International Journal of Research in Medical Sciences
Narendra S et al. Int J Res Med Sci. 2017 Jul;5(7):2870-2877
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20172615

Original Research Article

Application of surgical periodontics for accelerated orthodontic correction of class ll division l malocclusion with skeletal discrepancy

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Received: 25 April 2017
Accepted: 22 May 2017

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ABSTRACT

Background: There is a constant pursuit for substituting orthognathic surgical options by minimally invasive pre-orthodontic surgical procedures. Application of osseous resective surgery for alveolar reshaping is referred to here as "surgical periodontics for accelerated orthodontics". A parallel randomized clinical trial was designed to evaluate the clinical outcome of class 2 division 1 malocclusion with skeletal discrepancy using pre-orthodontic surgical procedures, comparing periodontally accelerated osteogenic orthodontics with surgical periodontics for accelerated orthodontics.
Methods: Twenty-four adult orthodontics patients selected for this study were randomly divided into 2 equal groups. One group was treated with periodontally accelerated osteogenic orthodontics with augmentation grafting and the other was with surgical periodontics for accelerated orthodontics. These procedures were followed by fixed orthodontics treatment. Comparative evaluation of alveolar bone thickness was done by cone beam computed tomogram for both the groups.
Results: The cephalometric parameters, A point nasion B point (ANB) angle and over jet of these subjects before and after the surgical interventions at three, six and twelve month's intervals were compared to the base values, showing changes within 3 months when treated with surgical periodontics for accelerated orthodontics and within 6 months when treated with periodontally accelerated osteogenic orthodontics, without significant change in periodontal supporting alveolar bone thickness.
Conclusions: Surgical periodontics for accelerated orthodontics and periodontally accelerated osteogenic orthodontics are effective pre-orthodontics surgical procedures for accelerating orthodontic treatment, without bringing any change in periodontal alveolar bone thickness.

Keywords: Alveolar bone, Bone remodelling, Osseous recontouring

INTRODUCTION

The multidisciplinary team approach can bring about the rapid orthodontic tooth movement in much less time than that is required for conventional orthodontic treatment.[1] Non-responsive alveolo-skeletal cases and treatment for prevention of relapse are noticeable limitations of traditional adult orthodontic treatment. There is a change in the trend for utilization of skills required by the orthodontist because of the current trend in increase in percentage of adult orthodontics cases.[2] The recognition of the effect of fixed orthodontics taking advantage of growth and modification changed the focus of adult orthodontic treatment.[2] The tools of different

treatment protocols of orthognathic treatment differ from one another at different age groups.[3] The improvement of facial profile could be readily attained in children and adolescent simply by fixed orthodontic treatment and the same goal could be achieved in adults by utilization of orthognathic surgeries.[3] Orthodontists usually consider to incorporate those surgical protocols to assist their treatment which are more refined and less traumatic.[3] The changes in skeletal malformations bringing improvement in facial profile is truly remarkable and considered as important parameters for the motivation and satisfaction of patients.[3] Different types of surgical protocols are considered for application to accelerate orthodontic treatment at different time.[4] The surgical procedures such as periodontally accelerated osteogenic orthodontics (PAOO),complete corticotomy, alveolar selective decortications and the decalcification-recalcification procedure consistent with regional acceleratory phenomena are indicated to accelerate orthodontic treatment.[5] The interdisciplinary team addresses the dentofacial orthopedics problem with the objective of optimization of elaborated procedure to maximize stability, aesthetics and prevention of relapse.[6]

Now the patients are in constant per suit of selecting simplified minimally invasive surgical treatment protocols with less recovery time.[7] The treatment of skeletal discrepancies are less often conducted with the application of orthognathic surgical options because of the reluctance of patients, even though they are still now considered as the optimal treatment planning. These are some of the reasons for developing classified surgical techniques to facilitate orthodontic treatment without compromising periodontal bone support.[7] Periodontal surgery substituting one orthognathic surgery along with fixed orthodontics with the objectives of correction of skeletal discrepancy has been scarcely investigated and reported in the dental literature. This article compares the effectiveness of application of surgical periodontics for accelerated orthodontics (SPAO), referred here, "as the application of osseous resective surgery for the reshaping of alveolus to facilitate the orthodontic tooth movement" with the periodontally accelerated osteogenic orthodontics (PAOO) for the treatment of severe class 2 division 1 malocclusion with skeletal discrepancy. In both the groups the fixed orthodontics was carried out following the complete corticotomy at extraction site of the upper 1st premolars.

