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Dental Arch Dimension Changes Following Prematurely Extracted Deciduous Molars

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Abstract

The aim was to assess the vertical and horizontal dimensional changes in the maxillary and mandibular dental arches after the unilateral premature loss of deciduous molars. Methods: The sample consist of 100 child between 8-9 years of age with unilateral loss of first or second deciduous molars, either in the maxillary or mandibular arches, Study casts were made and measurements conducted on the Auto sketch program on the computer , The data obtained was subjected to statistical analysis. The Results of the study showed that when comparing the mean values of the loss groups with the control group a statistically significant difference in the maxillary (A) distance after the premature loss of first or second deciduous molars, however a high significant difference statistically in the (ML) distance recorded after the premature loss of maxillary second deciduous molar ,while in the mandibular arch a statistically high significant difference observed in most of the vertical and horizontal distances following premature loss of second deciduous molar. Conclusions: The major effect on the dental arch length and width following the premature loss of the deciduous molars, indicating the need for fitting the space maintainers' appliances as soon as the extraction is the final decision to the dentist.

Introduction

Dental arch dimensions and generalized spacing in deciduous dentition determine to a large extent the alignment of teeth in permanent dentition. After the complete eruption of deciduous dentition by the age of three, the entire arch and occlusion is relatively stable for the next two years. During this static period, if proper prediction of arch changes and occlusion are done by the pediatric dentist, it helps in establishing an acceptable esthetic and functional occlusion at a later age [(1).] The change from deciduous dentition to the permanent dentition is a complex phenomenon, which is composed of a variety of physiological adaptations of occlusion during this period, The exfoliation of the deciduous teeth, the permanent teeth eruption and the occlusion through independent, occur in a harmonious sequence [(2, 3).]The premature loss of deciduous teeth is one of the causes that effects on the development of the permanent dentition and it's a matter of great interest. The chief problem is the extent to which such loss is responsible for malocclusion. Results of earlier investigations in this field have been somewhat variable. A premature loss of deciduous molars was reported to cause an earlier eruption of permanent

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successors and interfere with the harmony of adult dentition resulting in crowding caused by shifting and or drifting of adjacent teeth toward the extraction space [4, 5].

The premature loss of the deciduous molars that results in mesial positioning of the first permanent molar is of a great concern during the mixed dentition .In 1965, Seward used serial cephalometric radiographs to determine whether space closure occurs by mesial or distal movement from teeth adjacent to the extraction site, he concluded that , in the maxilla all the spaces were closed by mesial migration of posterior teeth into the extraction site , while in the mandible for space losses greater than 2 mm the spaces were closed mainly by distal movement of the teeth mesial to the extraction site [6] . Another study by Love and Adams1971 found a greater percentage of space loss following the premature extraction of deciduous molars occur by mesial migration of the posterior teeth than distal migration of the anterior teeth, especially in the mandible. In majority of children, the occlusion and space would be influenced by premature extraction of deciduous molars as the premature loss of deciduous teeth is still a very common situation within the population [7] .Miyamoto, Chung and Yee (1976) studied 255 children aged 11 years or older to observe the effects of the early loss of the deciduous canines and first and second molars on malocclusion of the permanent dentition, they found that Children who had a premature loss of one or more canines or molars more commonly received orthodontic treatment for the permanent dentition. Orthodontic treatment need was increased with the number of prematurely lost teeth, The frequency of orthodontic treatment in children who had lost one or more deciduous teeth was three more times greater than the control group [8] . Another study done to investigate immediate and six month changes after the loss of the deciduous maxillary first molars, they found that predominantly the premature extraction of deciduous maxillary first molars cause a mesial movement of the more distal teeth, causing the first and second deciduous molars space reduction. While in the mandible, distal movement of the canine and incisors as well as mesial movement of the permanent first molar and the deciduous second molar occurs, with the distal movement predominating [9].

In the present study a certain vertical and horizontal measurements were conducted on the study cast for a selected sample aged 8-9 years Iraqi children having unilateral premature loss of either the first or second deciduous molars, then comparing the results with the control groups values which has been measured in previous studies conducted for the same age group children [10,11] ,to find the changes in dental arch dimensions following unilateral premature loss of deciduous molars at the mixed dentition stage.

