A COMPARISON OF THE EFFECTS OF RAPID MAXILLARY EXPANSION SCREW HEIGHT (DEEP VS SHALLOW) ON THE DENTOALVEOLAR STRUCTURES IN MAXILLARY CONSTRICTED PATIENTS

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The aim of the present study was to compare the dentoalveolar expansion effects of rapid maxillary expansion (RME) using either a shallow or deep height of hyrax expansion screw. The study involved 16 patients with skeletally narrow maxilla and mild to moderate crowding of the maxillary arch. Rapid maxillary expansion was performed in half of the patients with the shallow hyrax expansion screw and other half with the deep screw. Models and model photocopies were obtained before and after rapid maxillary expansion and compared with Wilcoxon signed ranking test. Both appliances were equally effective in rapid expansion of maxilla.

Key words: *Rapid maxillary expansion (RME), Narrow maxilla, Hyrax.*

INTRODUCTION

Rapid maxillary expansion (RME) is a dramatic procedure with a long history of over 100 years [1]. Although clinicians agree about many of the indications for and outcomes of RME, a review of literature[2] indicates that numerous disagreements persist about the procedure. Haas[3] and Wertz[4] advocated splitting of the midpalatal suture to widen narrow maxillary arches. On the other hand, Graber[5] believed that the technique was originally dropped because of development of open bites, relapse, and the fact that improvement of nasal breathing was only temporary. Furthermore, orthodontic appliances routinely achieve the needed maxillary intercanine and intermolar expansions. Graber[5] asks, "What are the criteria for lateral apical base deficiency?"

In normal maxilla the transpalatal width of 35 to 39 mm suggests a bony base of adequate size to accommodate a permanent dentition of average size, so by providing some mechanism of widening the bony base and increasing arch width and perimeter, more space can be obtained for the alignment of the permanent dentition. One of the mechanisms that is used to increase the maxillary width is the rapid maxillary expansion with Hyrax expansion screw[6].

The rapid maxillary expander as described by Haas[3] is a rigid appliance designed for maximum dental anchorage that uses a jackscrew to produce expansion in 10 to 14 days. The basis for the rapid expansion procedure is to produce immediate midpalatal suture separation by disruption of the sutural connective tissue. Haas[3] believes this will maximize the orthopedic effects. Forces produced by this appliance have been reported in the range of 3 to 10 pounds [7].

Despite a history of more than 100 years[1] and increasing use in recent years by clinicians to correct orthodontic transverse anomalies, most research has been concerned with reactions in the sutures. There have been surprisingly few studies of changes in the teeth and supporting tissues[8]. Some histological studies have dealt with the extent of damage to the root surface and the subsequent repair of such root defects[8,9]. Marked pulp changes have also been observed following rapid expansion[9].

The aim of the present study was to assess and compare the dentoalveolar effects of expansion screws in the depths of 0.75mm and 1.25mm.

MATERIAL AND METHODS

This study was conducted in the department of Orthodontics and Prosthodontics of Lahore Medical and Dental College, Lahore. It involved 16 patients (7 male and 9 females); their average age was 14.2 years. All patients had skeletally constricted maxilla with maxillary first molars and first premolars present. None of the patients had craniofacial anomalies such as cleft lip and cleft palate. The patients were divided into two equal groups of 8 patients each. Group I with shallow screw and Group II with deep screw. All patients were treated with Hyrax expansion appliance. Hyrax expansion screw was fixed to its predetermined depths (0.75 or 1.25mm), using a special gauge created for this purpose. The arms of the

expansion screw were soldered to the bands that were fitted on the first premolar and first permanent molar. The Hyrax device was centered in the maxillary arch and was sagittaly placed parallel to the mesial half of the permanent first molar and second premolar region.

After cementation, the appliances were activated twice a day with one-quarter turn in the morning and one in the evening until the desired expansion was attained. The amount of expansion anticipated was 0.5 mm per day. The expansion was done for an average period of 15.5 days. The study was carried on models and photocopy of models. The records were taken before and immediately after expansion.