METHODS

Twenty-four subjects with adult orthodontic problems and severe skeletal discrepancy are included in this study. Patient inclusion criteria for this study consisted of:

- Systemically healthy subjects with similar kind of orthodontic problems of severe class 2 division 1 malocclusion with skeletal discrepancy (Figure 1A, B and 2A, B)
- Patients with skeletal discrepancy of mean A-point-nasion B point (ANB) angle 90 and occlusal discrepancy with, mean overjet 10mm
- Subjects were in the age group of 18 - 35 years
- Subjects were free from deleterious habits
- Subjects were willing and able to comply with all study-related procedures
- Subjects who read, understood, and were willing to sign an informed consent statement.

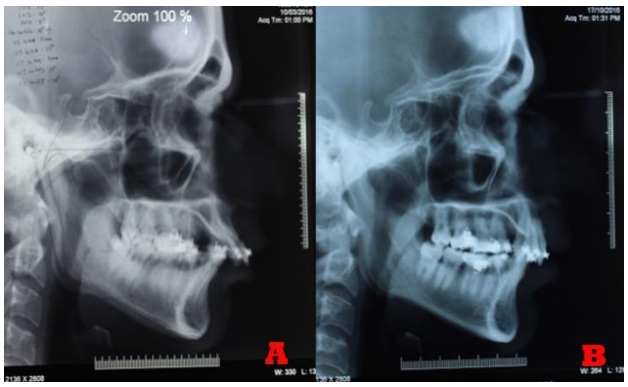

Figure 1: A) skeletal discrepancy with (ANB) angle and overjet of group 1; B) Reduction in skeletal discrepancy with decrease in (ANB) angle and overjet of the patient of group 1 after 6months of treatment.

Figure 2: A) skeletal discrepancy with (ANB) angle and overjet of group A2; B) Reduction in skeletal discrepancy with decrease in (ANB) angle and overjet of the patient of group A2 after 3 months of treatment.

Exclusion criteria

- Patients with habits of smoking and medically compromised condition
- Patients on long term corticosteroid therapy or any other incapacitating systemic illness.

Study design

These 24 patients were divided into 2 groups designated as group A1 and group A2, each having 12 patients.

Group A1 included randomly selected patients for the procedure of periodontally accelerated osteogenic orthodontics, showing one patient in (Figure 1A). Group A2 included randomly selected patients for the procedure of surgical periodontics for accelerated orthodontics, showing another patient in (Figure 2A).

Clinical parameters

- ANB angle
- Overjet used for monitoring orthodontic changes and
- Alveolar thickness used for monitoring changes in periodontal bone support at different levels.

Group A1 included 12 patients selected for periodontally accelerated osteogenic orthodontics procedure.

Surgical procedure

The selective decortications and augmentation grafting with the application of resorbable grafting material is done for this group (Figure 3 A, B). Complete corticotomy at extraction sites of 1st premolars were done during the same sitting of surgery followed by fixed orthodontics treatment.

Figure 3: A) The selective decortications; B) Augmentation grafting with the application of resorbable grafting material is done for this group.

Group A2 included 12 patients selected for surgical periodontics for accelerated orthodontics.

Surgical procedure

periodontal osseous resective surgery is done with step by step procedures, like vertical grooving, radicular blending and gradualization of marginal bone, as the substitute techniques for the process of alveolar reshaping procedure with the objective of selective decortication (Figure 4 A, B). The cortical bone is completely removed from extraction site of 1st premolars followed by fixed orthodontic treatment.

Figure 4: Periodontal osseous respective surgery is done; A) on labial side; B) on palatal side as the substitute technique for alveolar reshaping procedure.

All these 24 patients in group A1 and A2 continuing orthodontic treatment were called at regular intervals as per the fixed orthodontic treatment protocol.

