The orthodontic therapy lasted for 10 months and it was stabilized and finished with rigid wires. The orthodontic appliances were then removed and essix form retener was given in the upper arch. Active orthodontic treatment was completed in 13 months when the patient was 59 years old.

Patient cooperation in maintenance of oral hygiene was excellent, and the examination after active orthodontic treatment revealed that the clinical status and radiographic results observed at the completion of the treatment was excellent (**Figures 13, 14 and 15**). The patient was completely satisfiedwith the results of the periodontic-surgical-prosthodontic-orthodontic treatment.

Patient is now under regular follow-up (more than 2 years after orthodontic treatment). Patient still maintained optimal oral hygiene. Follow-up clinical status showed satisfactory maintenance of accomplished treatments(**Figure 16**).

## Discussion

In this patient, spontaneous correction of infrabony pocket in pathologically migrated tooth 11, due to severe periodontitis was improved with non-surgical periodontal therapy and stabilized with splinting. Sato et al. (2004) also observed spontaneous improvement in position of the particular tooth, after non-surgical periodontal therapy and before splinting.[9]

The different types of bone grafting materials are autogenous bone grafts, allografts, alloplasts and xenografts. Autogenous bone grafts are osteoinductive and osteoconductive, however required harvesting from other sites causing second wound. The alternative commonly chosen is the xenografts, such as in this case, the bone mineral derived from bovine produced locally by the Universiti Sains Malaysia (USM) was used. The combination of bone grafts (deproteinized bovine bone mineral-DBBM e.g. Bio-Oss®) and guided tissue regeneration-GTR using resorbable barrier membranes showed better result with periodontal regeneration.[10]It was found that particulate graft combined with barrier membrane gives non-significant improvement in bone level, but significant attachment level gain and probing depth reduction when compared with graft used alone.[11] In this patient, the attachment levels gained on tooth 23 were 2mm on mesio-buccal, and 4 mm on mesio-palatal.

A common problem in elderly patient with periodontal disease is the migration, elongation and spacing of incisors.[12]Wennstrom et al. (1993) have suggested that orthodontic force can have negative effects such as loss of attachment and further bone destruction when periodontal inflammation is present.[13] Therefore, it is essential to eliminate inflammation of periodontal tissues prior to orthodontic treatment. In this case, as intensive effort was made to recover the periodontal environment with no inflammation before the orthodontic treatment. During orthodontic treatment, special consideration must be given to force application, particulary its magnitude and duration in a dentition that demonstrates a reduced periodontal support mechanism.[14]Alignment of elongated or crowded or malposed teeth should be an advantage to maintain proper oral hygiene, which is essential care for the periodontitis.[15]Orthodontic treatment also contributes to the promotion of oral health of the patient.

In this periodontally compromised elderly patient, successful results were achieved. This case report presents the effect of non surgical periodontal therapy in contribution to spontaneous correction of pathologically migrated tooth due to severe periodontal breakdown. The same case also showed the attachment level gained by periodontal regeneration surgery. Periodontal treatment was carried out until the stable periodontal condition and it was maintained throughout the whole treatment. The tooth migrated into a favourable position, and temporarily splinted to stabilize the position before undergoing orthodontic treatment to realign the teeth. During active orthodontic treatment, attention was paid to the option for the use of sectional mechanics. An edgewise appliance with sectional mechanics were used to allow for good oral hygiene and periodontal health.

## Conclusion

This article presents satisfactory and successful accomplished interdisciplinary (periodontic-surgical-restorative-prosthodontic-orthodontic) management that was applied for restoration of function and appearance.

## References

Figure 1. Pre-treatment intraoral photograph.

Figure 2. Pre-treatment orthopantomogram (OPG).

Figure 3. Pre-treatment periapical radiograph of tooth 11.


Figure 4. Pre and Post restoration of tooth 16.

Figure 5. Extruded and rotated tooth 11 stabilized using twist-flex orthodontic wire with composite resin.

Figure 6. Pre-operative photograph of the tooth 23.

