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Research Article

ASSESSMENT OF PRETREATMENT AND POST TREATMENT ARCH-WIDTH CHANGES IN EXTRACTION AND NON EXTRACTION CASES IN A CHINESE PATIENT POPULATION

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ABSTRACT

The debate and controversy of extraction and nonextraction has nearly been 100 years old. Some researchers claim extraction to constrict arch and subsequently create unaesthetic black triangles at the corner of the mouth, however recent studies show that instead extraction treatment causes increase of archwidth in canine reason due to distal movement of canine in extraction space.

The aim of the study is to assess the archwidth change in extraction and non extraction treatments separately, with the objective to compare thus obtained change of pre-treatment and post-treatment archwidth between extraction and nonextraction treatment.

The study consisted of two groups; the extraction group with sample size of 24 patients, patients whose first premolar were extracted as treatment plan, male-14, female-10, other group was nonextraction group in which teeth was not extracted with sample size 14 patients, male-6, female-8. The archwidth measured at canine, second premolar and first molar. Pretreatment and post treatment values for each group compared using paired t-test, and difference between pre and post treatment values for each group compared using independent t-test. The SPSS 18.0 software used for the statistical purpose and 0.05 significance level for all calculations.

Statistically significant increase in archwidth in lower canine region, and decrease in archwidth in upper as well as lower second premolar and molar region was noted in extraction cases ($\alpha \leq 0.05$). Whereas increase in archwidth in upper canine region of extraction cases and all variables of nonextraction cases were noted though not significant.

Keywords: Extraction, Nonextraction, Archwidth, Archform, Esthetics, Orthodontics.

INTRODUCTION

The debate over extraction and nonextraction in orthodontic treatment has been more than 100 years old. Soon after the practitioners recognized that orthodontic treatment can influence the patient's profile and esthetics the extraction of teeth in orthodontics has been a matter of debate[1].

The major area of debate is regarding the placement of teeth within the jaw and establishment of arch width and that extraction treatment constricts the arch width subsequently compromising the fullness of smile. Some researchers believe that extraction treatment constricts arch width while others believe that extraction treatment does not constrict arch form. Dierkes, spahl and witzig state that extraction treatments constrict arch form[2]where as Gianelly[3-4] through his series of researches believe that extraction treatment does not constrict arch form. Presumably, extraction treatment results in narrower dental arches which, in turn are associated with a less esthetic smile because the dentition is less full during a smile. In addition this arch width reduction creates unaesthetic black triangles at the corner of the mouth and 'negative' spaces lateral to buccal segment[5-6].

The maintenance of pre treatment value for intercanine and intermolar distance was suggested as the key to post treatment stability because these values were believed to represent a position of muscular balance for the patient[7]. It is believed that any change in arch width will cause structural imbalance and cause instability of dentition in new position, because inter canine and inter molar width tends to return towards their original dimensions, so there will be difficulty in retaining the teeth in their new position.

Recent studies of extraction Vs nonextraction are mainly focused on effects on profile change. Choice of treatment should not depend only on the profile but may be also on some other skeletal and dental parameters[8]. Besides profile, crowding or spacing, feasibility for expansion and growth

pattern are examples of few other parameters that may dictate the choice of extraction for orthodontic treatment. The extraction/non-extraction decision on the basis of good diagnostic criteria does not have a detrimental effect on the facial profile[1]. Therefore this study was planned to assess the arch width change in extraction and non extraction treatments separately, with the objective to compare thus obtained change of pre-treatment and post-treatment arch width between extraction and non extraction treatment.

MATERIALS AND METHODS

The sample Size and Composition

The experimental group consisted of 38 patients of which 24 were extraction cases and 14 were nonextraction cases, reporting to the department of Orthodontics, Stomatological Hospital of Zhengzhou University, Zhengzhou, China.

The age range of the sample was 13-24 years, with a mean age of 16 years. The sample consisted of 20 males and 18 females.