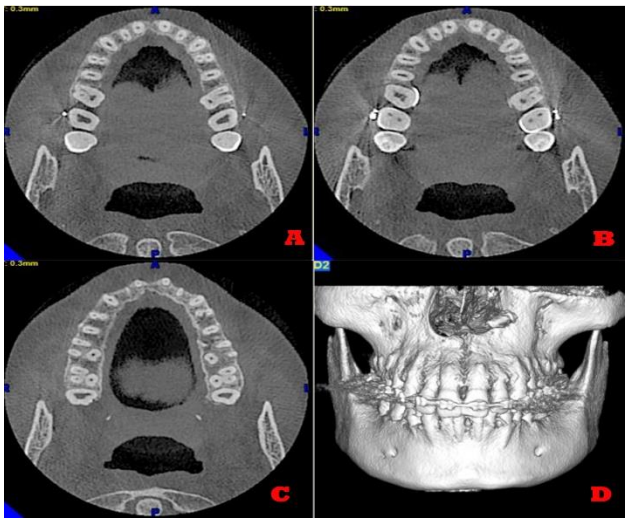

Figure 5: Alveolar bone thickness showed adequate bone support at the end of 1 year in the group A1; A) Just below the cement enamel junction (C1); B) At the middle of the root (C2); C) Just above the apical level (C3); D) Bone pattern on labial aspect.

Recording of clinical parameters has been done with lateral cephalograms representing the case from group A1 (Figure 1A-1B) and representing the case from group A2 (Figure 2A-2B). Cone beam computed tomographic (CBCT) image evaluation was done for monitoring changes in periodontal alveolar bone thickness representing the case from group A1 (Figure 5 ABCD) and representing the case from group A2 (Figure 6 ABCD). The thickness of the alveolar bone around the roots of the teeth shown in cross sections were measured at 3 specified levels i.e. just below the cement enamel junction (C1), at the middle of the root (C2) and just above the apical level (C3).

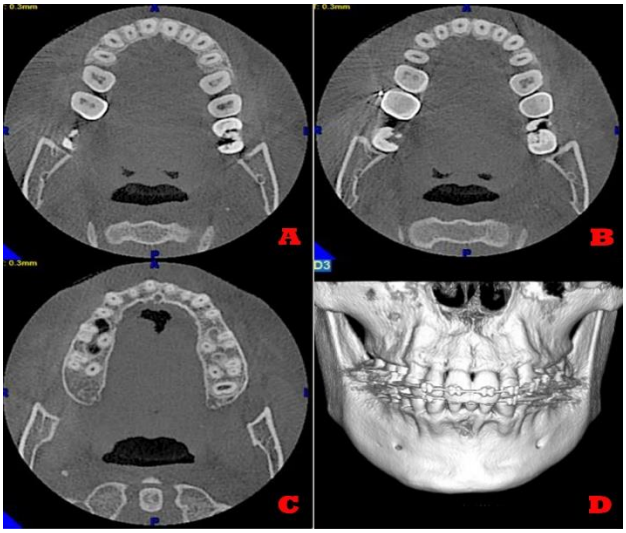

Figure 6: Alveolar bone thickness showed adequate bone support at the end of 1year in the group A2; A) Just below the cement enamel junction (C1); B) At the middle of the root (C2); C) Just above the apical level (C3); D) Bone pattern on labial aspect.

The two main cephalometric parameters, ANB Angle for determination of skeletal discrepancy and overjet for determination of occlusal discrepancy are recorded to compare the results in both these groups at 3 months, 6 months and 1 year interval. These data were analyzed and displayed in Table 1 and 2 for group A1 and A2 respectively. The changes in periodontal alveolar thickness at different level are displayed in (Table 3A) and (Table 3B) for the respective groups.

RESULTS

The following observations are made: In groupA1: changes in values of ANB angle and overjet in the 1st six months following PAOO are found to be significant (Figure 1A, B). The improvement of skeletal profile could be observed from the changes in cephalometric parameters (Table 1).

The changes in ANB angle and overjet between the base value and at 3 months interval is not found to be significant (Table 1).

