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Comparison of Time for Orthodontic Treatment in Normal versus Cleft Alveolus Patients- An Original Research

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Abstract

Introduction: The main apprehension of new orthodontic patients, other than the outcome, is the time taken of treatment. A thorough knowledge of orthodontic treatment time as well as factors affecting the treatment time is useful for effective patient therapy and better clinical practice. Henceforth, the aim of our study was to compare the treatment durations of subjects with Class I, Class III and Class II division 1 (II/1) malocclusions, pre and post- secondary alveolar bone grafting (SABG) orthodontic treatments, and to recognize the factors affecting the treatment time of these malocclusions.

Materials and Methods: The study included 120 subjects and data were noted from their treatment records. ANOVA was done to know the difference in treatment durations of Class I, Class III and Class II/1 malocclusions, pre and post secondary alveolar bone grafting (SABG) orthodontic treatments, whereas multiple linear regression was applied to identify the factors affecting the treatment time. A level of significance ($p \leq 0.05$) was used for the statistical tests.

Results: A statistically significant difference was found between the treatment durations of class II nonextraction cases ($p \leq 0.007$) and other groups, class I extraction cases and other groups ($p \leq 0.001$), class III ($p \leq 0.004$), post SABG and other groups ($p \leq 0.004$). The factors significantly increasing the treatment time included missed appointments, breakages, and lower incisor proclination.

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Conclusion: Orthodontic treatment of cleft and Class II/1 malocclusion lasts longer than that of Class I malocclusion or Class III. Prolonged treatment time is associated with missed appointments, band/bracket debonds and increased lower incisor inclination. The variance in treatment time can be explained most significantly by number of missed appointments and breakages

Keywords: Orthodontic Treatment, Time, Cleft Alveolus, Malocclusion

Introduction

A precise judgment of treatment time by an orthodontist is essential for a fruitful practice. Orthodontic literature just as our clinical experience recommend that one of the principal worries of new orthodontic patients, aside from the result, is the time needed for the of treatment. Additionally, while treating a patient, an orthodontist faces a few occasions where anticipation of treatment time gets important. Ideal consummation of treatment brings about patients' satisfaction.[1] Moreover, better comprehension of elements influencing the time of orthodontic treatment brings about productive patient counseling, exact assessment of treatment cost, and along these lines, an improved clinical practices.[2]

A malocclusion can require various kinds of treatment relying upon its severity, patient's age and his/her compliance. The different treatment modalities used to address the malocclusion and the types of malocclusion affect the treatment time. So, for an orthodontist, it is essential to identify the malocclusions, their treatment modalities just as their treatment lengths. A few studies have been led to understand the frequency of various malocclusions among different populaces and it was discovered that patients with Class I and Class II Division 1 (Class II/1) malocclusions were more and also seek orthodontic treatment, while Class II Division 2 (Class II/2) and Class III happen less frequently.[3]

Since the invention of secondary alveolar bone grafting (SABG) in 1972 (Boyne and Sands, 1972), this strategy has become the standard treatment for reestablishing the alveolar cleft in most cleft centers.[4] Presurgical orthodontics assumes a significant part in correcting misaligned central incisors or repositioning displaced maxillary alveolar segments, which are normal findings in the cleft maxilla. Presurgical orthodontics permits the specialist better access for placement of the graft and closure of the soft tissue. Also, higher grafting success was found in cases of orthodontic space conclusion than in cases of space openings, recommending the influence of postsurgical orthodontics.[5]

Despite the fact that it is complex to precisely foresee the time needed to address these malocclusions, the orthodontic treatment records offer significant data that can be utilized for this reason. An unexplained variety in treatment time among different orthodontic practices requires the identification of components related with these variations. Accordingly, the aim of this examination is to analyze the treatment time required for Class I, Class III and Class II/1 malocclusions, pre and post optional alveolar bone uniting (SABG) orthodontic treatments, and also to recognize the components influencing the treatment duration of these malocclusions.

Materials and methods

We conducted a retrospective study of patient-records from the orthodontic office. Study

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participants comprised a sequential convenience sample of 140 subjects with Class I, Class III and Class II/1 malocclusions, pre and post secondary alveolar bone grafting (SABG) orthodontic treatments, who had undergone complete orthodontic treatment in the department. Patients were excluded if they were <10 or >30 years at the start of treatment. Data were collected from the records, casts and imagings.

Age and gender, overjet, overbite and occlusal relationship, Cephalometric information, start and finish dates of orthodontic treatment, type of appliance premolar extractions (yes/no), number of breakages, number of missed appointments, All the patients included in the present study were treated by single orthodontist, using preadjusted fixed appliances with 0.022" x 0.028" bracket slot. ANOVA was applied to determine the difference in treatment durations of Class I, Class III and Class II/1 malocclusions, pre and post secondary alveolar bone grafting (SABG) orthodontic treatments subjects, and extraction and non-extraction groups. Multiple linear regression analysis was used to determine significantly related variables to the treatment time. $p \leq 0.05$ was considered significant.