Material and Methods

The sample of the present study consists of 100 Iraqi healthy children ranging in age between 8-9 years, at the mixed dentition stage, belonging to a mixed socioeconomic status selected from different deciduous schools from Baghdad city. The children divided into four groups:

Maxillary First deciduous molars Group: include 25 children (13 male and 12 female) have unilateral premature loss of maxillary first deciduous molars.

Maxillary Second deciduous molars Group: include 25 children (13 male and 12 female) have unilateral

premature loss of maxillary second deciduous molars.

Mandibular first deciduous molars Group: include 25 children (13 male and 12 female) have unilateral premature loss of mandibular first deciduous molars.

Mandibular second deciduous molars Group: include 25 children (13 male and 12 female) have unilateral premature loss of mandibular second deciduous molars.

All groups had the period of absence of prematurely extracted deciduous molars between 6-12 months. The remaining dentition are healthy with no extensive caries or malformation and had no history of space maintainer therapy or orthodontic treatment. Dental study models were prepared by taking alginate hydrocolloid impressions for each child with perforated metal trays, pouring it with dental stone according to the manufacturing instructions, then for every dental cast a proper plaster base was made and trimmed then labeled with certain number [10,11,12].

Study Models Measurements:-

figures 1 (a) and (b) shows the dental arch length" vertical" measurements include distances [13] which are:-

1- **(A)** the distance between the contact points of the permanent central incisors to the line tangent to the cusp tip of the deciduous canines (or when worn, to the centers of resulting facets).

2- **(B)** The distance between the contact points of the permanent central incisors to the line tangent to the distal surfaces of the deciduous first molars.

3- **(C)** The distance between the contact points of the permanent central incisors to the line tangent to the distal surfaces of the deciduous second molars.

4- **(D)** The distance between the contact points of the permanent central incisors to the line tangent to the distal surfaces of the first permanent molars.

Figures 2 (a) and (b) shows the dental arch widths "horizontal" measurements which include:

(IC): inter-canine distance which extends between the cusp tips of right and left deciduous canines (and / or the centers of the facets of the weared deciduous canines).

(IM): inter-molars distances which are represented by 4 distances [14,15,16] :

(MB): the distance between the mesiobuccal cusp tips of right and left first permanent molars.

(ML): the distance between the mesiolingual cusp tips of right and left first permanent molars.

(DB): the distance between the distobuccal cusp tips of right and left first permanent molars.

(DL): the distance between the distolingual cusp tips of right and left first permanent molars.

Each of these landmarks were marked on the study casts by a sharp lead pencil to facilitate accurate recognition, then the occlusal surface of study casts were facing the glass window of the scanner directly, then accurate and exact image of the casts were saved and transferred to the Auto sketch program on Pentium 4 computer according to the instruction read from that software program, the Auto sketch (Germany) software provides a complete set of CAD tools for creating professional-quality precision drawing, such software program were accurately used in many other dental measurements[10,11,17] .

Later on the results obtained from the present study were compared with the results of previous Iraqi study because the age of the studied sample

was the same and no other study has been done in Iraq to measure such dimensions [10,11] .

Results

The present study was undertaken to evaluate the changes in the dental arch dimensions after premature loss of unilateral deciduous molars among 100 Iraqi children aged 8-9 years at the mixed dentition stage from different primary schools in Baghdad city. The measurement the present study of the dental arch dimensions includes the vertical and horizontal distances for the extraction groups .then a comparison were made statistically by using two – tailed t –test between the mean values of the loss groups with a control sample studied previously at the same age in Baghdad city [10,11].

Figure 1 (a) and (b) shows the vertical measurement on the study cast includes the dental arch length which represented by four vertical distances (A, B, C, and D) for the loss group.

Table (1) and table (2) shows the mean values of the maxillary and the mandibular dental arch length respectively for the control group and the loss groups ,also in the same tables a comparison were done by applying t test statistically to compare between the mean values of the control and the loss groups .

Figure (3) and figure (4) represented the bar chart of the mean values of the maxillary and the mandibular dental arch length for the control group and the loss groups.

While the horizontal measurement as shown in figure 2(a) and(b) ,includes the dental arch width which represented by five distances which are (IC, IM distances includes MB, ML, DB, DL) for the loss groups .

Table (3) and table (4) revealed the maxillary and mandibular dental arch width respectively for the control and loss groups. At the same time a comparison were done by applying t test statistically to compare between the mean values of the control and the loss groups. Figure (5) and figure (6) represented the bar chart of the mean values of the maxillary and the mandibular dental arch width respectively, for the control group and the loss groups.