Horizontal landmarks were marked on the study cast and photocopies of the casts were taken on the same machine with 1 to 1 duplication. Vertically, the casts were cut till the distal surface of the upper molars and upper first premolars respectively to take the bone and dental measurements. Horizontally, landmarks were marked on the study casts with a sharp HB pencil and photocopied of the cast were taken on the same machine with 1 to 1 duplication[10]. Vertically, the models were cut till the distal surface of the upper first molars and upper first premolars to take the bone and dental measurements.

Horizontal model landmarks (Fig. I)

- mb: mesiobuccal cusp tip of the upper first molar.
- mp: mesiopalatal cusp tip of the upper first molar.
- db: distobuccal cusp tip of the upper first molar.
- dp: distopalatal cusp tip of the upper first molar.
- CM: The point that dissects mb – dp line with mp – db line on the right upper first molar.
- CM^1: The point that dissects mb – dp line with mp – db line on the left upper first molar.
- bc: buccal cusp tip of the upper first premolar
- pc: palatal cusp tip of the upper first premolar.
- CP: the midpoint of bc – pc line on the right upper first premolar.
- CP^1: the midpoint of bc – pc line on the left upper first premolar.

Vertical model land marks (Fig. III)

- A**:** a point on the right half of the palatal bone midway between the deepest point of the palatal and the palatal crevice of the upper right molar.
- A^1: a point on the left half of the palatal bone midway between the deepest points of the palatal and the palatal crevice of the upper left molar.
- B: a point on the palatal crevice of the upper right molar.
- B^1: a point on the palatal crevice of the upper left molar.
- C: a point on the right half of the palatal bone mid way between the deepest points of the palate and the palatal crevice of the upper right premolar.
- C: a point on the left half of the palatal bone mid way between the deepest points of the palate and the palatal crevice of the upper left premolar.
- D: a point on the palatal crevice of the upper right premolar.
- D^1: a point on the palatal crevice of the upper left premolar.

Model measurements (Fig. II and IV)

- MI: The distance between CM and CM^1 (intermolar width).
- IPW: The distance between CP and CP^1 (interpremolar width).
- IBW: The distance between A and A^1 (interbony width).
- IDW: The distance between B and B^1 (interdental width).
- IBW^1: The distance between C and C^1.
- IDW^1: The distance between D and D^1.

The pre expansion and post expansion dental casts were photocopied [10] and measured carefully. The changes in measurements of the pre and post dental casts were analyzed with wilcoxon signed teat.

RESULTS

Inter molar width (IM) showed a significant change of 5.38mm ($p < 0.01$) in group 1 and 5.63mm in group 2. Both changes are considered significant. Inter premolar width (IPW) showed a significant change of 5.50mm ($p<0.01$) of increase in Group I and 5.25mm ($p<0.01$) in Group II. Changes in both the groups were significant. Inter bony molar width (IBW) showed a significant change of 3mm ($p<0.01$) for both groups. Inter dental width (IDW) showed a significant change of 4.50mm ($p<0.01$) for Group II and V.00mm for Group I. Changes in both were significant. Inter bony premolar width (IBW^1) showed an increase of 1.88mm ($p < 0.05$) in Group I while in Group II

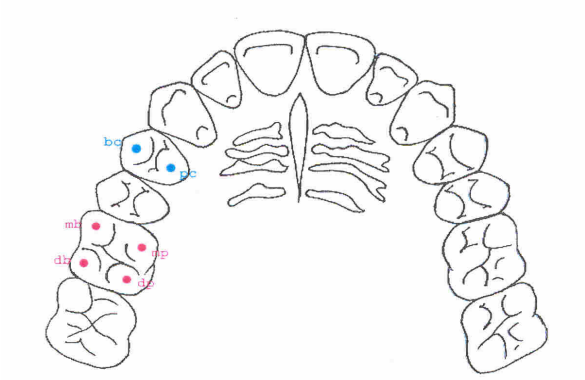

Fig. 1: Horizontal model landmark.

