

Evaluation of the Combined Orthodontic-Periodontal Therapy in the Management of Extruded Anterior Teeth in Patients with Aggressive Periodontitis

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ABSTRACT

This study assessed surgical periodontal treatment using Naringin collagen graft versus surgical procedure only in the treatment of extruded anterior teeth in patients with aggressive periodontitis after orthodontic treatment. Fourteen patients 20 to 40 years old having progressive periodontal disease leading to extrusion of one or more of the anterior teeth with at least one periodontal defect and a radiographic evidence of alveolar bone loss received a pre-orthodontic periodontal preparation phase. An orthodontic phase followed to intrude and align the extruded teeth. Seven patients received an open flap surgery with a Naringin graft, the other seven patients acted as a control only receiving an open flap surgery for mechanical debridement without graft placement. The following parameters were registered clinically and with standardized radiographs (plaque index, sulcus bleeding index, tooth mobility, pocket depth, bone level and bone density) before and after the orthodontic phase and at 3, 6, and 9 months following the periodontal surgery. Results showed a significant increase in all parameters from pre to post orthodontic intrusion. A significant improvement in plaque index, sulcus bleeding index, pocket depth, and bone density were detected following the periodontal surgery in both grafted and non-grafted groups. A significant improvement in pocket depth in the first 3 months following the periodontal surgery in both groups however the improvement in the grafted group was significantly higher. An improvement in bone level and bone density following the periodontal therapy was significantly higher throughout the follow-up period in the grafted group compared to the non-grafted group.

Key Words: Orthodontic- Naringin - Periodontitis - Graft – Intrusion

INTRODUCTION

Migration, spacing, tipping, and extrusion of incisors are common problems in patients suffering from aggressive periodontal diseases as a result of severe bone loss. ⁽¹⁾ Disjunction of the equilibrium between the available periodontal support and forces acting over the teeth may lead to positional changes that consequently results

in traumatic occlusion that may enhance further periodontal destruction. ^(2,3)

Anterior teeth are not protected by occlusal forces and have no antro-posterior contact inhibiting migration particularly with increased overjet. ⁽⁴⁾ With progressive bone loss the center of resistance moves apically, ⁽⁵⁾ so the forces acting on the crowns induce a large moment which leads

to more displacement and further periodontal destruction.

Correction of these problems demands advanced techniques and an understanding of the biologic situation present in those patients. Treatment planning should involve both periodontal and orthodontic considerations to achieve a satisfactory result. ⁽⁶⁾

The feasibility of treating patients with reduced but healthy periodontium has been demonstrated by several authors. ⁽⁷⁻¹¹⁾

In an attempt to increase the bone support of the periodontally involved teeth, providing that both biomechanical force system and oral hygiene are kept under control, orthodontic intrusion can be used to change a horizontal bone defect into a deep and narrow vertical bone defect. In this way regenerative therapy can be more favorably performed. ⁽¹¹⁻¹⁵⁾

Rabie et al. 2001 ⁽¹⁶⁾ presented a technique where orthodontic intrusion was utilized to change a horizontal bone defect into a deep and narrow vertical defect that is more favorable for regenerative therapy using demineralized bone matrix (DBM).

DBM derived from intramembranous bone has extremely good osteogenic properties and greatly improves the integration of autogenous bone grafts. ⁽¹⁷⁾ However, the risk of transmission of infection such as the mad cow disease and immunological reaction prompted scientists to continue to search for new materials that increase bone formation, especially from using plant or synthetic materials. ⁽¹⁸⁾

Naringin is a flavonoid available commonly in citrus fruits. Naringin in collagen matrix have the effect of increasing new bone formation locally in bone defects in vivo. ⁽¹²⁾ Therefore Naringin has the potential to be utilized in periodontal bone defects to increase bone formation.

Based on this we decided to evaluate the combined orthodontic- regenerative periodontal therapy using Naringin collagen graft in the management of extruded anterior teeth in patients with aggressive periodontitis. We comprehensively

validated the technique presented by Rabie and co-workers ⁽¹⁶⁾ in a clinical study by measuring plaque index, sulcus bleeding index, and tooth mobility; and radiographically by measuring bone level and density, investigating the possibility of combining the orthodontic intrusion, periodontal therapy and local application of Naringin as a mean to regenerate the lost bone in these patients.

MATERIALS AND METHODS

The present study included fourteen patients ranging in age from 20-40 years with a mean age of 31.9 years. All patients had migration of one or more of the incisors with increase in gingival recession and at least one periodontal defect with a probing pocket depth ≤ 5 mm, and a radiographic evidence of horizontal alveolar bone loss that had been noted in relation to aggressive periodontal disease.

Periodontal protocol and interdisciplinary treatment planning:

1) Plaque Control Phase:

All patients received adequate periodontal treatment involving supra and sub-gingival scaling and root planning with detailed instructions in self-performed plaque control measures, including tooth brushing and inter-dental cleaning with inter-dental brush and using chlorhexidine mouth wash.

2) Pre-Operative Periodontal Assessment:

Patients were recalled after four weeks of the initial therapy and the following measurements were recorded using a graduated periodontal probe (William's probe).