Discussion

The major responsibility of the Pedodontist is the active supervision of the developing dentition and the management of space problems associated with the transitional stages from deciduous to permanent dentition [2, 3]. Dental arch length is the most important of dental arch dimensions in the developing individuals. The maintenance of the dental arch dimensions during deciduous, mixed and early permanent dentition is of great significance for the normal development of a functional, well-aligned and balanced adult occlusion, one of the causes that effect on the dental arch dimensions is the premature loss of deciduous molars at the mixed dentition stage [18].

Premature loss of a deciduous molars is of concern not only because of the loss of function, but also because of the increased possibility that the other teeth may drift. It would be useful in determining the treatment, if the dentist could predict the sequel of premature loss of deciduous molars [19] .The premature loss of deciduous molars influences the occlusion and normal development and can disrupt the integrity of the arch and lead to problems that affect the alignment of the permanent dentition which will creates an increased need for orthodontic treatment [8].

This study was undertaken to evaluate the scientific evidence concerning dental arch dimensional

changes in the mixed dentition stage following the unilateral premature loss of a deciduous molars which appear as follows:

The maxillary arch dimensional changes:

The early space changes to the maxillary arch subsequent to premature loss of a deciduous maxillary first molar are primarily distal drift of the deciduous canines toward the extraction space and to a lesser extent a palatal migration of the maxillary incisors, which is appeared by the increase in the A distance ,about 1.09 mm. of space was lost, which is statistically significant when compare with the control group ,On another hand, minimal changes appear in the IC,IM distances which Increase less than 1mm. without any significant difference .this come in accordance with other studies which shows that in case of early loss of the first deciduous molar, deciduous canine (and sometimes permanent incisors too) may move or incline to the distal [20] ,also this come in accordance with other studies who found that The early space changes to the maxillary arch subsequent to premature loss of a deciduous maxillary first molar are primarily distal drift of the deciduous canines toward the extraction space and palatal migration of the maxillary incisors[9] .

On the other hand The second deciduous molar is the member of the buccal segment teeth which is most often prone to destruction and early loss, regarding the fact that the second deciduous molar is the tooth with The greatest morbidity in deciduous dentition in our subjects as well as in all subjects in general, Its early loss in the period of mixed dentition and even later may result in mesial movement of the first permanent molars [21, 22, 23].

In this study The early space changes to the maxillary arch subsequent to premature loss of a deciduous maxillary second molar primarily the position of the first permanent molars which is tend to move more forward positioning with lingual positioning which is presented by decrease the IM distances by about 2.1 - 2.9 mm. with high significant difference when compared with the control group..

The first permanent molar makes either mesial movement (more often in the upper jaw) or mesial inclination (more often in the lower jaw). In either case, the length of the dental arch decreases.

the explanation of the mesial migration of the maxillary permanent molars may due to the inclination of the maxillary molars ,but in addition to that the maxillary teeth receive a mesial force from the buccinators muscle which extends distally to the last erupted molar teeth which could well account for the mesial migration of maxillary teeth[6,20,21,22] .

In another hand the changes in the B distance demonstrating an increase with about 1.27mm. Indicating the distal movement of anterior teeth and deciduous cuspids[20].

In addition to that there was a slight decrease in the IC distance less than 1mm. without any significant difference.

The mandibular arch

This study shows that The premature loss of first deciduous molars tend to produce more effect on the position of second deciduous molars and first permanent molars by decreasing the C,D distances about 1,5-2mm. with high significant difference statistically when compared with the control group i.e. mesial migration of the teeth distal to the first deciduous molars extraction spaces, at

the same time, there is a decrease in the IM distances about 1mm. which is explained the slight lingual tipping of the first permanent molars accompanied the mesial forwarding movement[16,19,23,24] . In addition to that, the premature loss of mandibular first deciduous molars affect also on the A distance [24]. The result of the present study confirm with the conclusion of other studies [22,24,25] , They reported that space loss was more common in the mandibular arch after the premature loss of first deciduous molar. The results of the present study partly support the conclusions that space in the mandible is lost by both mesial migration of posterior teeth and distal movement of anterior teeth [26] .