Inclusion criteria of samples into experimental group were as followings:

1. Patients with recently completed Orthodontic treatment.
2. All permanent sets of teeth, from first molar to first molar, present pre-treatment.
3. Patients with good and measurable dental record casts.

Exclusion criteria of samples into experimental group were as followings:

1. Patients with any congenital anomalies or systemic conditions.
2. Patients in mixed dentition period.

The collected study casts were measured with digital caliper with minimum measurement of 0.05 mm. The distance between the mesiobuccal cusp tip of the first molars, buccal cusp tip of second premolars and cusp tip of the canines were measured to determine the intermolar, interpremolar and intercanine archwidth respectively.

Measurement Error:

All the measurements were done two times at the same sitting, and if the two values were same, then it was recorded as final. If the two values were not same, then again another measurement was done and two coinciding values or near values noted and averaged as final. Then all the values were rounded to nearest 0.5 mm. The minimum amount of measurement error was determined by Dahlberg method. The ten study casts were randomly selected and measured again at two different intervals. Then the two measurements were tested statistically.

The Statistical Analysis

The SPSS 18.0 software was used for statistical purpose. Data collected into an Excel spreadsheet (Microsoft Corporation) was transferred to SPSS statistical package.

The pretreatment archwidth values of each experimental group were compared with the corresponding post treatment arch width value and paired t-test was employed to assess the significance of change in archwidth. Similarly, the change in archwidth values after treatment of both the groups (extraction and nonextraction)were compared with each other and independent t-test was employed to assess the significance.

All Conventional descriptive statistics; these (and their abbreviations) are sample size (n, taken as counts of individuals, the standard deviation (Sd), and the standard error of the mean (Sem, calculated as sd/√n), were calculated. The conventional alpha level of 0.05 was used, and all of the tests were two-tailed.

RESULTS

Frequency and Distribution

The results of the research are presented in different graphs and tables as listed below.

The total number of cases were 38,out of which 20 (52.6%) were male and 18 (47.4%) were female (Table1,Fig.1).

Table1: Frequency table of sex distribution

Sex	No.	Per.
Male	20	52.6%
Female	18	47.4%
Total	38	100%

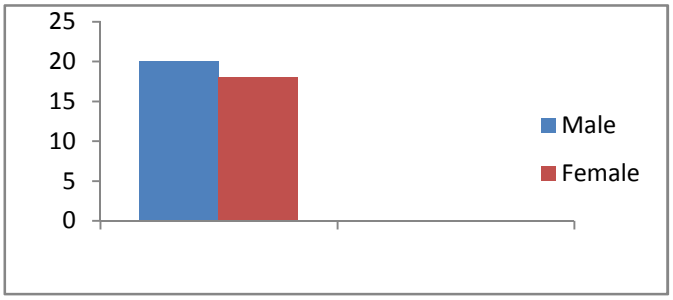

Figure 1: Bar diagram showing distribution of Male and Female

Among all 38 cases, 24 were extraction cases and other 14 were nonextraction cases (Fig 2). 14(58.3%) of the extraction cases were male and 10(41.7%) were female.

Similarly 6(42.8%) of nonextraction case were male and 8 (57.2%) were female (Table. 2,Fig. 2). There were more male patients than female patients in extraction group and more female patients than male patients in nonextraction group (Fig. 3).

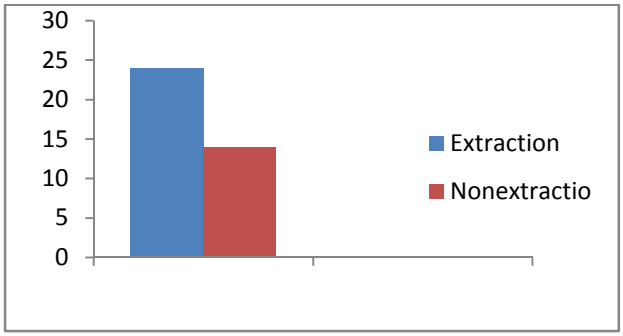

Figure 2: Bar diagram showing extraction and nonextraction cases

Table 2: Frequency table of Extraction and Nonextraction

Sex	Extraction		Nonextraction	
Male	14	58.3%	6	42.8%
Female	10	41.7%	8	57.2%
Total	24	100%	14	100%