1. Plaque index (PI) ⁽¹⁹⁾
2. Sulcus bleeding index (SBI) ⁽²⁰⁾
3. Probing depth (PD) ⁽²¹⁾
4. Tooth mobility ⁽²²⁾

3) Supportive periodontal therapy

During orthodontic treatment the patients will receive professional dental cleaning (supra and sub gingival debridement) at three month intervals.

4) The Orthodontic phase:

The aim of the orthodontic treatment was to intrude the extruded teeth. All patients were treated by the use of 45 degrees intrusion adjustments bent into a loop of a 0.016 inch stainless steel round wire. The intrusion bend will place the wire at the gingival margin or slightly higher in the labial vestibule before tying the wire into the bracket slot. The force delivered by the wire was adjusted to 5 grams and was confirmed by a force gauge, the moment was ranging between (150 to 200 gm/ mm²).

A 2x2 or 2x1 Edgewise appliance with 0.018 x 0.025 .inch slot brackets was used. It reduced the forces delivered by the teeth (low range of force for intrusion) by increasing the inter-bracket distances and consequently increased the springiness of the system.

Following the intrusion some cases received a full set of brackets to complete the arch alignment.

The orthodontic treatment time varied from 10 to 12 months.

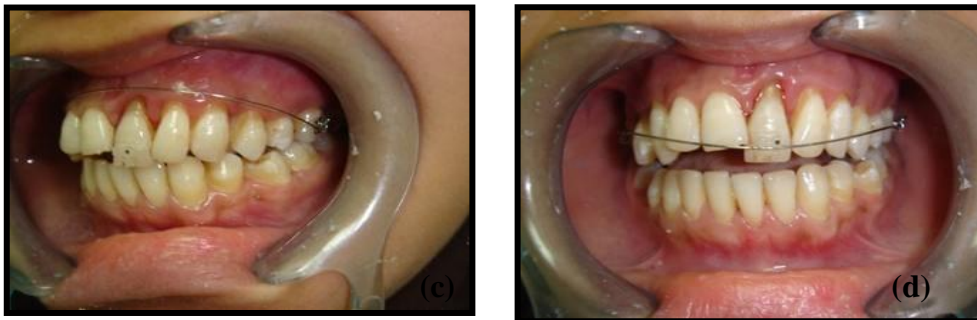


Figure (1): Intra-oral views showing the 2x1 orthodontic appliance used to intrude an extruded maxillary incisor using a 0.016 stainless steel wire with a 45 degrees intrusive bend.



Figure (2): The force moment gauge used in the study

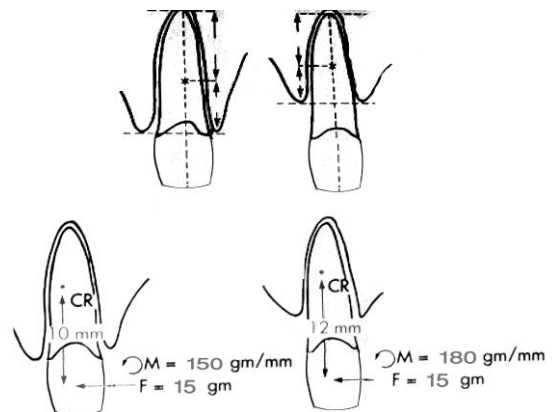


Figure (4): A diagram showing the increase in the moment value following the apical migration of the center of resistance of the tooth after the alveolar bone resorption.



Figure (3): Measurement of the moment created in the wire after adding the intrusive bend in the 0.16 stainless steel wire.

5- Radiographic Evaluation

Serial standardized intra-oral direct digital radiographs were taken by the Digora (Orion Corporation, Soredex, Medical system, Helsinki, Finland.) system for assessment of bone height and density on the defect site immediately before, immediately after orthodontic intrusion, 3, 6, and 9 months following the periodontal surgery. The exposure parameters were

fixed for all patients and over the follow up period.

6-Image Analysis

Both linear and radiometric measurements were performed as follows:

a) Measurements of bone height:

From the radiographic cemento-enamel-junction (CEJ), to the radiographic base of alveolar bony defect were taken as a line parallel to the long axis of either mesial or distal surface of the studied tooth. A comparison between bone heights at the different intervals was calculated to determine the extent of bone height gain after the surgical procedure.



Figure (4): The Digora system measurement of bone level (distance).

b) Measurements of bone density:

The density was measured along three lines on the side of each tooth drawn 0.2 mm apart and parallel to the root surface from the CEJ (as a reference point) to the apex of the root. The mean value of the readings of the three lines was calculated to get the gray level mesial and/or distal to the tooth for further evaluation.

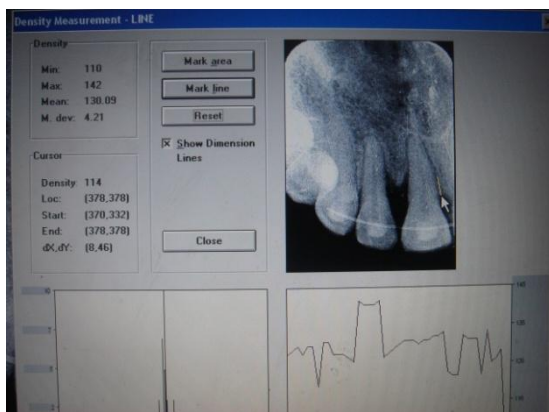


Figure (5): The Digora system measurement of bone density.