The possible explanation to the fact that the space loss in the mandible is mostly due to distal movement of deciduous cuspids during the following eight months, is that the erupting anterior incisors pushed the deciduous cuspids towards the distal more than the erupting first permanent molar did on the second deciduous molar towards the mesial. The findings of the present study support the findings to a study who concluded that the space changes occurred mainly by the distal migration of In the mandible[27] i.e. distal movement of the canine and incisors as well as mesial movement of the permanent first molar and the deciduous second molar occurs, with the distal movement predominately.

This study found that The influence from the premature loss of mandibular second deciduous molars was on the A distance ,there's decrease in A distance from (4.8) to (3.8) mm. with high significant difference statistically when compared with the control group ,this explained either because of the action of lower lip [28] ,or by the distal movement of permanent incisors and canines following the distal movement of the first deciduous molar toward the second deciduous molar space, and this come in accordance with many studies who found that space closure following premature loss of second deciduous molars occur by distal migration of canines in the mandible [16,23,24,29] .

The distal movement of the incisors toward the extraction spaces may attributed to the lip positions, and the Differential lip pressures in the various malocclusions, thus, lip forces may contribute to increased space loss should a deciduous molar loss occur. Some research seems to indicate that incisor position determines resting lip pressure, and patients with retroclined incisors and smaller overjets have lower lip pressures.

Thus, it is difficult to make firm conclusions as to whether lip pressure would play a significant role in the etiology of space loss [30,31].

The distal migration of anterior teeth accounted for more space loss in the mandibular arch this explained by the six mandibular anterior teeth subjected to a strong lingual force produced by its maxillary antagonists. The lingual force on the incisors has a distal component at the cuspids. when the distal component no longer resisted by the first or second deciduous molars, the cuspids move distally ,so the mandibular midline shift to the extraction side and the incisors collapse lingually[19].

Another major effect following the premature loss of the mandibular second deciduous molars was mainly on the first permanent molars position by causing mesial forward movement toward the second deciduous molars extraction space which is obvious from the reduction in the first primary molar distance about 4mm. this reduction in the first primary molar distance from (34.87) to (30.6) mm. with high significant difference when compared

with the control group, indicating the strong mesial forward movement of the first permanent molars toward the second deciduous molar extraction spaces [16,20,23,24,30] . Also there is decrease only in the MB distance about 1mm. the (IM) distances decreased with a high significant difference statistically only in (MB) distance.

the premature loss of mandibular second deciduous molars has an effect on the inter molar distances more than the inter canine distance leading to the fact that whenever second deciduous molars lost prematurely there is mesial forward movement of first permanent molars with lingual tipping [32].

On the basis of these findings ,we must point to the fact that maintaining of a high standard of dental service for preschool children to reduce the need for premature extractions of deciduous molars because, one of the important services that a pedodontist can render to a pediatric patient is that of maintaining the arch length prior to the eruption of the succeeding permanent tooth, so the main target in our study is the prevention of loss of deciduous molars during childhood years to preserve the space for the permanent successors.

Conclusions

In the maxillary arch, the following dental arch dimensional changes occur:

1) The unilateral premature loss of the first or second deciduous molars lead to an increase in the (A) distance with statistically significant difference when compared with the control group, indicating the distal drift of the anterior teeth toward the extraction spaces.
2) The unilateral premature loss of second deciduous molar lead to mesial forward movement of the first permanent molars toward the extraction space with lingual tipping, which appeared by the reduction in (IM) distanced with statistically significant difference in the (MB,DL) distances and a high significant difference in the (ML)distance only when compared with the control group.

In the mandibular arch the following changes occur:

1) The unilateral premature loss of first deciduous molar lead to high significant difference in the (C) and (D) distances when compared with the control group. While a high significant difference recorded in the (A) and (D) distances following premature loss of the second deciduous molar , indicating the mesial and distal migration of adjacent teeth toward the extraction site.
2) The premature loss of first or second deciduous molars lead to significant difference in the (MB) distance indicating the mesial forward movement of the first permanent molars with lingual tipping toward the extraction space .