Results

Our study sample included 140 subjects with mean ages of 16 years at the beginning of treatment. The mean treatment durations of Class I non-extraction, Class I extraction, Class II non-extraction and Class II extraction groups were 36.7 months, 41.3 months, 48.83 months and 54.17 months, respectively; Class III 42.443 months, Pre-SABG orthodontics 47.843 months, Post-SABG orthodontics 53.147 months and there was statistically significant difference in the treatment time between groups (Table-1).

The differences in treatment time are statistically significant between class II nonextraction cases ($p \leq 0.007$) and other groups, class I extraction cases and other groups ($p \leq 0.001$), class III ($p \leq 0.004$), post SABG and other groups ($p \leq 0.004$). (Table-2)

The descriptive statistics of continuous variables are given in table-3. The effect of independent variables on the treatment time was assessed by using multiple regression analysis is presented in Figure 1. The regression model showed 85.71% of variance in the treatment time. All premolar- and upper premolar-extraction protocols increase the treatment time by 8.5 and 9.9 months, respectively, as compared to non-extraction therapy. Whereas, each degree increases in the pre-treatment lower incisor inclination, each month of functional appliance wear, each breakage and missed appointment increase the treatment time by 0.3, 0.5, 0.4 and 1 month respectively. These independent variables were included in a stepwise linear regression analysis to provide an explanation for the variance found in treatment time.

Table 1: Comparison of treatment durations between groups

Study Groups	**Treatment Time (Months)**		***p*-value**
	Mean	**SD**	
Class I Non-ext (n = 20)	36.717	12.819	0.001*
Class I Ext (n = 20)	41.432	10.31	

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Class II Non-ext (n = 20)	48.853	14.59	
Class II Ext (n = 20)	54.147	17.348	
Class III(n = 20)	42.443	11.301	
Pre-SABG orthodontics(n = 20)	47.843	13.529	
Post-SABG orthodontics(n = 20)	53.147	18.318	

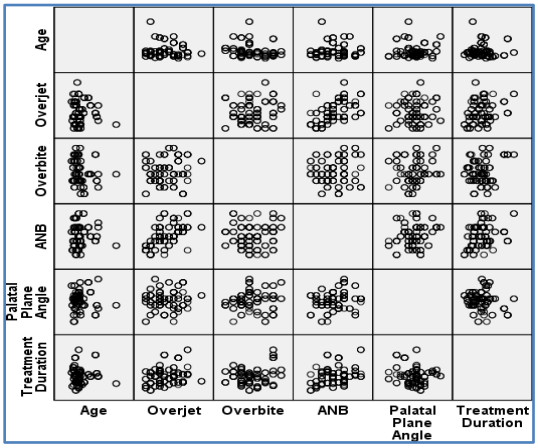

Figure 1: independent variables on the orthodontic treatment time was assessed by using multiple regression analysis

Table 2: Comparison of time between different groups

Study Groups	**Mean Difference (Months)**	***p*-value**
Class I Non-ext and others	-4.671	1.000
Class II Non-ext and others	-12.061	0.007*
Class I Ext and others	-17.440	0.001**
Class II ext and others	-7.42	0.260
Class III and others	-12.713	0.004*
Pre-SABG and others	-5.343	0.863
Post-SABG and others	-17.450	0.004*

Table 3: Descriptive statistics for model, cephalometric and treatment variables (independent

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variables)