Measurements were performed twice by the same observer and the mean of both trails was calculated as an attempt to eliminate intra observer errors.

7) Periodontal surgical phase:

After completion of orthodontic procedures, patients received open flap surgeries.

In Group I, (seven cases) the defects were filled with Naringin graft (Naringin graft. Bone research lab, Hong Kong University.) mixed with deionized sterile water mixed drop by drop till we got a condensable putty consistency.

In Group II, (seven cases) received only open flap debridement and no graft were placed

Periodontal packs were placed over the surgical sites for 1 week.

Patients were instructed to rinse with 0.12% chlorhexidine gluconate (Antiseptil, Kahira Co. for Pharm. & Chem. IND. Cairo. ARE) Systemic antibiotic therapy was prescribed (doxycycline hyclate) (Doximycin, Nile Co. for Pharm. & Chem. IND. Cairo. ARE) 100 mg every 12 hours for 10 days. (23-25)

Post-surgical retention was performed using fixed lingual retainers (Twisti-flex 17 100/259 Ortho Organizer Co.) adapted on the cinguli of the six anterior teeth away from the bite, not only to prevent the relapse but also to reduce the tooth mobility. (26)

8) Post-operative assessment:

Follow up was employed at 3, 6 and 9 months to evaluate the effectiveness of the combined orthodontic-periodontal treatment both clinically and radiographically.

Statistical Analysis:

The clinical and radiographic data were analyzed by computer with SAS statistical program (Release 6.03 ed., SAS Institute, Cary NC, USA). (27)

1. One way analyses of variance (Procedure GLM of SAS) for repeated measurements followed by Least Square Means Test to test the effect of time on parametric measurements within each group.

2. SAS program (SAS, 1988). Student t test (Procedure T Test of SAS) was run to compare the effect of group (grafted vs. non-grafted) on parametric measurements (probing depth, bone level and bone density) within each time interval. It was also used to test the effect of group on the changes in the previous parameters with time.

RESULTS

The data of all recruited subjects included in this study were recorded, tabulated, and subjected to statistical analysis. The results showed changes in both clinical and radiographic measurements.

Probing Depth

- The results of the present study showed a significant increase in the probing depth during the intrusion phase in all patients.
- Three months post surgically, there was reduction in pocket depth in both groups which was statistically significant.
- A non-significant decrease in the probing depth was reported from the 3 months follow-up throughout the rest of the follow-up period
- The reduction in the probing depth at 3, 6, and 9 months post surgically was more significant in the grafted group when compared to the non-grafted group.

Table (1): Descriptive statistics and Least Square Means test of significance for the effect of time on probing depth.

Group	Grafted			Non grafted		
	Mean	S.D.	LSM	Mean	S.D.	LSM
Before intrusion	3.417	0.691	b	3.726	0.863	b
After intrusion	6.467	1.175	a	6.226	1.063	a
3 months	3.967	0.647	b	4.661	0.869	b
6 months	3.475	0.564	b	4.232	0.943	b
9 months	3.425	0.528	b	4.185	0.943	b

S.D. = Standard deviation.
 LSM = Least square means for the effect of time.

Means with the same letter within each column are not significantly different at $p \leq 0.05$.

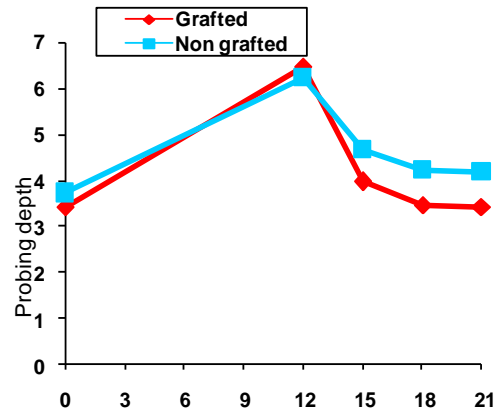


Figure (6): A Graph showing the mean probing depth in different groups during the treatment and follow-up period.

Table (2): Descriptive statistics and Paired T-test of significance for the effect of group on changes in probing depth.