References

1- S Prabhakaran, CH Sriram, MS Muthu, Chandrasekhar R Rao, N Sivakumar .Dental arch dimensions in primary dentition of children aged three to five years in Chennai and and Hyderabad. Ind.J Den.Reearch.2006; 17 (4): 185-189.
2- Foster TD, Hamilton MC. Occlusion in primary dentitions. Br Dent J 1960; 126:76-9.
3- Moyers RE. Ortodontia. 4th ed. Cuanabara Koogan: Rio de Janeiro; 1991:107-8
4- Hennemann K, Holtgrave EA. The effects of premature deciduous molar loss on the succeeding premolars. Fortschr-kieferorthop 1989; 50(1): 35-42.
5- Ceranic I. Position - holders in the prevention of consequences of premature loss of primary teeth. Acta Stomatol Croat .1990; 24(3): 209-15

6- Seward FS. Natural closure of deciduous molar extraction spaces. Angle Orthod 1965; 35:85-94.
7- Love WD, Adams RL. Tooth movement into edentulous areas. J Prosthet Dent 1971; 25:271-8.
8- Miyamoto W, Chung CS, Yee PK. Effect of premature loss of deciduous canines and molars on malocclusion of the permanent dentition J Dent Res. 1976 Jul-Aug;55(4):584-90.
9- Lin YT, Lin WH, Lin YTJ. Immediate and six-month space changes after premature loss of a deciduous maxillary first molar. J Am Dent Assoc.2007; 22:117-20
10- Aldulayme DA. maxillary dental arch dimensions in a sample of Iraqi children at the mixed dentition stage MDJ.2009; 6(4); 349-355.
11- Aldulayme DA. ,ALkhannaq MR. mandibular dental arch dimensions in a sample of Iraqi children at the mixed dentition stage. J Bagh College Dentistry.2010 22(2).104-107.
12- Woodward JD, Morris JC, Khan Z., J Prosthet Dent. 1985; 53(3):347-50.
13- Aluko IA. ,Dacosta OO. ,Isiekwe MC.Dental arch widths in the early and late permanent dentitions of a Nigerian population nig.dent.J.2009; 17(1).
14- John YK Ling and Ricky WK. Wong .Dental arch widths of southern Chinese. The angle.orthod .J. 2009; 97:54-63.
15- AL-Taee ZH .A comparison of arch width in adults with normal class I occlusion and adults with class II malocclusion in Ramadi city Anb.med.J .2012; 10:75-80.
16- Rao AK and Sarkar S .Changes in the arch length premature loss of deciduous molars .J Indian soc. Pedod prev. dent. 1999; 17(1): 28.32.
17- Al-Azzawi RAW .Assessment of dental arch crowding by the use of two methods in Iraqi youngster sample.2005. M.Sc. thesis submitted to the college of dentistry, university of Baghdad.
18- Durward CS. Space maintenance in the primary and mixed dentition Ann R Australas Coll Dent Surg. 2000; Oct; 15:203-5
19- Kumari PB and Kumari RN. Loss of space and changes in the dental arch after premature loss of the lower primary molar: A longitudinal study**.** J of Indian Society of Pedodontics and Preventive Dentistry.2006; 24(2):90-96.
20- TatjanaT, Zorica B, Julia R .the effects of early loss of lateral teeth .medicine & biology J.2008; 15(2): 68-73.
21- Davey KW .effects of premature loss of primary molars on the anteroposterior position of maxillary first permanent molars and other maxillary teeth.dentj.child.1967; september: 383-394.
22- Owen DG. The incidence and nature of space closure following the premature extraction of deciduous teeth .a literature survey .Am J ortho. 1971; 59(1):37-49.
23- Northway WM, Wainright RL, Demirjian A .Effect of premature Loss of deciduous molars. Angle Orthod.J .1984; 54(4):295-329.
24- Lin YT, Chang LC .Spaces after premature loss of the mandibular primary first molar: A longitudinal study. J Clin Pediat Dent. 1998; 22:311-316.
25- Helm S. Prevalence of malocclusion in relation to the development of the dentition. Acta Odont Scand .1970; 28:1.
26- Cuoghi OA, Bertoz FA, de Mendonca MR, Santos EC. Loss of space and dental arch length after the loss of the lower first primary molar: A longitudinal study. J Clin Pediatric Dent 1998; 22:117-20
27- Johnsen DC. Space observation following loss of the mandibular first primary molars in mixed dentition. J Dent Child 1980; 47:247.
28- Tunison W, Flores F, ElBadrawy H, Nassar U, and El-Bialy T. Dental Arch Space Changes Following Premature Loss of Primary First Molars: A Systematic Review.2008. PED.DENT .J; 30(4) JUL-AUG: 297-302.
29- Hoffding J, Kisling E .Premature loss of deciduous teeth, part I: its overall effect on occlusion and space in the permanent dentition. ASDC J Dent Child. 1978; 45(4): 279-283.
30- Luffingham JK. Pressure exerted on teeth by the lips and cheeks. Dent Pract Dent Rec 1968; 19:61-4.
31- Thuer U, Ingervall B. Pressure from lips on teeth and malocclusion.Am J orthod dentofacial orthop .1986; 90 234-42.
32- Macena MC, Katz CR, Heimer MV, Silva JF, Costa LB. Space changes after premature loss of deciduous molars among Brazilian children. Am J Orthod Dentofacial Orthop. 2011; 140 (6):771-8.