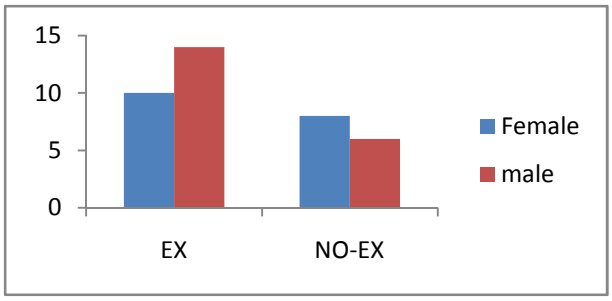

Figure 3: Bar diagram showing distribution of Male and Female

Among the total 38 patients,24 had Angle's class I,11 had Angle's class II and 3 had Angle's class III molar relationship. In class I patients, 14 were extraction cases and 10 were nonextraction cases. Similarly, in class II patients, 7 were extrzction cases and 4 were non- extraction cases. But in class III all 3 patients were extraction cases and there was no nonextraction case (Table. 3,Fig. 4).

Table 3: Frequency table showing distribution of Angle's Molar relation

Sl. No	Extraction	Nonextraction
class I	14	10
class II	7	4
class III	3	0

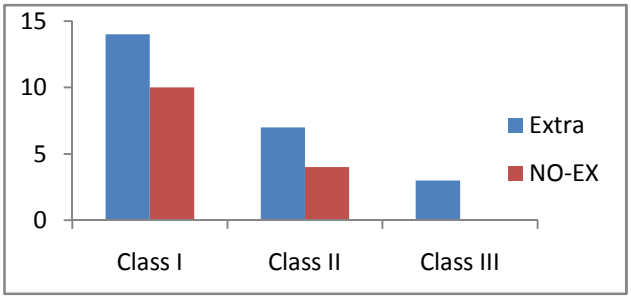

Figure 4: Bar diagram showing frequency of Angle's Molar relation

Arch width change in Upper

In extraction cases on upper arch, expansion was observed in canine and narrowing in second premolar and first molar (n=24). There was a mean expansion of 0.833 mm in extraction cases at canine on upper arch, but it was not significant. But there was significant narrowing of arch in second premolar and first molar by 1.81 ($p \leq 0.005$) and 3.1 ($p \leq 0.00$) mm respectively (Table.4).

Table 4: Paired t-test for archwidth change before and after treatment for extraction cases, Upper (n=24)

Sl. No	Mean	Std. Deviation	Std. Error Mean	t	p
U3	-.8333	2.5481	.5201	-1.602	.123
U5	1.8125	2.8961	.5912	3.066	.005
U6	3.1042	1.9890	.4060	7.646	.000

Some amount of expansion was observed in canine, second premolar and first molar region in nonextraction cases (n=14).The mean expansion was 0.32mm in canine, 0.6 mm in second premolar and 0.71 mm in first molar, but none of them were significant (Table5).

Table 5: Paired t-test for archwidth change before and after treatment for nonextraction cases, Lower (n=14)

Sl. No	Mean	Std. Deviation	Std. Error Mean	t	p
U3	-.3214	2.1358	.5708	-.563	.583
U5	-.6071	2.1678	.5794	-1.048	.314
U6	-.7143	2.2076	.5900	-1.211	.248

Arch width change in Lower

Similarly in lower arch, significant expansion of arch width was observed in canine and narrowing of archwidth in second premolar and first molar in extraction cases(n=24). The mean expansion of archwidth in canine was 1.08 mm ($p \leq 0.05$). The mean reduction in archwidth in first premolar and first molar was 1.52mm ($p \leq 0.05$) and 1.06 mm ($p \leq 0.05$) respectively(Table 6).

