A normative study to evaluate inclination and angulation of teeth in North Indian population and comparision of expression of torque in preadjusted appliances

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ABSTRACT

Aim: The aim of this study was to evaluate angulation and inclination of teeth from the study models of individuals with normal occlusion and evaluation of actual expression of torque expressed by three different bracket systems.

Materials and Methods: In this study, the inclination and angulation were measured on 30 study models of North Indian individuals. A self-developed instrument (torque angle gauge) was used for the measurement. Fifteen study models were duplicated for the evaluation of torque expression in the bracket of three different manufacturers with different shape and size of bases.

Results: The results give the mean, minimum and maximum, standard deviation of the normative data individually for each tooth. A significant correlation was noted in the angulation of maxillary canine and first premolar, and between premolars; and between mandibular central incisor with lateral incisor and canine, and between premolars.

Conclusions: There was a highly significant correlation of teeth angulation and inclination in the maxillary and mandibular arch. Though the error in expression of torque was not significant, but it showed a large range, indicating the need to vary the position of brackets in different bracket systems for achieving optimum torque.

Key words: Brackets, intraarch correlations, tip, torque

INTRODUCTION

The development of the preadjusted or straight wire appliance (SWA) led to achievement of same or high quality results with less wire bending and more simplified mechanics. Andrews made extensive measurements on untreated excellent malocclusions.[1,2] Average tip and torque angles of each tooth were determined. It was assumed that each point on the facial contour of each type of tooth was identical for all patients. Racial variation[3-5] facial profile,[6] facial type,[5] arch length,[7,8] jaw sizes and contour of the labial tooth surface[9,10] are the factors that vary among individuals with normal occlusion and thus can influence the normal angulation and inclination of teeth. It has been reported that individual variation in tooth morphology was larger than the variation between the different types of preadjusted appliances.[3]

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Hence, one preadjusted appliance prescription cannot fit all orthodontic patients. Among the several reasons that have been reported for current preadjusted orthodontic appliances not achieving ideal tooth positions with the use of straight wires, are:

1. Inaccurate bracket positioning
2. Variation in tooth structure and jaw relationship and
3. Mechanical deficiencies such as play and force diminution.

Moreover, the axial positioning of teeth in faciolingual plane is currently the most controversial factor contributing to the limitations of preadjusted appliances. Furthermore, the bases of different brackets adapt differently on the tooth surface and may be the source of errors in torque expression.

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Aim and Objectives

This study was designed to:

1. Evaluate the angulations and inclinations of teeth in individuals from Northern India having a normal occlusion.
2. To assess the accuracy of torque expression in three different preadjusted appliance systems.
3. Different preadjusted appliance systems when placed accurately on theses study model teeth.

MATERIALS AND METHODS

Sample

The study models of 30 North Indian individuals (male = 15, female = 15), (age 14-30 years) were selected from different academic institutes and health camps conducted in various schools and colleges of Chandigarh.

Sample Selection Criteria

The following inclusion and exclusion criterion were followed, while selecting the subjects for the study.

Inclusion Criterion

Individuals with pleasing profile (orthognathic profile), Angle's Class I molar relationship bilaterally, well-aligned teeth in the maxillary and mandibular arch and having a full complement of the permanent dentition.

Exclusion Criterion

Individuals with history of orthodontic treatment, crossbite and spacing, >2-3 mm crowding, history of trauma or plastic surgery, carious, fractured, hypoplastic or abnormal crown morphology of anterior teeth, lip incompetency and Class 1 bimaxillary protrusion, Class II and Class III malocclusion.

Instrument for Measurement of Normal Angulation, Inclination of Teeth and Torque

Alginate impressions of the subjects were made and poured with stone. A base mounting jig (positioning plates with rails) was used to orient the bases parallel to the occlusal plane [Figure 1].

After fabricating bases on the models, half of the models were duplicated twice by molds prepared with 2 mm bioplast sheets (BioStar) The molds were then poured with orthodontic stone.

An indigenously designed angle measurement device (torque angle gauge) was used for the measurement of angulation and inclination of teeth [Figures 2 and 3]. It consisted of a metal base and vertical holding arms that support the horizontal arms. The vertical position of the horizontal arm can be altered by screws attached for facilitate vertical adjustment in order to avoid interference with the gingival portion on the model. On the horizontal arm of the device, a protractor was fixed and a scale attached on the vertex in such a way that it can swing freely like a pendulum. A midline is drawn in the center of the scale vertically coinciding with a 90° line on the protractor. A straight stainless steel wire was attached to the side of the ruler coming in contact with surface of the model or aligning with L-shaped wire for measurement. The instrument and the study model were placed on an 18 inch square glass slab of 10 mm thickness to prevent any error during measurement. A magnifying lens was used to reduce the measurement error of angulation and inclination. Reference lines were placed on the glass slab to improve repeated repositioning of the measuring device.

Measurement of Normal Angulation and Inclination of Teeth and Torque Expression in the Bracket Slots

For the measurement of teeth inclination and angulation, facial axis of the clinical crown (FACC) and facial axis (FA) point was marked on the clinical crown of each tooth [Figure 4]. FACC was marked as the most prominent portion of the central lobe on each clinical crown's facial surface. The FA point was marked at the midpoint of FACC.

