CLINICAL CROWN SIZE RELATIONSHIP AND THE NEED FOR ESTHETIC CROWN LENGTHENING IN PRE- AND POST-ORTHODONTIC PATIENTS: A PILOT STUDY.

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ABSTRACT:

Introduction: Excessive gingival display has been a problem in orthodontic patients after completion of treatment. Prevalence information regarding this subject is limited. This pilot study aims to evaluate the size relationships of the clinical crowns of the teeth in pre- and post-orthodontic patients to aid in identification of patients in need of esthetic periodontal surgery. **Methods:** Fifty plaster models were evaluated pre and post orthodontically for the crown size of maxillary anterior teeth in both length and width to compare with the ideals. Widths to length (W/L) ratios were also calculated for the maxillary incisors for the need of esthetic gingival re-contouring procedures. **Results:** Study revealed significant increase in the length in post orthodontic models compared to pre-orthodontic lengths, but mean length still lagged behind the ideal values. Mean W/L ratio for the central incisors was 92% while 84% of central incisors had W/L ratio >80% **Conclusion:** A close collaboration between the orthodontist and the periodontist is important to identify patients in need of periodontal re-contouring as the prevalence of non ideal W/L ratio was >80% in the maxillary central incisors. This study also calls for further research with a larger sample and longer term crown size evaluation.

Keywords: Smile esthetics, Crown lengthening, Orthodontics, Tooth crown

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INTRODUCTION:

"Beautiful smile is an added asset to a beautiful face".[1] Esthetic smile has various parameters that are displayed by teeth, lip frame work, gingival scaffold and many others.[2,3] An orthodontist's primary goal is not only attainment of ideal dental, but also facial esthetics. Obtaining perfect smile is more difficult than just aligning teeth. Impact of both the dental and gingival complex on the esthetic qualities of smile is remarkable. With regard to the dental component, each of the six maxillary anterior teeth is important for the esthetic smile.[4] Centrals are interpreted to provide stability, laterals provide charm and canines are meant for strength.

As for the gingival complex, both dentists and parents are developing greater appreciation for importance of gingival health on beauty of smile.

Gummy smile poses a restorative challenge for the orthodontist to achieve an acceptable esthetic smile. Gingival excess is a common problem in orthodontic patients. Gingival excess has been defined as abnormal location of the gingival margin due to psuedo-pocketing, inconsistent gingival margins, excessive gingival display due to vertical maxillary excess or inflammatory enlargement[4].Excessive gingival display has been a subject of not only orthodontics but also of periodontics. Many studies have been performed in the past years as to determine the cause and management of the patients seeking esthetic results.

The prevalence data for the crown size dimensions is limited, more so when its relationship with an esthetic smile is considered. A recent study[4] evaluated the need for esthetic gingival re-contouring[5,6] in a post orthodontic Caucasian population, and found more than half of the cases required the crown lengthening procedure. This significant proportion of post orthodontic patients

call for similar evaluations and prevalence information in different populations. Prevalence data provide information on how often the clinicians should be looking for a given condition. It has been suggested that if practitioners observe a prevalence more or less than the established prevalence data indicates, the clinical evaluation methods should be revised for improved diagnostic capability.[7]

The objective of this pilot study was to determine the pre- and post-orthodontic clinical crown lengths of the maxillary anterior teeth for comparison with the known ideals and also to determine the prevalence of the need of esthetic crown lengthening in post-orthodontic patients treated at Islamic international dental hospital, Islamabad.

MATERIALS AND METHODS:

Fifty completed orthodontic cases were randomly selected from the records of the patients presenting to Islamic International Dental Hospital and the post-orthodontic study models were obtained. As per departmental protocol informed written consent was taken at the time of procuring records. Inclusion criteria comprised of patients with at least maxillary anterior six teeth bonded with fixed orthodontic appliances. Malformed, traumatized and restored teeth were excluded.