Group	Grafted		Non grafted		P
	Mean	S.D.	Mean	S.D.	
Base – Post-ortho	3.050	0.685	2.500	0.647	NS
Post-ortho – 3 M	-2.500	0.662	-1.565	0.386	**
Post-ortho – 6 M	-2.992	0.770	-1.994	0.370	**
Post-ortho – 9 M	-3.042	0.865	-2.042	0.354	*

S.D. = Standard deviation.
 P = Probability level for the effect of group
 NS = Insignificant ($p > 0.05$).
 * = Significant at $p \leq 0.05$
 ** = Significant at $p \leq 0.01$
 *** = Significant at $p \leq 0.001$

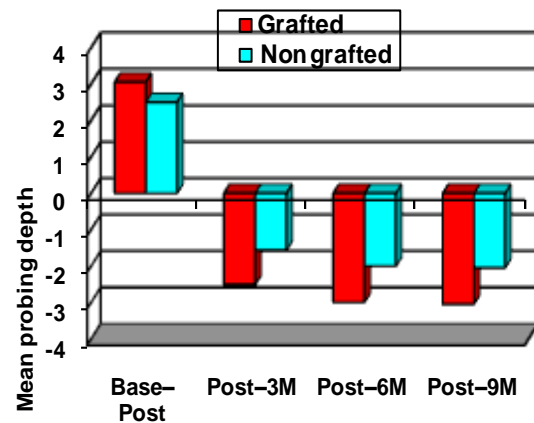


Figure (7): A histogram showing the mean changes in probing depth in different groups during the treatment and follow-up period.

Bone Level

- There was a non-significant decrease in the bone level during the intrusion phase in all patients, followed by a significant increase throughout the follow-up periods (3, 6, and 9 months) in the grafted group, while the non-grafted group showed a non-significant increase in the bone level over the same period.

At the end of orthodontic treatment the mean of bone level in the grafted group was 0.26. It increased significantly reaching (0.182, 0.175, and 0.173) at (3, 6, and 9 months) respectively.

N.B.: The negative measurements is considered an increase in bone level as the gain in bone causes reduction in the measurement from the cemento-enamel junction to the base of the defect; bone gain = decrease in the defect size.

Table (3): Descriptive statistics and Least Square Means test of significance for the effect of time on bone level.

Group	Grafted			Non grafted		
	Mean	S.D.	LSM	Mean	S.D.	LSM
Base	0.234	0.068	a	0.211	0.061	a
Post-ortho	0.258	0.052	a	0.221	0.054	a
3 months	0.182	0.043	b	0.219	0.054	a
6 months	0.175	0.043	b	0.217	0.054	a
9 months	0.173	0.043	b	0.216	0.053	a

S.D. = Standard deviation.

LSM = Least square means for the effect of time.

Means with the same letter within each column are not significantly different at $p \leq 0.05$.

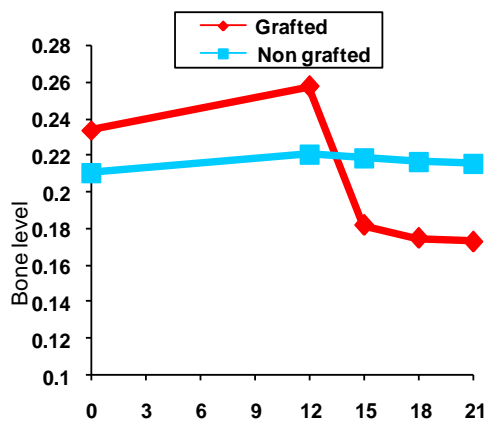


Figure (8): A graph showing the mean bone level in different groups during the treatment and follow-up period.

Table (4): Descriptive statistics and Paired T-test of significance for the effect of group on changes in bone level.

Group	Grafted		Non grafted		P
	Mean	S.D.	Mean	S.D.	
Base – Post-ortho	0.024	0.023	0.011	0.019	NS
Post-ortho – 3 M	-0.076	0.018	-0.003	0.004	***
Post-ortho – 6 M	-0.083	0.020	-0.004	0.004	***
Post-ortho – 9 M	-0.085	0.019	-0.005	0.004	***

S.D. = Standard deviation.

P = Probability level for the effect of group

NS = Insignificant ($p > 0.05$).

* = Significant at $p \leq 0.05$

** = Significant at $p \leq 0.01$

*** = Significant at $p \leq 0.001$

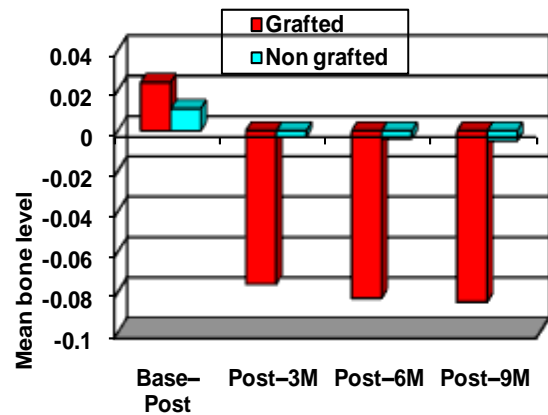


Figure (9): A histogram showing the mean changes in bone level in different groups during the treatment and follow-up period.

Bone density

- Significant increase in the bone density was detected after the intrusion phase in all patients. The mean bone density in the grafted and non-grafted groups before orthodontic treatment was 84.57 and 84.06 respectively, reaching 99.99 in grafted group and 94.68 in non-grafted group at the end of orthodontic treatment.

- Significantly more increase in the bone density from the post-orthodontic phase throughout the follow-up phase (3, 6, and 9 months) was detected in the grafted group when compared to the non-grafted one which showed a non-significant increase in the bone density at $p \leq 0.05$.

Table (5): Descriptive statistics and Least Square Means test of significance for the effect of time on bone density.