In group A2, the significant differences between the base values and at the end of 3 months of same parameters, explain the advantages of the surgical periodontics for accelerated orthodontics. The improvement of facial profile within 3 months interval could be observed (Table 2 and Figure 2A, B). The evidences of changes in cephalometric parameters at 3 months interval could also be observed (Figure 2A, B). Here the changes between the base values of ANB angle, over jet at 3 months, 6 months and at 1 year interval are displayed (Table 2).

Table 1: Changes in ANB angle and over jet over period of time (0, 3, 6 and 12 months) in patients treated with PAOO.

Clinical parameters	ANB angle (in degree)	Over jet
Base value (0 month)	9.8±1.8	10.2±1.5mm
3 months	7.9±7.4	8.6±8.1mm
Difference 0-3 months (D1)	1.9±5.6	1.6±6.6mm
Test of significance	T=1.76, DF=11 P>0.05	t=1.35, DF=11 p>0.05
6 Months	2.0±1.7	1.4±0.9mm
Difference 0-6 months (D2)	7.8±0.1	8.8±0.6mm
Test of significance	T=5.78, DF=11 P<0.001	T=6.39, DF=11P<0.001
12 Months	1.9±0.9	1.3±0.6mm
Difference 0-12 months (D3)	7.9±0.9	8.9±0.9mm
Test of significance	t=4.78, DF=11 P<0.001	T=5.57, DF=11 P<0.001

The results of changes in alveolar bone thickness for both the groups as measured from CBCT images are shown (Table 3A, 3B) for Group A1 and Group A2 respectively. In both the groups, the changes in thickness of alveolar housing were found to be not significant at the end of the treatment. Alveolar bone thickness showed adequate bone support at the end of 1year in the group A1 (Figure 5 ABCD) and A2 (Figure 6 ABCD).

Table 2: Changes in ANB angle and over jet over period of time (0, 3, 6 and 12 months) in patients treated with SPAO.

Clinical parameters	ANB angle (in degree)	Over jet
Base value (0 month)	9.9±1.7	10.1±1.6mm
3 months	3.2±1.4	3.1±0.9mm
Difference 0-3 months (D1)	6.7±0.3	7.0±0.7MM
Test of significance	T=7.78, DF=11 P<0.001	t=6.17, DF=11 p<0.001
6 Months	2.8±1.3	1.4±0.9mm
Difference 0-6 months (D2)	7.1±0.4	8.7±0.7mm
Test of significance	T=7.14, DF=11 P<0.001	T=6.72, DF=11 P<0.001
12 Months	1.9±0.9	1.2±0.7MM
Difference 0-12 months (D3)	7.9±0.9	8.9±0.9MM
Test of significance	T=7.52, DF=11 P<0.001	T=6.71, DF=11, P<0.001

Table 3A: Change in alveolar bone thickness in subjects treated with PAOO (group A1).

Tooth No.	Sites of variables	Pre-t/t thickness	Post-t/t thickness	Change in treatment	Paired t test T value at Df=11	P value
UL1	C1	5.75±0.4	5.72±0.75	0.03±0.35	2.01	>0.05
	C2	5.85±0.5	5.79±0.75	0.14 ±0.25	1.92	>0.05
	C3	6.15±0.16	6.05±0.04	0.10±0.12	1.97	>0.05
UL2	C1	5.65±0.53	5.69±0.75	0.04± 0.22	2.05	>0.05
	C2	5.75±0.64	5.76±0.75	0.01±0.11	2.13	>0.05
	C3	6.05±0.07	6.07±0.15	0.02± 0.08	1.94	>0.05
UR1	C1	5.69±0.66	5.70±0.75	0.01±0.09	1.98	>0.05
	C2	5.75±0.74	5.73±0.75	0.02 ± 0.01	2.08	>0.05
	C3	6.08±0.06	6.05±0.14	0.03± 0.08	1.97	>0.05
UR2	C1	5.87±0.85	5.83±0.75	0.04± 0.10	2.09	>0.05
	C2	5.97±0.75	5.98±0.73	0.01± 0.02	1.99	>0.05
	C3	6.25±0.75	6.26±0.73	0.01±0.02	1.92	>0.05

Table 3B: Change in alveolar bone thickness in subjects treated with SPAO (group A2).