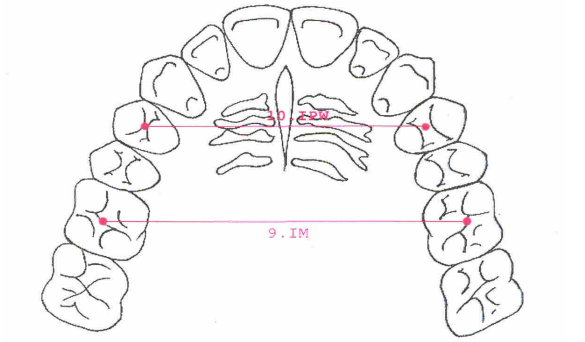

Fig. 2: Horizontal model measurements.

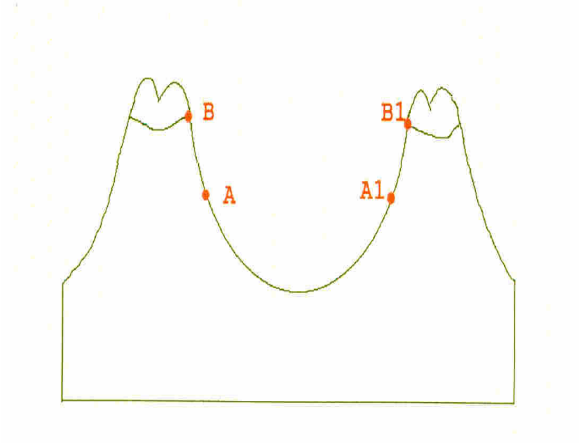

Fig. 3: Vertical model landmarks.

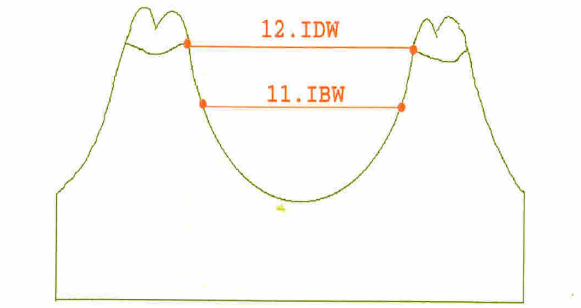

Fig. 4: Vertical model measurements.

Table 1: *Pre and post expansion horizontal mean values in the model photocopy analysis of Group I.*

Model analysis		Before				After			
		Mean	SD	Min	Max	Mean	SD	Min	Max
IM	mm	43	1.85	40	45	48.375	1.92	45	51
IPW	mm	31.625	3.11	25	34	37.125	2.90	32	40

Table 2: *Pre and post expansion horizontal mean values in the model photocopy analysis of Group II.*

Model analysis		Before				After			
		Mean	SD	Min	Max	Mean	SD	Min	Max
IM	mm	42.125	4.12	34	46	47.750	5.23	38	53
IPW	mm	31.875	1.73	30	35	37.125	3.36	31	42

Table 3: *Pre and post expansion vertical mean values in the model analysis of Group I.*

Model analysis		Before				After			
		Mean	SD	Min	Max	Mean	SD	Min	Max
IBW	mm	17.250	1.83	15	20	20.250	2.25	16	23
IDW	mm	33.500	1.93	30	36	38.000	1.77	35	40
IBW[1]	mm	11.125	3.44	3	36	13.000	2.14	9	15
IDW[1]	mm	23.750	2.87	18	27	28.375	3.16	23	33

Table 4: *Pre and post expansion vertical mean values in the model analysis of Group II.*

Model analysis		Before				After			
		Mean	SD	Min	Max	Mean	SD	Min	Max
IBW	mm	18.125	4.88	8	25	21.125	3.40	16	27
IDW	mm	32.250	5.06	22	37	36.750	2.86	27	43
IBW[1]	mm	11.500	2.20	8	14	13.875	2.17	11	17
IDW[1]	mm	24.250	1.98	22	28	28.375	3.07	22	32