Table 6: Paired t-test for archwidth change before and after treatment for extraction cases, Lower (n=24)

Sl. No	Mean	Std. Deviation	Std. Error Mean	t	p
L3	-1.0833	1.5511	.3166	-3.422	.002
L5	1.5208	2.6436	.5396	2.818	.010
L6	1.0625	2.1484	.4385	2.423	.024

In case of nonextraction, in lower arch expansion was observed in canine, second premolar and first molar region (n=14) but none of them were significant. The mean expansion noted were 0.35 mm, 0.25 mm and 0.07 mm in canine, second premolar and first molar respectively (Table 7).

Table 7: Paired t-test for arch width change before and after treatment for nonextraction cases, Lower (n=14)

Sl. No	Mean	Std. Deviation	Std. Error Mean	t	Sig.
L3	-.0357	1.4995	.4008	-.089	.930
L5	-.2500	1.6496	.4409	-.567	.580
L6	-.0714	1.0716	.2864	-.249	.807

Arch length change

There was a mean reduction of archlength by 5.18 mm in upper and 4.39 mm in lower arch in extraction cases (n=24) and were highly significant (Table 8).

Table 8: Paired t-test for archlength change before and after treatment in extraction cases for extraction cases, Upper and Lower (n=24)

Sl. No	Mean	Std. Deviation	Std. Error Mean	t	Sig.
UAL	5.1875	2.2593	.4612	11.248	.000
LAL	4.3958	2.1365	.4361	10.079	.000

Increase in archlength was observed in nonextraction cases (n=14) on both upper and lower arch by 0.46 mm and 0.64 mm respectively, but was not significant (Table9).

Table 9: Paired t-test for archlength change before & after treatment for nonextraction cases, upper and lower (n=14)

Sl. No	Mean	Std. Deviation	Std. Error Mean	t	Sig.
UAL	-.4643	3.1284	.8361	-.555	.588
LAL	-.6429	1.7478	.4671	-1.376	.192

Comaprision between extraction and nonextraction

The result of comparision of archwidth change in extraction and non extraction using independent t-test in this study shows that there is mean expasion of 0.5 mm more in canine of extraction cases than non extraction cases, but it is not significant. In second premolar and first molar there is mean narrowing of archwidth by 2.4 mm and 3.81 mm ($p \leq 0.05$)respectively,more in extraction cases than in nonextraction cases (Table. 10).

Table 10: Independent t-test for archwidth change between extraction and nonextraction cases in Upper arch

Sl. No	Mean difference	Std. Error Difference	t	Sig.
U3	.5119	.8096	.632	.531
U5	-2.4196	.8933	-2.709	.010
U6	-3.8185	.6963	-5.484	.000

Similarly, in lower arch significant expansion of arch by 1.04 mm ($p<0.05$) more in canine was observed in extraction cases compared to non extraction cases. In second premolar and first molar significant narrowing of arch by 1.77 mm and 1.13 mm more respectively ($p<0.05$) was observed in extraction cases compared to nonextraction
cases (Table 11).

Table 11: Independent t-test for archwidth change between extraction & nonextraction cases in Lower arch.

Sl. No	Mean difference	Std. Error Difference	t	Sig.
L3	1.0476	.5154	2.033	.050
L5	-1.7708	.7849	-2.256	.030
L6	-1.1339	.5238	-2.165	.037

Archlength reduction on upper arch was 5.65 mm and 5.03 mm ($p \leq 0.05$) on lower arch, significantly more in extraction cases compared to non extraction cases(Table 12).

Table 12: Independent t-test for archlength change between extraction and nonextraction cases.

Sl. No	Mean difference	Std. Error Difference	t	Sig.
UAL	-5.6518	.8767	-6.447	.000
LAL	-5.0387	.6742	-7.473	.000

DISCUSSION

The objective of this study is to investigate and quantify change of archwidth and archlength by extraction and nonextraction treatment. Mean age for this study sample was 16 years, thus the effect of growth and development was not of concern[9]. However many other factors like crowding or spacing, overjet and overbite, presence of ectopic and/or supernumerary teeth, variable shape of arch may play a major role in treatment outcome. Similarly, type of treatment and materials used during treatment also influence the treatment outcomes[10-23]. Long term stability and relapse are also not covered in this research.