This pilot study was designed to evaluate the clinical crown size i.e. in both length and width. Teeth included for measurement were maxillary right and left central incisors, lateral incisors and canines. All measurements were made on the plaster models with the help of a Vernier caliper. Crown length was taken from the zenith of gingival scallop to the incisal edge. Crown width was taken horizontally i.e. distance between the inter-proximal contacts (Fig 1). Data obtained for the teeth were compared with ideal values which were set as 11 to 13 mm for centrals, 10mm for laterals and 11 to 13mm for canines as suggested by McGuire.[8] Width-to-length ratio for incisors was also calculated as it is more consistently accepted as a standard for tooth size. A maximum of 80% of clinical crown width to length ratio was considered as acceptable. Central incisors with ratios exceeding this value were the only teeth included in the group requiring esthetic crown lengthening procedure in this study. Age and gender were also considered, which are potentially significant cofactors in excessive gingival display[9].

Figure 1: Crown Width and Length Measurements

All statistical calculations were performed with SPSS version 10 (Chicago, Ill). Statistical analysis was used to determine the percentage of subjects lying outside of the accepted normal values for tooth sizes and ratios. Tooth-to-tooth values and gender differences were tested for significance by paired t test, as were pre-orthodontic and post-orthodontic measurements. A *p* value of <0.05 was considered as significant.

RESULTS:

Fifty completed orthodontic cases with pre and post orthodontic plaster models were evaluated. Age distribution is given in Table 1 while gender distribution is in Figure 2. Gender differences were not significant for clinical crown size in both pre and post orthodontic population ($p > 0.05$). Mean pre and post orthodontic clinical crown lengths are given in Table 2. Lateral incisors and canines were significantly longer following orthodontic therapy compared to pre-treatment values ($p < 0.001$). Central incisors did not have a significant increase in crown length following orthodontic therapy ($p > 0.05$). Mean width-to-length ratios for incisors are presented in Figure 3. Table 3 summarizes the percentage of teeth exceeding the crown W/L ratio. In total, 32% of subjects were found to have at least one central incisor with a width-to-length ratio $\geq 100\%$.

Table I: Age Distribution

AGE RANGE (years)	SUBJECTS (N)
12-14	17
14-16	20
16-19	13

Figure 2: Gender Distribution

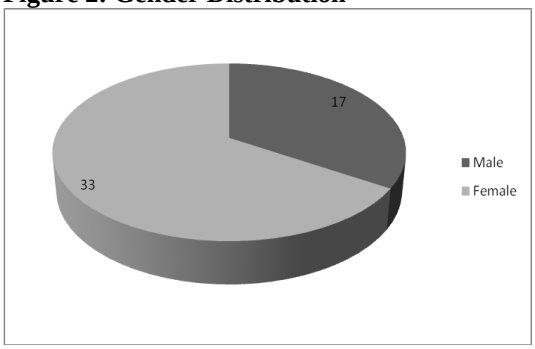

Table 2: Mean Clincal Crown Lengths, Pre- and Post-orthodontic

Tooth No.	Normal Length	Ideal Length	Mean Observed Pre-othodontic Length (mm)	Mean Observed Post-orthodontic Length(mm)
6	10	11 to 13	8.6	9.3
7	9	10 to 12	7.8	8.4
8	9.5	11 to 13	9.3	9.6
9	9.5	11 to 13	9.5	9.6
10	9	10 to 12	7.6	8.5
11	10	11 to 13	8.5	9.1

Figure 3: Changes in Width/Length ratios pre- and post-orthodontics

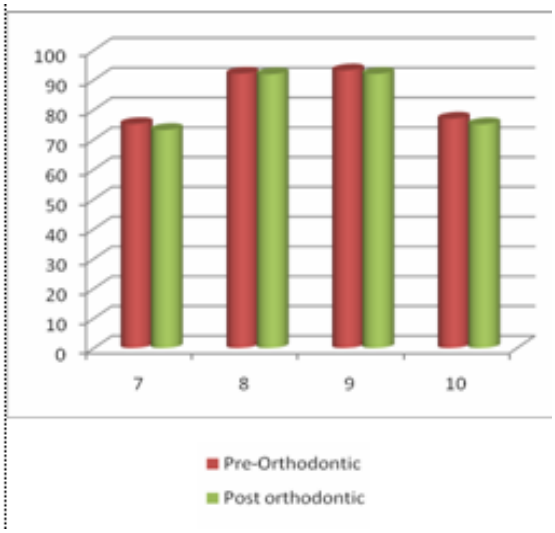

Table 3: Number of teeth exceeding the normal W/L ratio

	Tooth #7	Tooth #8	Tooth #9	Tooth #10
>80%	23	78	88	26
>100%	1	23	25	2

Figure 4: Central incisors with normal W/L ratio

Figure 5: Central incisors with W/L ratio of >80

DISCUSSION:

Recent advances in research have led to certain guidelines that facilitate the orchestration of an esthetic smile. Although factors like facial asymmetry, labial curve, gingival display, positions of midlines and buccal corridor display, all affect the smile of a person, this study focuses on the dental aspects of a smile only i.e. clinical crown size relationship. [4] Using certain ideal reference measurements described by McGuire [8] et al for a Caucasian population, a comparison of clinical crown lengths was made in a Pakistani sample along with an attempt to quantify the proportion of orthodontic patients who may benefit from esthetic crown lengthening.[10]

Results of the data revealed crown length of 83% of patients pre-orthodontically was shorter than the ideal values as presented by Townsend and McGuire.[8,10] Improvement in the length was seen in 85% of cases post-orthodontically but in spite of that only 24% of cases post-orthodontically had values within the ideal values. The maxillary anterior teeth were on average 1.6mm shorter than the ideals with a minimum difference of 1.4mm and a maximum of 1.9mm. Lateral incisors and canines means showed a shortening of 1.5mm and 1.8mm respectively. These results compare favorably with Konikoff et al who found both canines and lateral incisors to be shorter by more than 2mm than the ideals.[4]

However, recent evidence indicates that the W/L ratio of the teeth, as opposed to the ideal millimetric dimensions, is a more reliable and factual marker of an esthetic clinical crown size in a given smile.[11] While the width of the teeth in pre and post orthodontic models remained unchanged, our results showed that the width to length ratios increased remarkably compared to the ideal values. Mean ratios of 91.9% to 92% were found for central incisors, and 83% to 86% of central incisors exceeded the normal 80% tooth width-to-length ratio. Lateral incisors had a mean ratio of 74%, which is acceptable under both normal and ideal definitions. Figures 4 and 5 show the different types of clinical width-to-length ratios studied. Again the result is in concordance with Konikoff and co workers, who found more or less similar values for the respective data.[4]

Varied age range and gender distribution should also be considered in future studies. Given the mean age of the sample, the progressive lengthening of the clinical crowns from pre- to post-orthodontic population can be explained by the phenomenon of passive eruption, which according to Morrow and colleagues continues until the age of 19 years. On the other hand, Volchansky[12] found that the marginal soft tissue position did not change after the age of 12 years in maxillary central incisors and canines. Our study agreed with Volchansky's findings for maxillary central incisors as their clinical crown length in maxillary central incisors remained unchanged from pre-orthodontic to post-orthodontic values.[12] However, the crown length of maxillary lateral incisors and canines did change.

As this study was performed on the plaster models only certain aspects were not addressed properly e.g. gingival inflammation. Further research work should be done on the subject prospectively that can evaluate pre- post orthodontic and retentive phase measurements. Further studies can be performed on the live subjects as plaster models were used in this study.

Future studies could utilize calibrated photographs, which can also aid in the total smile evaluation and that can help in a better assessment of the prevalence and need for intervention.

Despite of the fact that the study was performed on a very small population of orthodontic patients, it still provides us with some important findings. Clearly the need for esthetic crown lengthening exists in the orthodontic population. Gingival recontouring option for the patient for an esthetic smile should always be taken into account.

CONCLUSIONS AND RECOMMENDATIONS

1. A significant proportion of post orthodontic patients (76%) had clinical crown lengths shorter than the ideals.
2. W/L ratios of the incisors were significantly increased above normal in 85% of patients.
3. A definite need exists for esthetic crown lengthening in post orthodontic population and other indications for the similar procedure should be explored in a larger and more exhaustive prospective controlled trial.
4. Orthodontists should stress on the importance of evaluating gingival health and the possibility of crown lengthening should be included in the treatment plan.

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