Table (1) maxillary dental arch length for the control and loss groups sample.

EXTRACTED TOOTH	A	CONT.	P VALUE	B	CONT.	P VALUE	C	CONT.	P VALUE	D	CONT.	P VALUE
FIRST DECIDUOUS MOLAR LOSS	10.23	9.14	0.0009**	X			28.46	28.07	0.46*	38.86	38.11	0.26*
SECOND DECIDUOUS MOLAR LOSS	10.29	9.14	0.0013**	20.59	19.32	0.063*	X			37.8	38.11	0.60*

.* Not significant ** significant *** highly significant

Table (2) mandibular dental arch length for the control and loss groups sample.

EXTRACTED TOOTH	A	CONT.	P VALUE	B	CONT.	P VALUE	C	CONT.	P VALUE	D	CONT.	P VALUE.
FIRST DECIDUOUS MOLAR LOSS	5.01	4.81	0.244*	X			22.92	24.56	0.000***	33.3	34.82	0.000***
SECOND DECIDUOUS MOLAR LOSS	3.8	4.81	0.000***	14.53	15.19	0.305*	X			30.62	34.82	0.000***

.* Not significant ** significant *** highly significant

Table (3) maxillary dental arch width for the control and loss groups sample.

ISSING OOTH	IC	CONT.	P VALUE	MB	CONT.	P VALUE	ML	CONT.	P VALUE	DB	CONT.	P VALUE	DL	CONT.	P VALU
IRST ECIDUOUS OLAR OSS	33.67	33.98	0.57*	51.33	50.79	0.50*	40.72	40.67	0.95*	53.44	52.60	0.33*	42.99	42.00	0.30*
ECOND ECIDUOUS OLAR OSS	33.05	33.98	0.14*	48.41	50.79	0.0031**	37.77	40.67	0.000***	49.49	52.60	0.072*	40.27	42.00	0.042*

.* Not significant ** significant *** highly significant

Table (4) mandibular dental arch width for the control and loss groups sample .

MISSING TOOTH	IC	CONT.	P VALUE	MB	CONT.	P VALUE	ML	CONT.	P VALUE	DB	CONT.	P VALUE	DL	CONT.	P VALUE.
FIRST DECIDUOUS MOLAR LOSS	26.63	27.17	0.276*	42.78	44.48	0.002**	33.88	34.63	0.147*	45.51	46.82	0.021**	35.00	36.45	0.008*
SECOND DECIDUOUS MOLAR LOSS	26.72	27.17	0.418*	43.60	44.48	0.227**	33.75	34.63	0.210*	45.98	46.82	0.206*	36.39	36.45	0.920*

(* Not significant ** significant *** highly significant)

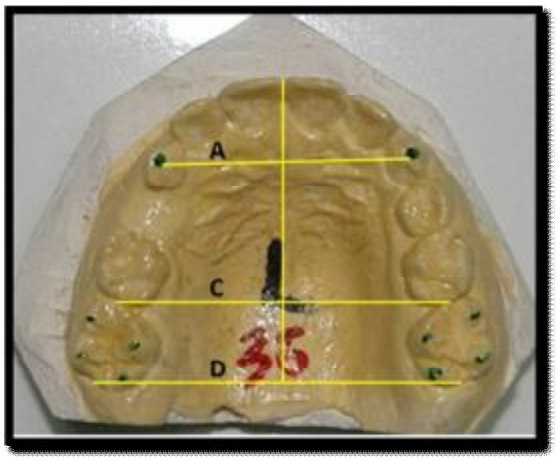

Fig. (1) a – vertical measurement on the study cast for the first deciduous molar loss