Group	Grafted			Non grafted		
	Mean	S.D.	LSM	Mean	S.D.	LSM
Base	84.567	14.759	d	84.064	29.315	b
Post-ortho	99.990	15.729	c	94.676	29.348	a
3 months	111.088	14.650	bc	95.214	29.513	a
6 months	117.859	14.738	ab	95.488	29.634	a
9 months	125.347	15.045	a	95.607	29.636	a

S.D. = Standard deviation.

LSM = Least square means for the effect of time.

Means with the same letter within each column are not significantly different at $p \leq 0.05$.

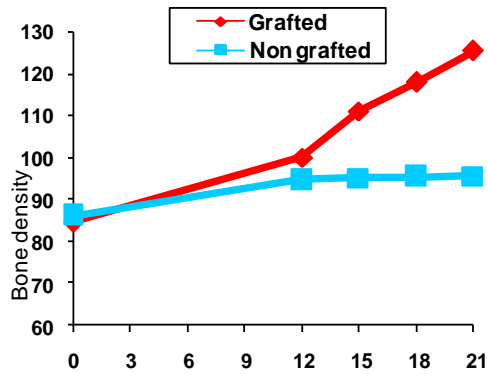


Figure (2): A graph showing the mean bone density in different groups during the treatment and follow-up period.

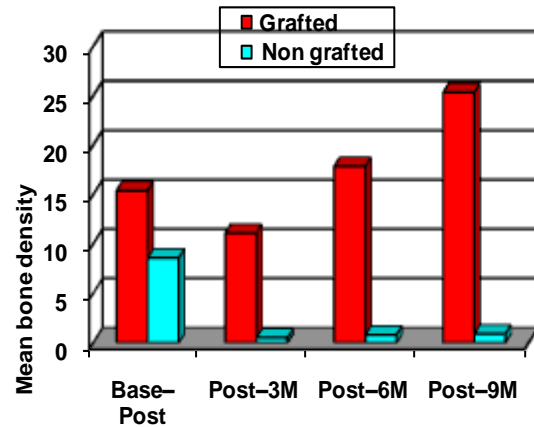


Figure (3): A histogram showing the mean changes in bone density in different groups during the treatment and follow-up period.

Table (6): Descriptive statistics and Paired T-test of significance for the effect of group on changes in bone density.

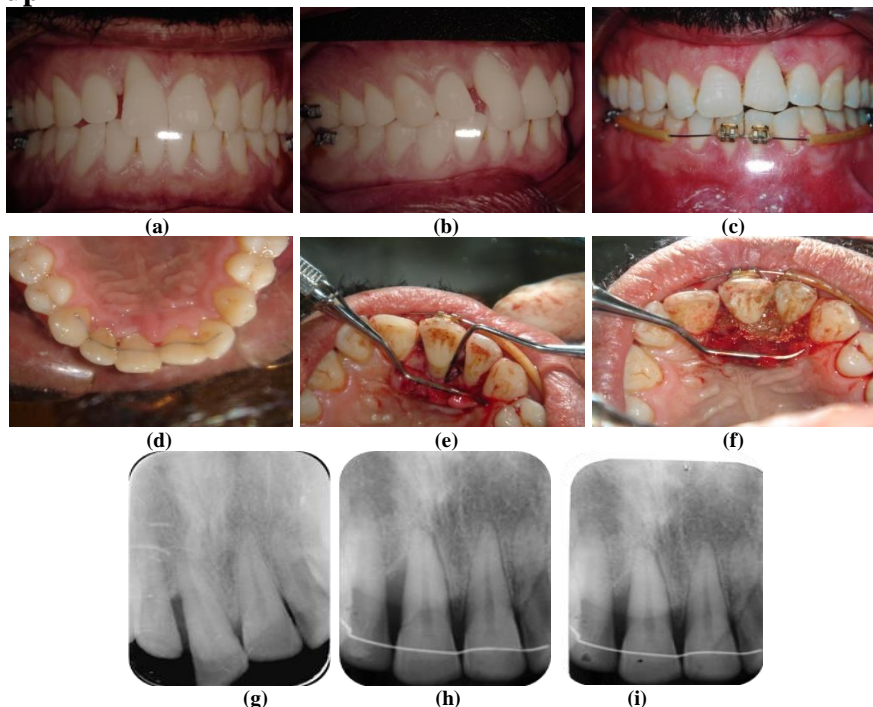
Group	Grafted		Non grafted		P
	Mean	S.D.	Mean	S.D.	
Base – Post-ortho	15.424	8.640	8.611	4.183	NS
Post-ortho – 3 M	11.098	6.099	0.539	0.288	***
Post-ortho – 6 M	17.869	7.111	0.812	0.405	***
Post-ortho – 9 M	25.357	8.799	0.931	0.405	***