Variables	Study Groups							Total Sample Mean (SD)
	Class I Non-Ext Mean (SD)	Class-I Ext Mean (SD)	Class-II Non-Ext Mean (SD)	Class-II Ext Mean (SD)	Class-III Mean (SD)	Pre-SABG Mean (SD)	Post-SABG Mean (SD)	
Age (years)	14.816 (8.320)	16.023 (3.454)	12.225 (1.701)	19.86 (5.48)	16.03 (3.44)	12.25 (1.71)	19.86 (5.48)	15.75 (5.94)
Overjet (mm)	3.620 (1.312)	4.717 (1.641)	8.813 (2.329)	7.90 (1.78)	4.77 (1.61)	8.83 (2.39)	7.90 (1.78)	6.28 (2.81)
Overbite (mm)	3.303 (1.302)	2.320 (1.329)	4.427 (1.853)	3.50 (2.01)	2.30 (1.39)	4.47 (1.83)	3.50 (2.01)	3.40 (1.81)
ANB Angle (°)	3.213 (1.721)	5.020 (2.405)	7.031 (2.223)	5.43 (0.89)	5.00 (2.45)	7.03 (2.23)	5.43 (0.89)	5.18 (2.33)
SNMx (°)	7.920 (2.618)	7.203 (2.121)	7.900 (3.120)	7.30 (3.12)	7.23 (2.11)	7.90 (3.10)	7.30 (3.12)	7.58 (2.76)
SNMP (°)	33.033 (4.205)	33.923 (4.305)	33.623 (5.042)	31.03 (4.46)	33.93 (4.35)	33.63 (5.04)	31.03 (4.46)	32.91 (4.62)
UISN (°)	106.87 (6.49)	110.87(3.54)	107.620 (7.812)	110.13 (6.49)	110.87(3.54)	107.60 (7.81)	110.13 (6.49)	108.87 (6.34)
IMPA (°)	96.83 (7.01)	104.07(7.37)	103.233 (5.852)	105.70 (6.53)	104.07(7.37)	103.23 (5.85)	105.70 (6.53)	102.46 (7.44)
Expansion (mon)	0.93 (3.55)	0.00	2.517 (4.601)	0.50 (1.13)	0.00	2.57 (4.60)	0.50 (1.13)	1.00 (3.08)
Functional Appliance (mon)	4.03 (7.22)	0.00	11.810 (8.872)	1.33 (3.03)	0.00	11.80 (8.87)	1.33 (3.03)	4.29 (7.43)
Non-compliance (n)	0.83 (1.26)	0.57 (1.04)	4.127 (3.106)	1.73 (2.56)	0.57 (1.04)	4.17 (3.06)	1.73 (2.56)	1.83 (2.56)
Breakages (n)	12.33 (11.61)	7.83 (5.11)	13.53 (9.02)	13.03 (8.72)	7.83 (5.11)	13.53 (9.02)	13.03 (8.72)	11.68 (9.10)

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Missed Appointments (n)	8.00 (6.33)	7.20 (6.24)	12.150 (8.522)	13.13 (12.78)	7.20 (6.24)	12.50 (8.52)	13.13 (12.78)	10.21 (9.15)
Intermaxillary Elastic (mon)	7.83 (5.08)	14.53 (6.17)	11.343 (6.582)	15.10 (13.62)	14.53 (6.17)	11.33 (6.58)	15.10 (13.62)	12.20 (8.93)

Discussion

The aim of our study was to conclude the difference in the treatment durations of prevalent malocclusions, i.e., Class I, Class III and Class II division 1 (II/1) malocclusions, pre and post secondary alveolar bone grafting (SABG) orthodontic treatments. From our study it is noted that Class III and Class II division 1 (II/1) malocclusions, pre and post secondary alveolar bone grafting (SABG) orthodontic treatments, on average, takes 12 additional months to be corrected as compared to Class I malocclusion. Skidmore et al in their study showed that pre- treatment class II molar relationship significantly escalates treatment time.[6] Though extraction cases took longer to be finished as compared to non-extraction, this variance is not significant. Likewise, no significant variance was seen between the mean time of Class II non- extraction and extraction groups (48.83±14.59 and 54.17±17.38 months, respectively).

Nonetheless, the regression analysis showed that extraction protocol results in an addition of 9 months on average to the total treatment time. Vig et al in their similar study that extraction of teeth extended the treatment time by 5 months on average.[7] Likewise, Alger[8] noted that for extraction patients, treatment time of 4.6 months longer than for non-extraction cases and Skidmore et al described that extractions caused in a additional increase of 2.6 months in treatment time.[6] Fink and Smith established extraction of teeth to be one of the most substantial variables accountable for the variance in treatment time.[9]

After examining 140 treated cases with completed treatment, we noted that the factors correlated with the treatment time were unused appointments, increased pre-treatment lower incisor proclination and breakages. The regression model showed that each failed appointment and breakage increase the treatment time by a month. An increase of 0.3 month in the treatment time is seen with a single degree rise in the pre- treatment lower incisor inclination. Furthermore, each month of functional appliance wear results in an addition of 0.5 month in the time of orthodontic treatment. These results are comparable to recent studies stating that increased treatment time is seen with number of replaced brackets, missed appointments, headgear, functional appliance, poor oral hygiene and premolar extraction.[3,6,11]

Also, the present study proposes that various factors are responsible for the variance in treatment time such as number of missed appointments, number of breakages, non-extraction or extraction treatment, time of functional appliance and pre-treatment incisor inclinations. Among them, missed appointments added considerably to the amount of explained variance.

Fink and Smith[9] found a significant association between treatment variables and treatment time. O'Brien et al[10] found that extractions in Class II/1 patients resulted in longer treatment time. In contrast, Vig et al[7] found no significant treatment time difference between extraction and non-extraction cases.