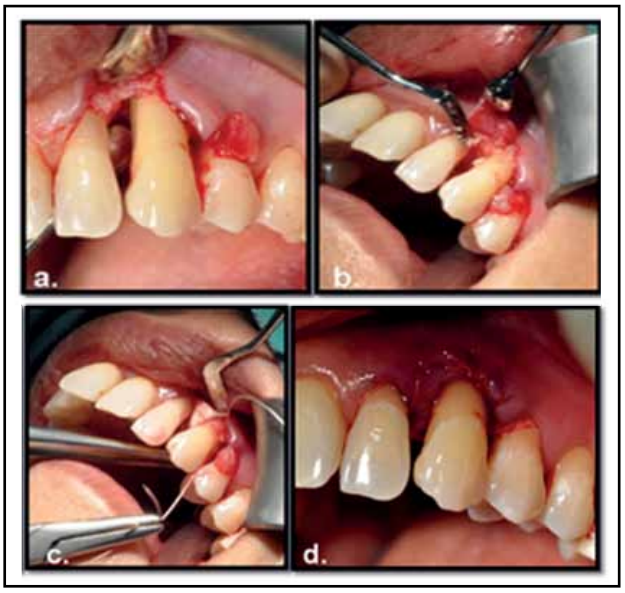


Figure 7. Regenerative procedure on tooth 23: a. sulcular incision, 2 wall vertical bone defect was noted; b. xenograft-bovine bone granules (Bank Tisu - HUSM) mixed with blood and placed in the vertical defect; c. the bone graft was subsequently covered with resorbable collagen membrane (bovine pericardium-Lyolemb, Bank tisu - HUSM); d. the flap was stabilized with modified vertical mattress suture using resorbable sutures (Safil 4/0).

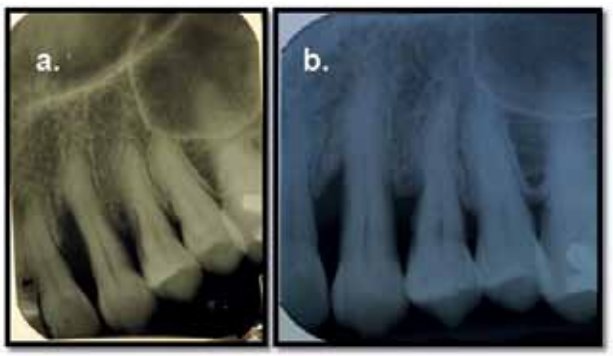


Figure 8. Pre and Post treatment periapical radiograph of tooth 23.

Figure 9. Post treatment periapical radiograph of tooth 11.

Figure 10.Pre Orthodontic (Post periodontal) treatment intraoral photograph.

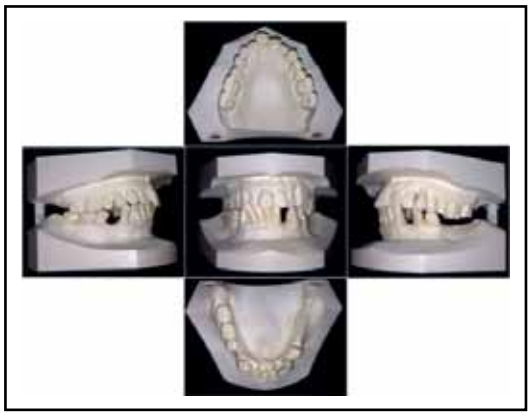

Figure 11.Pre Orthodontic treatment model photographs.

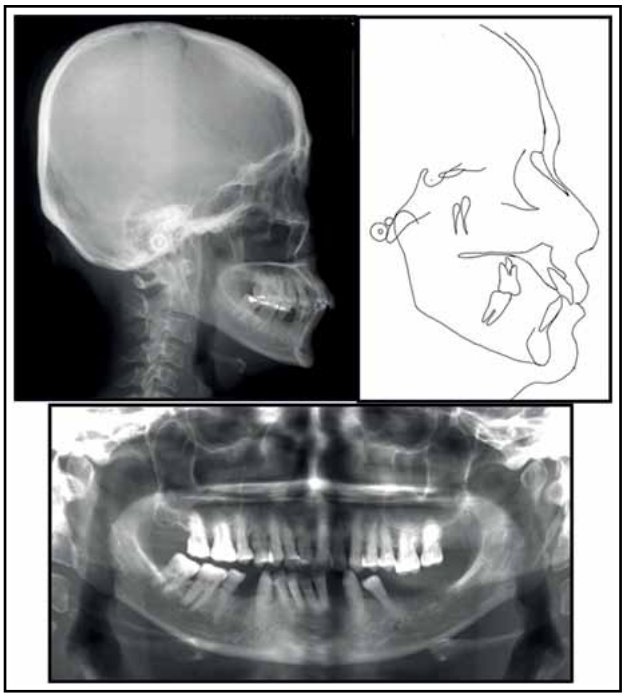

Figure 12. Pre Orthodontic treatment lateral cephalogram, lateral Cephalogram tracing and orthopantomogram (OPG).

Figure 13. Post Orthodontic treatment intraoral photograph.

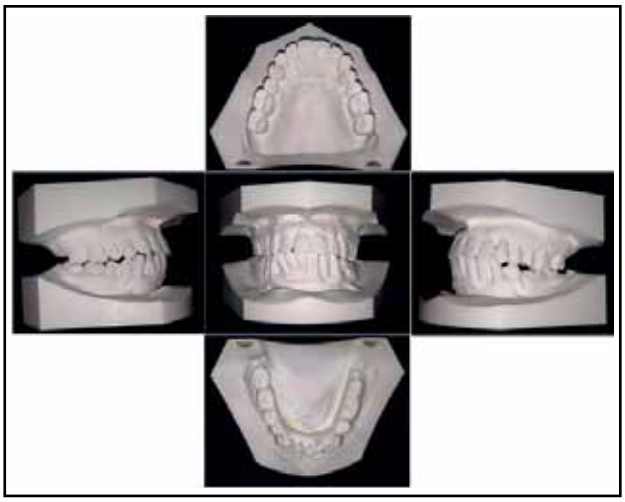

Figure 14. Post Orthodontic treatment model photographs.