S.D. = Standard deviation.
 P = Probability level for the effect of group
 NS = Insignificant ($p > 0.05$).
 * = Significant at $p \leq 0.05$
 ** = Significant at $p \leq 0.01$
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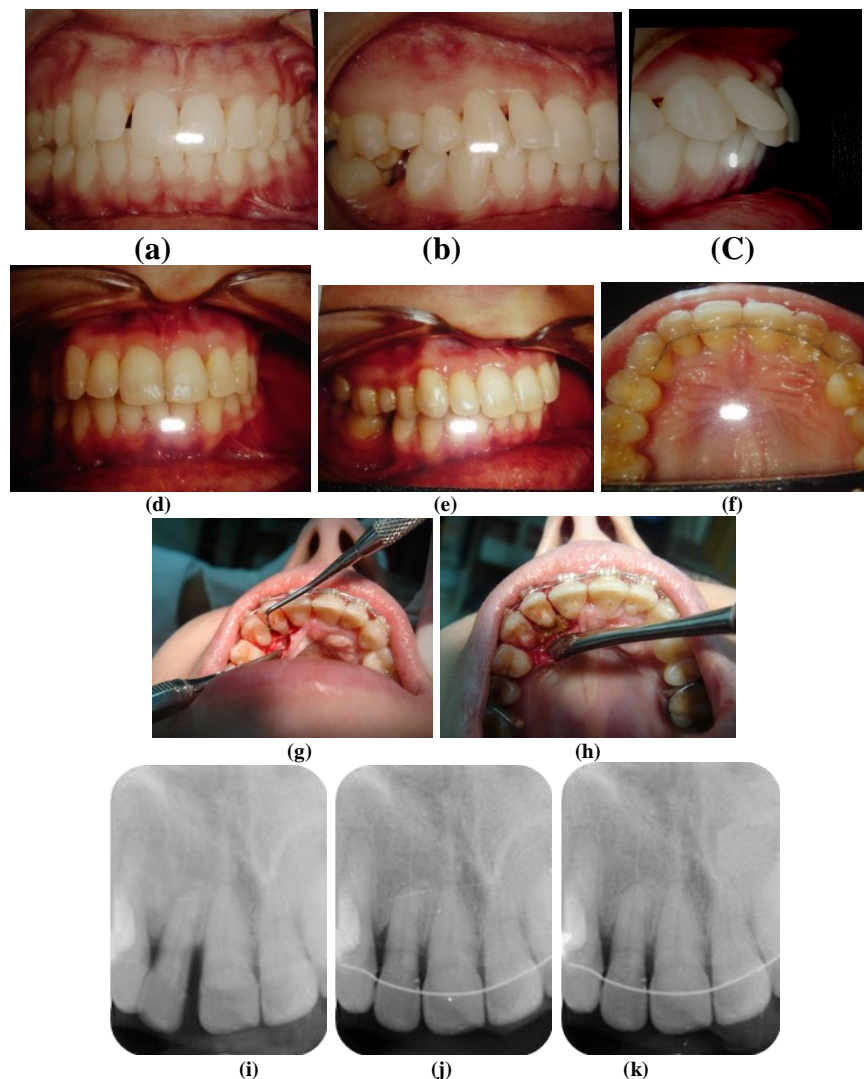
Results showed a significant increase in plaque index, sulcus bleeding index, tooth mobility, pocket depth, and bone density from pre to post orthodontic intrusion.

Significant improvement in plaque index, sulcus bleeding index, pocket depth, and bone density was detected following the periodontal surgery in both grafted and non-grafted groups.

Grafted group



Case (1): (a) and (b) Pre-treatment intra-oral views showing an extruded and spaced right central incisor. (c) An intra-oral view showing the same case after finishing the orthodontic intrusion. (d) An intra-oral view showing the fixed lingual retainer placed on the four incisors. (e) An intra-oral view of the periodontal surgery after flap reflection and debridement of the defect. (f) An intra-oral view showing the defect after being packed with the Naringin graft. (g) A pretreatment radiograph of the right central incisor showing severe bone loss on the distal side of the tooth. (h) An intra-oral radiograph showing the vertical defect created on the distal side of the tooth after orthodontic intrusion before the surgical grafting. (i) An intra-oral radiograph showing the vertical defect filled with bone 9 months after the graft placement.



Case (2)

- (a), (b) and (c) Pre-treatment intra-oral views showing an extruded and spaced right lateral incisor.
- (d) and (e) An intra-oral view showing the same case after finishing the orthodontic intrusion.
- (f) An intra-oral view showing the fixed lingual retainer placed on the six anterior teeth.
- (g) An intra-oral view of the periodontal surgery after flap reflection and debridement of the defect.
- (h) An intra-oral view showing the defect after being packed with the naringin graft.
- (i) A pretreatment radiograph of the right lateral incisor showing sever bone loss on the distal side of the tooth.
- (j) An intra-oral radiograph showing the vertical defect created on the distal side of the tooth after orthodontic intrusion before the surgical grafting.
- (k) An intra-oral radiograph showing the vertical defect filled with bone 9 months after the graft placement.

DISCUSSION

This study demonstrated the possibility of combining the orthodontic intrusion, periodontal therapy and bone induction as a mean to regenerate the lost periodontium in the cases of migrated incisors in patients with advanced periodontal disease and severe alveolar bone loss.