Tooth No.	Sites of variables	Pre-t/t thickness	Post-t/t thickness	Change in treatment	Paired t test t value at Df=11	P value
UL1	C1	5.29±0.6	5.63±0.59	0.34±0.35	1.91	>0.05
	C2	6.19±0.7	6.18±0.59	0.01±0.52	2.02	>0.05
	C3	6.07±0.16	6.17±0.11	0.10±0.05	1.95	>0.05
UL2	C1	5.37±0.64	5.48±0.84	0.11±0.20	1.99	>0.05
	C2	6.13±0.67	6.27±0.69	0.14±0.02	2.01	>0.05
	C3	6.09±0.07	6.19±0.13	0.10±0.06	1.97	>0.05
UR1	C1	5.59±0.67	5.67±0.69	0.08±0.02	1.93	>0.05
	C2	6.17±0.67	6.59±0.63	0.42±0.04	2.03	>0.05
	C3	6.19±0.17	6.13±0.16	0.06±0.01	1.85	>0.05
UR2	C1	5.73±0.77	5.79±0.73	0.06±0.04	2.02	>0.05
	C2	6.67±0.59	6.88±0.81	0.21±0.22	2.19	>0.05
	C3	6.29±0.37	6.37±0.81	0.08±0.44	1.98	>0.05

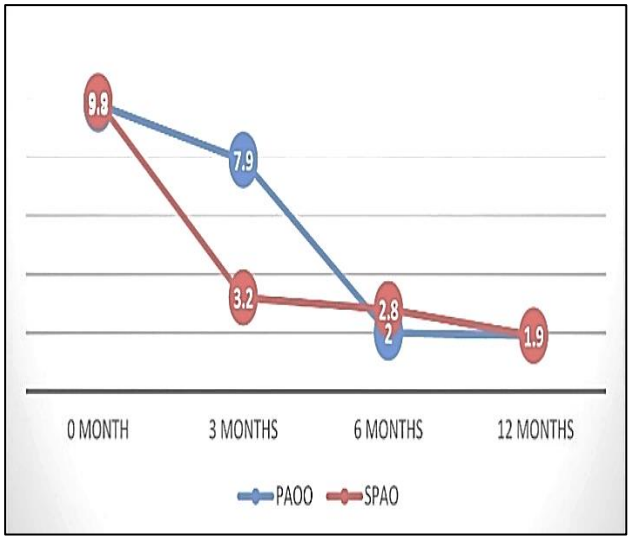

Figure 7: Changes in mean ANB over period of time.

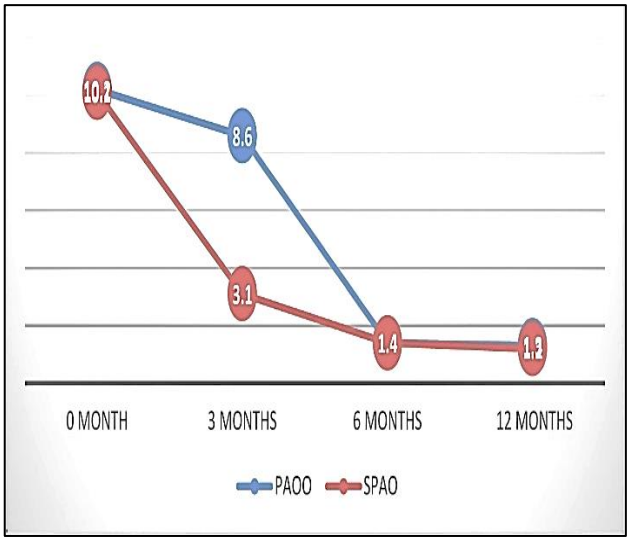

Figure 8: Changes in mean over jet over period of time.