Table 5: *he differences in the horizontal model analysis.*

Model analysis		Group I					Group II				
		Mean	SD	m	M	P	Mean	SD	m	M	P
IM	mm	5.38	0.74	4	6	0.01*	5.63	2.26	1	8	0.01 *
IPW	mm	5.50	1.60	3	7	0.01*	5.25	2.12	1	7	0.01 *

Table 6: *The differences in the vertical model analysis.*

Model analysis		Group I					Group II				
		Mean	SD	M	M	P	Mean	SD	m	M	P
IBW	mm	3.00	1.31	1	5	0.01*	3.00	2.07	2	8	0.01 *
IDW	mm	5.00	0.53	4	6	0.01*	4.50	2.14	1	8	0.01 *
IBW[1]	mm	1.88	1.88	0	6	0.03*	2.38	1.06	1	4	0.01 *
1DW[1]	mm	4.63	1.77	3	8	0.01*	4.13	2.10	0	7	0.02 *

Table 7: *Significance of differences between Group I and Group II.*

Measurements	P values
IM	0.45
IPW	0.78
IBW	0.45
IDW	0.46
IBW^1	0.34
IDW^1	0.40

the increase was 2.38mm ($p < 0.01$). They were both significant changes. Inter dental premolar width (IDW^1) showed a 4.63mm ($p<0.01$) of increase in group 1 whereas it was less in Group II. Both these changes were significant.

DISCUSSION

A reasonable percentage of patients coming for orthodontic treatment have maxillary constriction. In such cases expansion is carried out to increase maxillary width and also to resolve mild to moderate crowding[14].

The patients' group age in our study ranged from 11 to 17.4 years so as to demonstrate suture opening during the expansion as recommended by Person and Thilander[15]. The patient was asked to activate the appliance 0.5 mm per day (two quarter turns of the Hyrex screw each day). All patients showed opening of the palatal suture approximately 7 to 10 days after starting the expansion. This was checked and confirmed using the occlusal radiographs[1,4,5,10,15].

Inter molar width (IM) increased to 5.38mm in group I while in group II it increased to 5.63mm. This increase is a normal sequence of maxillary expansion due to the separation and dental tipping[15]. It has been reported that significant expansion can be gained through the premolar region and may be expected to be stable and the order of greater net arch width gained was for second premolar, followed by the first premolars, molars, and then for the canines[16], while in the present study we found more width gaining in the premolar area but the difference from the molar area was insignificant. Comparing the two groups there was no significant difference.

Inter premolar width (IPW) increased by 5mm in Group I and 5.25mm in Group II, the increase was a normal sequence of maxillary expansion due to maxillary separation and dental tipping. Comparing Group I and Group II there was no significant difference. We found that the amount of expansion in the molar area was about the same as in the premolar area. Timms[6] and Hass[12,13] stated that the ratio of expansion in the intercanine distance and intermolar distance is nearly the same.

The models were cut until the distal surface of the maxillary first molar and maxillary first premolars respectively to take the bone and dental measurements. Inter bony molar width (IBW) showed a significant change of 3.00mm for both the groups and the inter dental molar width (IDW) showed a significant change of 5mm and 4.50mm respectively. This gives us an idea that skeletal expansion was equal for both the groups that means that there is no difference between deep and shallow screw height. There is difference in inter dental molar width which was expected because of the response of the maxillary complex to expansion and dental tipping[1,14]. Inter bony premolar width (IBW^1) showed a 1.88mm of increase in group I which was significant, while it was more in group II and it counted for 2.38mm. They were both significant changes. Inter dental premolar width (IDW^1) showed a 4.63mm of increase in group I while it was 4.13 in Group II. These both were significant changes.

If we compare both groups for inter bony and interdental molar and premolar width we will see that in group II there is more or same amount of bony expansion as compared to group I and less amount of dental expansion which means that in the deep screw height group there is less amount of tipping as compare to the shallow one, although this difference is not significant because the difference of height is only 0.5mm.

CONCLUSION

From our study we conclude that the rapid maxillary expansion can be achieved by shallow and deep positioned screw. In addition there is lesser amounts of dental expansion and more skeletal expansion in the Group II.

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