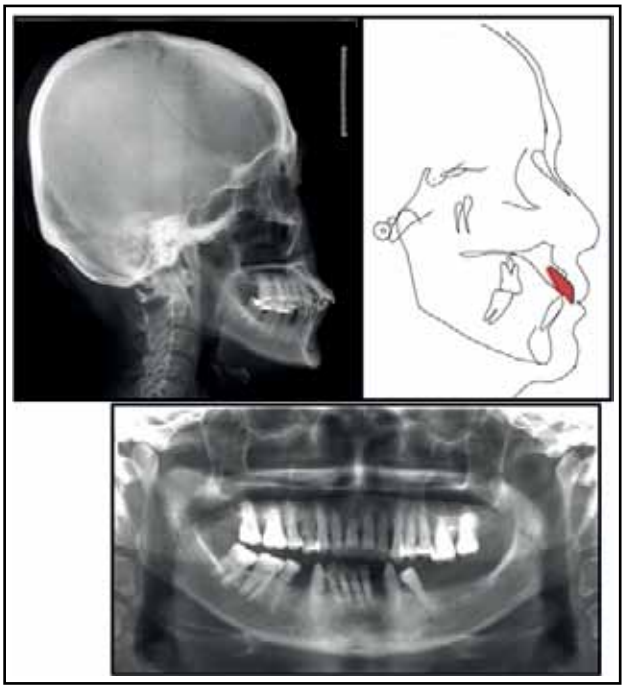

Figure 15. Post-treatment lateral cephalogram, lateral Cephalogram tracing and orthopantomogram (OPG).

Figure 16. Follow-up intraoral photographat the age of 60 years.

1. Chasens A. Periodontal disease, pathologic tooth migration and adult orthodontics. *New York J Dent*1979;**49:**40-43.
2. Towfighi P, Brunsvold M, Storey A, Arnold R, Willmann D, McMahan A. Pathologic migration of anterior teeth in patients with moderate to severe periodontitis. *J Periodontol*1997;**68**:967-72.
3. Martinez-Canut P, Carrasquer A, Magan R, Lorca A. A study on factors associated with pathologic tooth migration. *J Clinical Periodontol*1997;**24**:492-97.
4. Brunsvold M. Pathologic tooth migration. *J Periodontol*2005;**78:**859-66.
5. Heitz-Mayfield LJA. How effective is surgical therapy compared with non-surgical debridement. *Periodontol* 2000, 2005;**37**:72-87.
6. Bosshardt DD, Sculean A. Does periodontal tissue regeneration really work? *Periodontol* 20002009;**5:**208-19.
7. Tonetti MS, Fourmousis I, Suvan J, Cortellini P, Bragger U, Lang NP. Healing, post-operative morbidity and patient perception of outcomes following regenerative therapy of deep intrabony defects. *J Clinical Periodontol*2004;**31**:1092-8.
8. Chester S,Handelmanm DMD. Orthodontic care of the periodontally compromised patient followed long-term: Part – 2. *World J Orthod*2001;**2**:127-41.
9. Sato S, Ujiie H, Ito K. Spontaneous correction of pathologic tooth migration and reduced infrabony pockets following nonsurgical periodontal therapy: a case report. *Int J PeriodonticsRestorative Dent* 2004;**24**:456-461.
10. Stavropoulos A, Karring T. Guided tissue regeneration combined with a deproteinized bovine bone mineral (Bio-Oss) in the treatment of intrabony periodontal defects: 6-year results from a randomized-controlled clinical trial. *J Clinical Periodontol*2010;**37**:200-10.
11. Reynolds MA, Aichelmann-Reidy ME, Branch-Mays GL,Gunsolley JC. (2003) The efficacy of bone replacement grafts in the treatment of periodontal osseous defects. A systematic review. *AnnalsPeriodontol*2003;**8**:227-65.
12. Miller BH. Orthodontics for the adult patient. I. Introduction. *British Dent J* 1980;**148**:97-100.
13. Wennstrom JL, Stokland BL, Nyman S,Thilander B.Periodontal tissue response to orthodontic movement of teeth with infrabony pockets. *Am J OrthodDentofacialOrthop*1993;**103:**31-39.
14. Polson A, Caton J, Polson AP, Nyman S, Novak J, Reed B. Periodontal Response after tooth movement into infrabony defects. *J Periodontol*1984;**55**:197-202.
15. Re S, Corrente G, Abundo R,Cardaropoli D.Orthodontic treatment in periodontally compromised patients: 12 year report. *Int J Periodontics Restorative Dent* 2000;**20**:31-39.