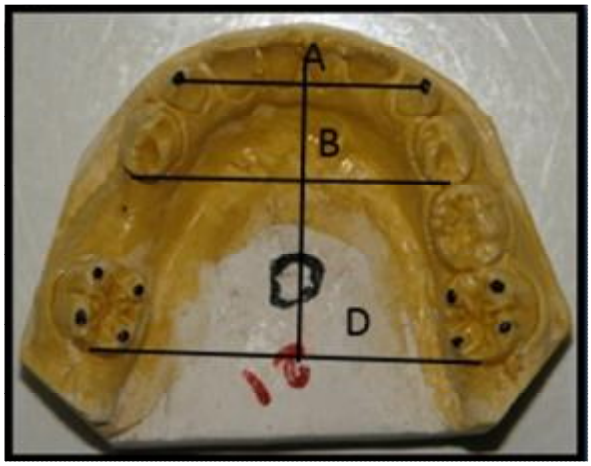

Fig. (1) b – vertical measurement on the study cast for the second deciduous molar loss

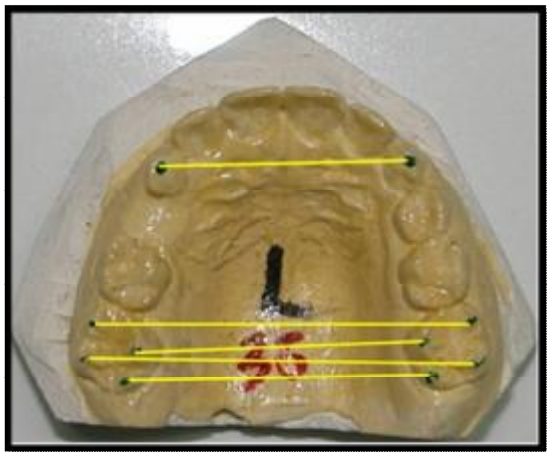

Fig. (2) a – horizontal measurement on the study cast for the first deciduous molar loss

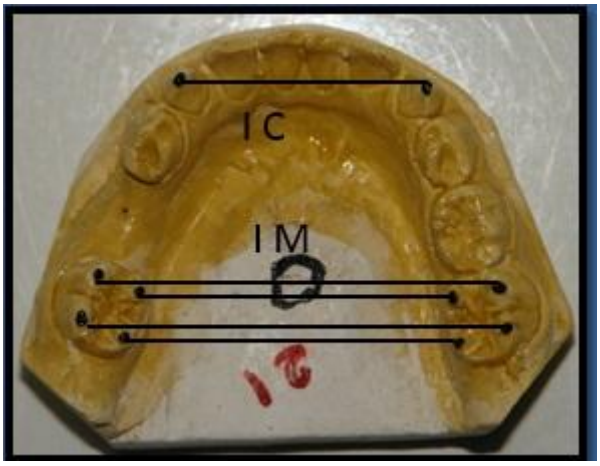

Fig. (2) b – horizontal measurement on the study cast for the second deciduous molar loss

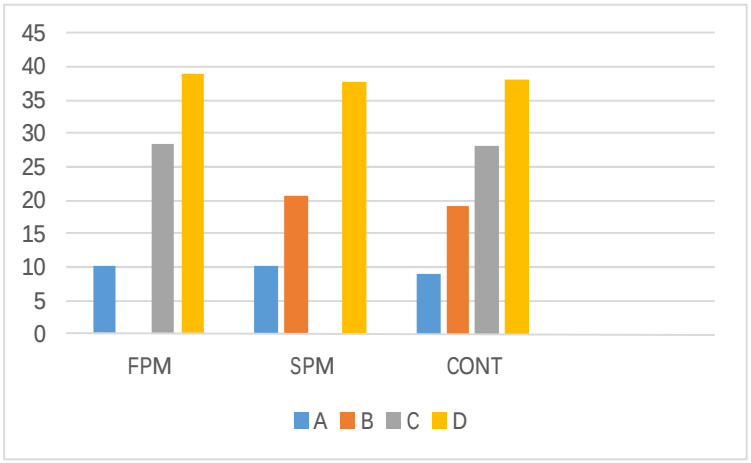

Figure (3) bar chart of maxillary vertical dimensions for the control and loss sample(FPM: first primary molar, SPM: second primary molar, CONT. :control).