The first basic principle for initiating orthodontic movement is the absence of inflammation. Orthodontic treatment in patients with reduced, but healthy

periodontium does not lead to significant long term changes in attachment and bone levels *Sadowski and BeGole 1981, (28) Artun and Osterberg 1987, (29) Boyd et al. 1989. (30)* Accordingly all patients of both groups were treated with mechanical debridement supra and sub-gingival scaling and root planning in addition to instructing them to perform good oral hygiene measures with a follow up period of three months.

However, orthodontic movement of teeth with deep, active pockets may accelerate disease progression and bone

destruction even in the presence of good oral hygiene Kessler 1976, ⁽³¹⁾ Ericsson et al. 1978, ⁽³²⁾ Thilander 1996 ⁽³³⁾ and Kocher et al. 2000. ⁽³⁴⁾ This is why we chose our candidates with a pocket depth of less than 5mm in order to allow proper scaling and sub-gingival curettage.

In order to avoid bacterial plaque accumulation on the orthodontic appliances, we used simple mechanics and avoided a lot of wire looping (Two by Two or Two by One appliance) with a 0.016 stainless-steel round wire with an active intrusive distal bend that was cinched back to prevent teeth proclination during intrusion) as recommended by Forsberg et al. 1991. ⁽³⁵⁾ Bonding and not banding of molars, together with meticulous removal of bonding resin excess around brackets were performed according to Boyd and Baumrind 1992. ⁽³⁶⁾

The moment acting upon the teeth was increased where the centers of resistance of the teeth were moved apically as a result of bone loss Melsen 1989. ⁽³⁷⁾ They were located halfway into the part of the root embedded into the bone, thus increasing the moment arm and consequently increasing the moment. So we designed the appliance (Two by Two or Two by One appliance) taking into consideration to reduce the forces delivered by the extruded teeth (low range of force) by increasing the inter-bracket distance, increasing the wire span and consequently increasing the springiness of the wire.

Orthodontic intrusion enhances the circulation of new blood supply into the defect site and favorably changes the horizontal bony defect into a bony defect with a vertical wall Cao et al. 2015. ⁽³⁸⁾ This vertical bony wall will hold the graft material and provides a good source of resident mesenchymal cells that could differentiate into useful cells, such as osteoblasts and fibroblasts, during the process of periodontal tissue regeneration Rabie et al., 2001 ⁽¹⁶⁾ Vandevska-Radunovic et al. 1994 ⁽³⁹⁾ Sifton 2006. ⁽⁴⁰⁾ Accordingly we have chosen the defects that were

horizontal in nature and started with the orthodontic intrusion followed by the regenerative periodontal surgery to alter the topography of the defects. This is supported by the work of Melsen 1991 ⁽⁴¹⁾ who recommended controlled intrusion in cases of extruded teeth with horizontal bone loss.

Following the intrusion patients in both groups received an open flap surgery. In one group the naringin in collagen matrix graft was packed into the defect while the other group acts as a control.

Naringin is a polymethoxylated flavonoid commonly found in citrus fruits. It has antioxidant and anticholesterol effect were demonstrated by Wong and Rabie in 2006. ⁽⁴²⁾ It was also shown to have a hepatic hydroxymethylglutaryl Coenzyme A (HMG-CoA) reductase inhibiting effect (Shin et al., 1999). ⁽⁴³⁾

Bone morphogenetic proteins (BMPs) are important regulators in osteogenic differentiation during fracture repair. Wang et al. (1993), ⁽⁴⁴⁾ Nakase et al. 1994, ⁽⁴⁵⁾ and Sakou 1998 ⁽⁴⁶⁾ showed that BMP-2 caused commitment and differentiation of multipotential stem cell line into osteoblast like cells. Activation of BMP-2 promoter was completely inhibited by the downstream metabolite of HMG-CoA reductase, indicating that the activation of BMP-2 was a result of the inhibition of HMG-CoA enzyme Sugiyama et al., 2000. ⁽⁴⁷⁾ Therefore, it is possible that any drug that inhibits the HMG-CoA reductase may have the effect of activation of the BMP-2 promoter that consequently will increase bone formation.

Apparently naringin graft will potentially cause the mesenchymal cells at the defect site to differentiate into bone-making cells and induce new bone formation Wong and Rabie, 2006. ⁽⁴²⁾

For retention of the orthodontic outcome in periodontal patients we aimed at stabilization of the position of teeth and long term maintenance of dental and periodontal health so we used the fixed lingual retainers as recommended by

Beckett et al. 1992⁽⁴⁸⁾ and Kahj-Nieke 1996.⁽⁴⁹⁾ Removable retainers should be avoided because teeth are subjected to giggling forces, thus delaying healing and bone regeneration following orthodontic treatment Zachirsson 1997.⁽⁵⁰⁾

The results of group I and II in this study represented significant increase in pocket depth (PD), plaque index (PI), sulcus bleeding index (SBI), and tooth mobility index during the intrusion phase in both groups. This might be explained as intrusive tooth movement can cause some level of inflammatory tissue response due to the gingival sulcus deepening and accumulation of the gingival tissues. These results were in agreement with Murakami et al. 1989⁽⁵¹⁾ Their results showed that: The gingival tissues moved in the same direction that the teeth were intruded, but only about 60% as far and the shortening of the crown and the deepening of the sulcus were both approximately 40% as much as the tooth intrusion.