Our study showed that there is increase of upper intercanine archwidth in extraction cases by 0.83 mm but it was not significant is also in accordance with Kim and Gianelly [4] who reported 0.55 mm increase which was non significant too.

This study showed that, during extraction treatment there is significant expansion of lower intercanine archwidth. This 1.08 mm increase is in agreement with previous findings by Fulya Isik et al[2] (0.6 mm) and Gianelly[3] (1.39 mm).

Interpremolar and intermolar archwidth was observed to significantly decrease in upper as well as lower in extraction cases. The decrease in interpremolar archwidth in upper was 1.81 mm in accordance with Kim and Gianelly [4] who reported significant 0.76 mm decrease, but against 0.03 mm increase reported by Fulya Isik et al[2]. This decrease was 1.52 mm in lower premolar region is in agreement to 0.95mm reported by Kim and Gianelly[4], 1.24 mm by Gardner and Chaconnas [12] and 2.62 mm by Fulya Isik et al[2].

Upper intermolar archwidth decrease was significant and recorded 3.1 mm, which was in agreement with 0.8 mm and 0.53 mm reported by Fulya Isik et al[2] and Kim and Gianelly [4] respectively. Similarly, lower intermolar archwidth decrease was 1.062 mm and was significant. This decrease was parallel to 0.94 mm decrease reported by Kim and Gianelly [4] and 1.42 mm decrease reported by Fulya Isik et al[2].

Increase in archwidth was observed for all parameters in nonextraction cases but were not significant. In upper canine region 0.32mm increase was noted, similarly in lower canine region 0.3 mm increase was noted.

In upper second premolar and first molar region archwidth increase was 0.6 mm and 0.7 mm respectively. Similarly in lower second premolar and first molar region 0.25 mm and 0.75 mm respective increase in archwidth was noted.

An attempt was made to compare the archwidth change in extraction and nonextraction cases by using independent sample t-test. Both upper and lower canine region showed more increase and both upper and lower, second premolar and first molar region showed more decrease in archwidth in extraction cases compared to non extraction cases. All the values were significant except upper canine.

It was observed that there would be 0.5 mm of more increase of intercanine archwidth on upper arch in extraction cases than in non extraction cases. But the result was not significant. Similarly, 1.04 mm of more expansion was observed in extraction cases than in nonextraction cases in lower canine region which was significant.

In upper second premolar region 2.41 mm and first molar region 3.81 mm of more decrease in archwidth was observed in extraction cases compared to nonextraction cases. Similarly, in lower second premolar region 1.77 mm and first molar region 1.13 mm of more decrease in archwidth was observed for extraction cases.

Archlength change has been given less priority by researchers. However it has a significant role in volume of oral cavity and for tongue. Though it is obvious that there will be reduction of archlength in extraction cases, we try to quantify the amount of reduction[21-23].

A decrease of archlength by 5.18 mm in upper arch and 4.39 mm in lower arch was observed in extraction cases. For nonextraction cases archlength increase by 0.46 mm and 0.64 mm in upper and lower arch respectively. The difference of change in archwidth between extraction and non extraction cases in upper and lower arch was 5.65 mm for upper and 5.03 mm for lower arch. All the values were significant.

CONCLUSION

1. Intercanine archwidth is increased in both extraction and nonextraction treatment. Thus the belief that extraction treatment causes appearance of unaesthetic black triangles at the corner of mouth needs to be reconsidered and revised.
2. Intercanine archwidth increases extraction treatment due to distalization of canine into extraction space.
3. There is decrease of archwidth in posterior teeth due to mesial movement of posterior teeth and consolidation of extraction space.
4. There is obvious decrease of archlength in extraction cases and increase in nonextraction cases.

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