This is in close agreement to the findings by Beckwith et al[1] who reported that inclusion of failed appointments in their statistical analysis added 17.6% to the amount of explained

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variance. Fink and Smith[9] also examined this variable and similar to the present findings, concluded that missed appointments added significantly to treatment time. Still, in their study, number of failed appointments described only 5.2% of variance in treatment time.

In the patients with cleft palate and alveolus the second strongest independent factor in our multivariate analysis for the association of SABG with the 3D outcome of oral cleft defect was presurgical orthodontic treatment, in contrast to previous results (Long et al., 1995).[11] This difference may be explained by the type of presurgical orthodontic treatment used in our study. Patients with UCLP commonly present with tilted, retroclined, or rotated central incisors. When patients have had a severe tilt (i.e., across the alveolar cleft), retroclination (i.e.,<60○) or rotation (i.e., >60○), they have routinely been given simple orthodontic treatment before surgery at our center since 2005

The observations from that study recommend that number of breakages significantly affect the treatment time; still, the statistical analysis showed only 15.6% of explanation to the treatment time variance. Similar observations were made by Shia[12] who investigated 500 treated cases to identify the factors accountable for treatment overruns and found that broken appointments, appliance breakage, and poor patient cooperation were the primary affecting treatment time. The only factors associated with the oral cleft defect in our multivariate analysis were orthodontic treatments before and after SABG. Our finding on postsurgical orthodontic treatment is consistent with a report suggesting that orthodontic space closure after grafting is linked to a lower level of graft resorption than orthodontic space openings (Schultze-Mosgau et al., 2003).[5] Similarly, pre- or postsurgical orthodontic treatment was independently associated with lower need for revision after bone grafting. Thus, post-SABG orthodontic movement of cleft-adjacent teeth can apply functional stress on the grafted bone and promote alveolar remodeling.[13]

Our study aimed to determine the treatment time of orthodontic patients in contemporary practice. Earlier literature proposes that the type of fixed appliances may also effect the treatment time.[18] Henceforth, in the our study, all the subjects were completely treated with fixed appliance of Roth prescription (with or without functional appliance) in order to present results which are applicable to current clinical practice. Also, Amditis and Smith[19] showed that difference in the slot size of fixed appliances also accounts for the variation in treatment time. In our study, only 0.022” x 0.028” slot sized fixed appliance was used which is the most common size used in the contemporary orthodontics.

The restrictions of this study were the small sample size and retrospective study design. Due to the strict inclusion criteria (particularly the standard of finishing) and limited time restraints, a study with larger sample and prospective design was not conceivable. Hence, future investigation in this regard would be helpful to reduce any bias. Also, the sample of current study was restricted to single orthodontic practice to avoid the potential of interoperator variation. However, a multi-practice assessment of factors affecting the treatment time would be beneficial in understanding the variance in time taken among different practitioners, with careful presentation of results to lower the confounders.

No evidence-based information is currently available to assess treatment time in cases in which non-conventional adjunctive methods are implemented in a view to reduce treatment time. Hence, this is an area of interest necessitating future research.

In general, the orthodontic treatment includes repositioning the tilted, retroclined, or rotated central incisors with a simple bracket and archwire. Accordingly, the surgeon performing

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SABG can have better access to place the graft and to close the soft tissue. On the other hand, Long et al. routinely expanded the maxillary segments before surgery, which increased the cleft width (Long et al., 1995).[11] They also found an inverse relation between presurgical cleft width and SABG success.

We did not find any significant association between graft failure and a wide cleft, despite cleft size commonly being assumed to affect bone graft success.[14] Our finding may be compromised by the representativeness of our patient sample, since our center does not use SABG to repair patients with an excessively wide alveolar cleft in association with a large fistula but segmental distraction for anterior advancement of the minor segment followed by gingivo- periosteoplasty or bone grafting. Instead, we found that graft success was strongly associated with the status of canine eruption at surgery, in agreement with many previous studies.[15,16] Taken together, these results suggest that the tooth germ adjacent to the alveolar cleft migrates into the newly formed bone and erupts. This tooth eruption does not cause resorption of the grafted bone but increases its vertical height. We found no association between graft success, however, and any orthodontic treatment. One explanation may be that the orthodontic tooth movement for space closure increases mainly alveolar ridge thickness but not its height.[18]

Conclusion

Based on the results of this study, the following can be concluded:

- Class III and Class II division 1 (II/1) malocclusions, pre and post- secondary alveolar bone grafting (SABG) orthodontic treatments, treatment lasts longer than Class I treatment
- Missed appointments, number of breakages and increased pre-treatment lower incisor proclination are the factors positively correlated with the orthodontic treatment time
- Missed appointments and breakages are the most important treatment variables for the explanation of variance in treatment time.
- The results of this study suggest that, in patients with unilateral cleft lip and palate, presurgical and postsurgical orthodontic treatments are associated with superior SABG outcome on oral cleft defect.

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