DISCUSSION

Interdisciplinary approach can bring about rapid orthodontic correction in fraction of the time required for conventional orthodontics. With increase in percentage of adult orthodontics and increase in demand for least invasive tools for orthognathic correction, surgery assisting for these said procedures needs to be more refined and less traumatic. Wilko, et.al. has recommended selective alveolar decortications with augmentation grafting combined with orthodontic treatment for accelerating orthodontic correction and patented this procedure as periodontally accelerated osteogenic orthodontics (PAOO). In this procedure reflection of full thickness flap was done on labial and lingual aspect around the teeth subject to movement. It was the thickness of the cortical bone which dictated how much bone was to be removed from which area. The depth of decortication cuts barely penetrated into medullary bone. Sufficient care was mandatory not to injure any roots of the teeth subject to movement. Resorbable allograft material applied over the bleeding bone before the closure of the surgical site.[1-7]

Accelerated orthodontic treatment facilitated by corticotomy in various forms has been getting momentum over last few decades.[8]Liou and Huang introduced dental distraction technique for distraction of periodontal ligament in 1998. The bone resistance to allow movement get compromised by this surgical technique and the mechanical stretching of the reparative bone tissue allows scaffold to grow new bone, which is called distraction osteogenesis.[9] Corticotomy was first introduced by Kole, in 1959 for facilitating rapid tooth movement during orthodontic treatment.[10] As Cortical plate of bone offers the main resistance to tooth movement, it was believed that, by disrupting the continuity of the cortical bone, much less time is required for the completion of orthodontic treatment.[11] Reflection of full thickness flaps is required to expose buccal and lingual alveolar bone in Kole's procedure, then inter dental cuts through the cortical bone is given for outlining the bone blocks around the teeth, in need for rapid movement. These cuts for vertical inter radicular corticotomy extending both facially and lingully were joined sub apically through the entire thickness of the alveolus.[12] It was also reported that, treatment duration and risk of side effects can be reduced significantly with the help of surgery for accelerating orthodontic tooth movement.[13] Suya conducted extensive research on 395 adult Japanese patients on the application of corticotomy-assisted orthodontic treatment.[14] In all his cases fixed orthodontic appliances were used following the surgery.

Completion of the treatment were found to be within 6 months in some cases and within 12 months in other cases. Extreme patient satisfaction and outstanding results are the remarkable features of corticotomy assisted orthodontic treatment.[14]

Suya believed that the tooth movements were possible because of the movement of blocks of bone using the crowns as the handles of the teeth. As for his recommendations tooth movement should be completed within 3 to 4 months, because of the possibility of fusion of the edges of the blocks of bone after that time.[14] Wilcko et al raised objections on kole's and suya's precept of "bony block" movement and offered an alternative hypothesis that marked but transient decalcification-recalcification of the alveolus brings about the rapid tooth movement following surgery.[4]

Corticotomy assisted treatment enhances the post orthodontic treatment stability.[15] Eruption of palatally impacted canine is facilitated by corticotomy assisted traction.[16] Direct correlation between degree and proximity of bone trauma and intensity of physiological healing response, had been established by Frost in 1983,describing it as regional acceleratory phenomenon (RAP).[17] The decalcification and recalcification described by Wilckow et al in 2001 and 2003 was an alternate hypothesis and consistent with RAP. In animal studies, canine retraction was shown to be accelerated by corticotomy assisted orthodontics .[18]Alteration of skeletal anchorage during the treatment of bimaxillary protrusion was assisted by corticotomy assisted orthodontics as adjunctive treatment.[19]

Multiple modalities of treatment protocol are combined in surgically-assisted orthodontics to shorten treatment time and to get the results that could not have been possible with orthodontics alone.[20] In a patient with cleft palate, surgical closure of palatal fistula could be accomplished by corticotomy assisted expansion.[21] This variety of treatment protocol brings about the comfortable risk free environment of own office setting for the surgeon, making the treatment more cost effective, decreasing the overall time span of treatment, there by ultimately increasing the patients acceptance.[22]

One of the most important currently emerging objective for an interdisciplinary team for orthognathic correction is to employ alternative methods for providing less invasive procedure on outpatient basis.[23] During orthodontic treatment, skeletal discrepancy is becoming more challenging because of mandatory need of hospital set up for delivery of these surgical services.[24] Intra bony Osseous defects in certain cases can be eliminated with appropriate orthodontic treatment. If the teeth are supererupted, orthodontic intrusion and alignment can help and level the osseous defects.[25]