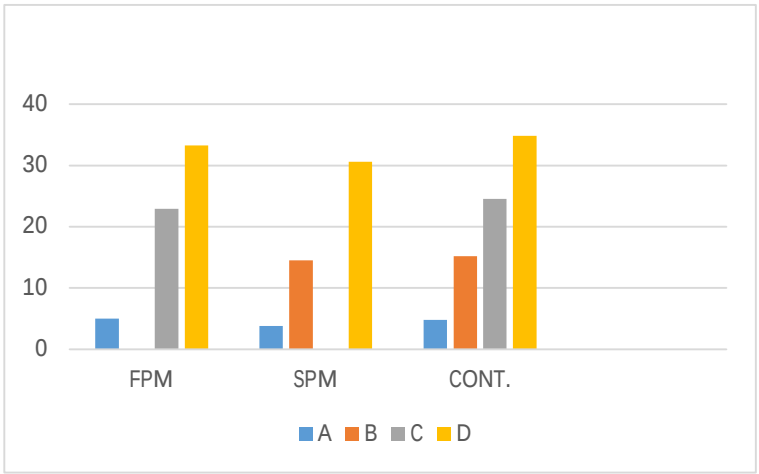

Figure (4) bar chart of mandibular vertical dimensions for the control and loss sample(FPM: first primary molar, SPM: second primary molar, CONT. :control).

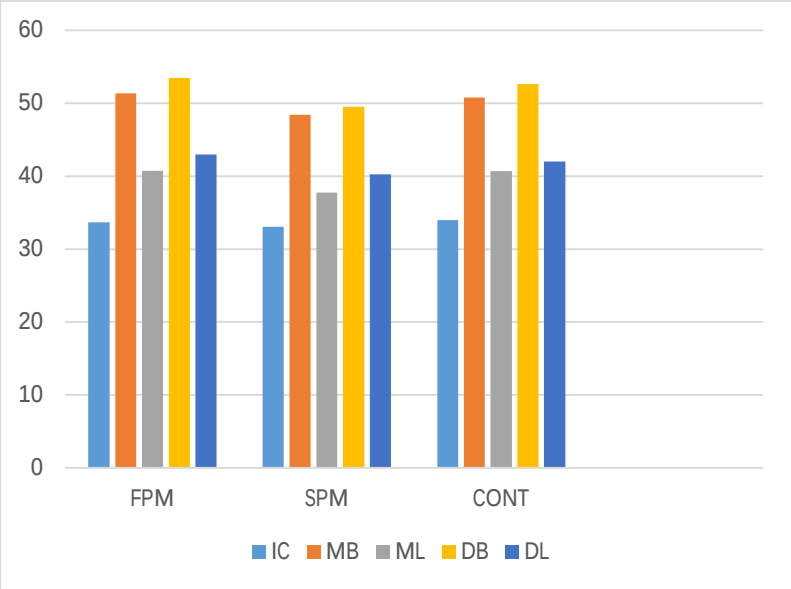

Figure (5) bar chart of maxillary horizontal dimensions for the control and loss sample(FPM: first primary molar, SPM: second primary molar, CONT. :control

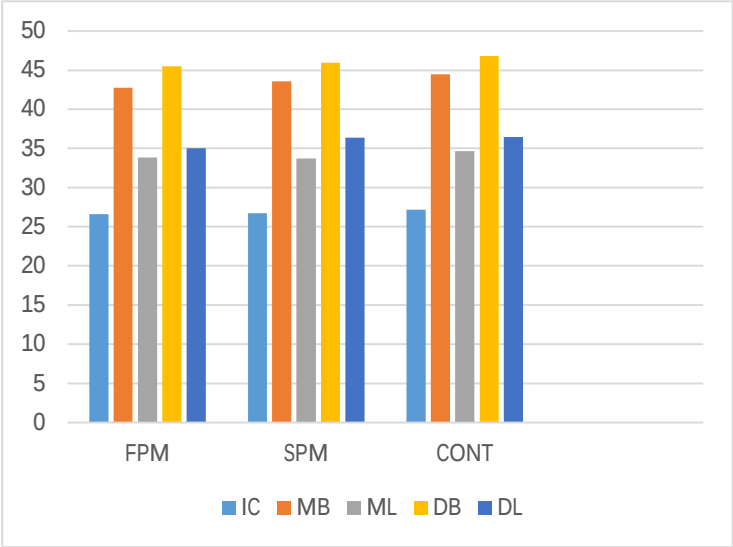

Figure (6) bar chart of mandibular horizontal dimensions for the control and loss sample(FPM: first primary molar, SPM: second primary molar, CONT. :control