The increase in the tooth mobility can be a result of the intrusion procedure which causes widening of the periodontal ligament space as a result of stretching of its fibers Melsen 2001.⁽⁵²⁾

In both groups there was a significant decrease in pocket depth 3 months following the surgical phase and then a non-significant decrease afterwards (from 3 to 6 and 9 months follow-up periods).

The reduction in pocket depth and improvement of plaque index and sulcus bleeding index in the first 3 months after the surgery which was significant in both groups is related to the healing process as well as the improvement of the periodontal status following the surgical debridement and removal of all sub-gingival plaque, also the recession of the tissues accumulated during the intrusive procedure (Cardaropoli et al. 2004.⁽⁵³⁾

The pocket depth reduction in the grafted group was significantly higher than the non-grafted group in the first follow-up period due to the bone filling that occur in

the intra-bony defect following the regenerative periodontal procedure.

Many studies confirm the effectiveness of using various graft material on the improvement of various clinical parameters including the pocket depth, as bovine bone mineral (Bio-oss) by Cardiopoli et al. 2001,⁽⁵³⁾ 2006⁽⁵⁴⁾ Emdogain by Heijl et al. 1997,⁽⁵⁵⁾ DBM (demineralized freeze-dried bone matrix) by Rabie et al. 2000,⁽¹⁷⁾ 2001,⁽¹⁶⁾ (Bone substitute covered with a resorbable barrier) by Esposito et al. 2015⁽⁵⁶⁾ and (enamel matrix derivative mixed with bone materials) by Jang et al. 2015.⁽⁵⁷⁾

Most of the probing depth reduction was established in the first 3 months following the treatment with very little change afterwards which was revealed as a non-significant change in the pocket depth in the rest of the follow-up period (at 6 and 9 months) in both groups. The previous result can be explained as most of the soft tissue healing occurs and bone level established in the first 3 months following the surgery.

The non-significant decrease in the bone level from pre to post-orthodontic phase in both groups is the result of the periodontal care that was maintained during intrusion. This result was in agreement with the results of Melsen et al. 1989⁽³⁷⁾ and Correntte et al. 2003.⁽¹¹⁾

On the other hand intrusion in the presence of bacterial plaque resulted in further bone resorption as observed by Ericsson et al., 1978.⁽³²⁾

The significant increase in the bone level in the grafted group relative to the non-grafted one after the surgery, throughout the follow-up period can be explained as orthodontic intrusion provides a suitable environment (vertical bone defect) that can hold and retain the graft material (naringin in collagen matrix)⁽¹²⁾ which allowed the bone osteogenic agents to work and produce vertical bone fill in the defect leading to significant increase in the bone level in the grafted group. The osteogenic potential of naringin was

reported by Wong and Rabie in 2006. ⁽⁴²⁾ This result is also in agreement with many other studies on different graft materials Rabie et al., 2001, ⁽¹⁶⁾ Re et al., 2002, ⁽⁵⁸⁾ Cardiopoli et al., 2006. ⁽⁵⁴⁾

A significant increase in the bone density occurred in both groups from pre to post-orthodontic phase before performing the surgical procedures with non-significant difference between groups. The explanation for that lies in the topography of the defects. Before intrusion they were horizontal in nature so no bone was present surrounding the teeth this appeared as increase in the radiolucency proximal to the teeth (less bone density). While after intrusion the topography of the defects changed into vertical ones (teeth were digged into the bone). So the bony walls around the teeth were reflected as an increase in the radio opacity (increased bone density).

A significant increase in the bone density occurred in grafted group relative to a non-significant change in the non-grafted group from post-orthodontic phase throughout the follow-up period (3-6-9 months) this is attributed to the bone induction effect of the naringin graft that initiated and proceeded the bone formation in the defects created by intrusion.

Our study was the clinical application of the histological study done by Rabie et al. 2000 ⁽¹⁷⁾ on albino rabbits.

Recommendations

From our clinical and radiographic findings it could be supposed that hard tissue filling the defects resulted from the replacement of the naringin in collagen matrix graft by new bone. The nature of the attachment between the newly regenerated tissue and the root surface cannot be examined without biopsy of treated teeth, and further studies are necessary to claim true periodontal regeneration from the therapy described in this study.

CONCLUSIONS

The combined orthodontic intrusion and periodontal surgery resulted in the

realignment of extruded anterior teeth with significant improvement of the densitometric measures.

Orthodontic intrusion potentially alters the topography of the alveolar bone resulting in vertical pattern of the osseous defect.

The use of naringin in Collagen matrix graft resulted in a significantly more improvement of both clinical and radiographic parameters including pocket depth reduction, increase in alveolar bone level and density as compared to non-grafted sites.

In cases of extruded teeth with horizontal bone defects, the orthodontic intrusion is better to precede the periodontal surgery to alter the topography of the defect to be more retentive for the graft material. In other cases where the bony defects are vertical in nature it is advised to start by periodontal surgery to help totally debriding the defect to prevent further periodontal destruction during intrusion.

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