With this background of history of literatures, this investigation is done to compare the effectiveness of application of surgical Periodontics for accelerated orthodontics (SPAO), referred here as “the application of periodontal osseous resective surgery for the reshaping of alveolus to facilitate the orthodontic tooth movement” with, the periodontally accelerated osteogenic orthodontics (PAOO). Corticotomy at extraction site of

the upper 1st premolars are also done during these said procedures followed by fixed orthodontics treatment. The treatment protocols in both these groups were considered as pre-orthodontic surgeries to facilitate treatment of severe class 2 division 1 malocclusion with skeletal discrepancy.

In the group treated with periodontally accelerated osteogenic orthodontics (PAOO), changes in values of ANB angle and over jet in the 1st six months following PAOO are found to be significant, the improvement of skeletal profile could be observed (Figure 1A, B). Again, the differences of changes in ANB angle and over jet between the base value and at 3 months interval (D1) are compared with the differences between the base values and at 6 months interval (D2). D2 is found to be having more significant value than D1 in Table 1.

In the group treated with surgical periodontics for accelerated orthodonics, the differences between the base values and the values at 3 months interval explain the significance of the procedure of SPAO. The improvement of facial profile with cephalometric parameters within 3 months interval could be observed (Figure 2A, B). Different steps completing the osseous resective surgery at inter-proximal areas are shown (Figure 4A, B), the changes between the base values of ANB angle, overjet at 3 months, 6 months and at 1 year interval (D3) are displayed in Table 2. Differences between base value and value at 3 months were compared to differences at 6 months and 1 year interval. The graph in (Figure 7) showing changes in mean ANB angle over period of time of 12 months. The graph in (Figure 8) showing changes in mean overjet over period of time of 12 months.

In both the groups, alveolar housing thickness was found to be within normal limit after 1 year interval. The results of alveolar bone thickness as measured from CBCT images after the success of treatment are shown in Table 3. At the crestal level alveolar bone thickness showed adequate bone support at the end of 1 year. The alveolar thickness of bone was continuing to improve with the improvement in alignment of the bone.

In those cases, treated with PAOO, resorbable graft materials packed into the sites of selective decortications was first getting resorbed and then followed by reorganization of bone. At these sites marked but transient decalcification-recalcification of the alveolus brings about the rapid tooth movement during the orthodontic treatment within 1st 6 months, following surgery. Whereas, the more rapid tooth movement noticed during the SPAO could be due to sorting of alveolar housing of the teeth with each other directly without being packed by resorbable materials during the immediate postoperative phase of orthodontic tooth movement. The alveolar bone thickness of bone was continuing to improve with the improvement in alignment of the teeth during orthodontic movement. The treatment phase of resorption and reorganization of the graft materials at the sites of decortications during the PAOO procedure as claimed by Wilko et al are simply skipped here, during the procedure of SPAO. The sorting of alveolar housing of adjacent moving teeth due to planned osseous respective surgery in SPAO preserves the thickness of alveolar housing as before. So, there was no need of putting the graft materials in between the decorticated sites for preserving the alveolar housing during the procedure of SPAO. The treatment time thus comparatively shortened in SPAO than the cases of PAOO. Both these procedures are to be classified as pre-orthodontic surgical procedures for enhancing orthodontic treatment.

CONCLUSION

Surgical periodontics for accelerated orthodontics, “referred here as the applications of periodontal osseous resective surgery for alveolar reshaping, is one equally effective procedure, when compared with periodontally accelerated osteogenic orthodontics for accelerating orthodontic treatment of class ll division l cases with skeletal discrepancy with added advantage of accelerated correction in immediate postoperative phase and without bringing any significant change in periodontal alveolar bone thickness. Periodontally accelerated osteogenic orthodontics and surgical periodontics for accelerated orthodontics are classified as Pre-orthodontic periodontal surgeries for facilitating orthodontics treatment.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Narendra S, Sahani NC, Jena S. Application of surgical periodontics for accelerated orthodontic correction of class ll division l malocclusion with skeletal discrepancy. Int J Res Med Sci 2017;5:2870-7.