Normal angulation of a tooth was measured by keeping the midline on the scale parallel to the FACC and taking the

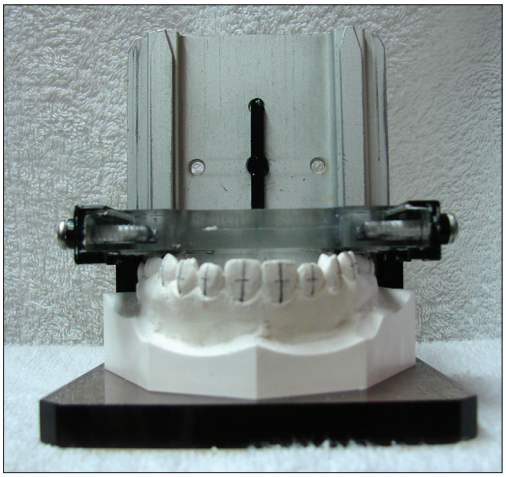

Figure 1: Base mounting zig

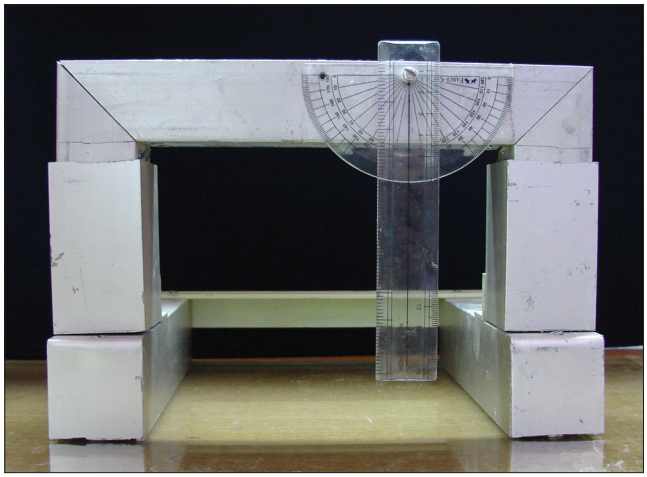

Figure 2: Torque angle gauze

readings on the protractor. Similarly, normal inclination of a tooth was measured by placing the scale tangent to the FACC at FA point [Figure 5]. Measurements were made for all the studied models for incisors, canines, and premolars in the similar manner.

Expression of torque was measured for preadjusted brackets of three different manufacturers on each of the 15 duplicated models [Figure 6]. Roth brackets of three different manufacturers, that is, Nu-edge (TP orthodontics, 0.18″ slot), mini-diagonal (Leone, 0.18″ slot), Gemini (3M Unitek 0.22″ slot) were bonded with a light cure adhesive. The bracket bonding principles were followed as suggested by Roth. A sharp explorer was used for bracket siting on to the tooth surface and care was taken to achieve uniform bracket base adaptation over the tooth.

After bonding the brackets on the tooth surface, a 0.18″ ×0.25″ straight length stainless steel wire was bent at an angle of 90° to make an L-shape with a 30 mm vertical arm. The wire was ligated into the bracket slots with elastomeric modules [Figure 7]. The vertical arm of the L-shaped wire was then aligned with the swinging arm of the instrument. The displacement of the vertical arm from the midline in the bucco (labio)-lingual direction was considered the expression of torque.

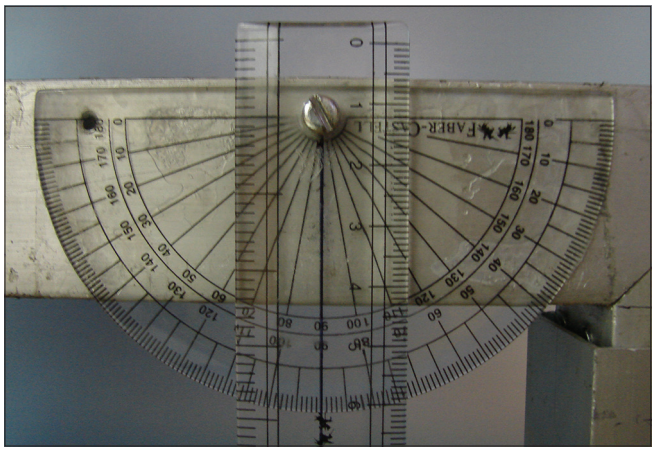

Figure 3: Protracter on torque angle gauze

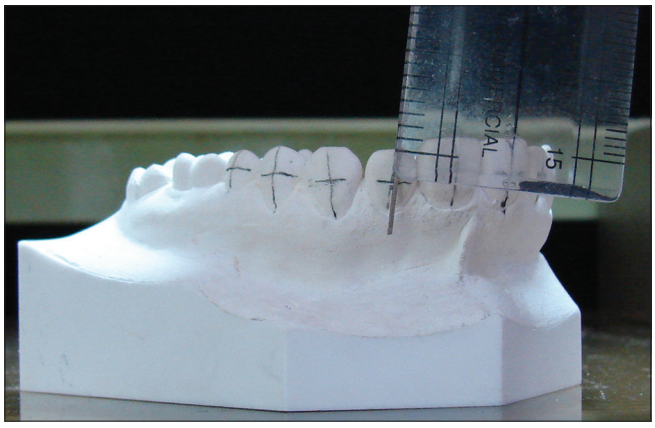

Figure 5: Measurement of angulation and inclination

Pilot Study

The intra-operator error was assessed by repeating the measurements on five pairs of models after an interval of 1 week. The two groups of measurements were subjected to Paired *t*-test. The amount of error was not significant to the $P = 0.05$.

Statistical Analysis

The collected data was statistically analyzed on a computer using SPSS software. The data were subjected to descriptive analysis for mean, standard deviation (SD), range and frequency of all the variables. One-way ANOVA was performed to determine if there was a significant difference in the error of torque expression among the groups. Probability value (*P* value) of 0.05 was considered as statistically significant. The intraarch correlations of teeth angulation and inclination were evaluated by Pearson's correlation coefficient.

RESULTS

The measurements of inclination and angulation were made on 30 nonorthodontic normal study models.

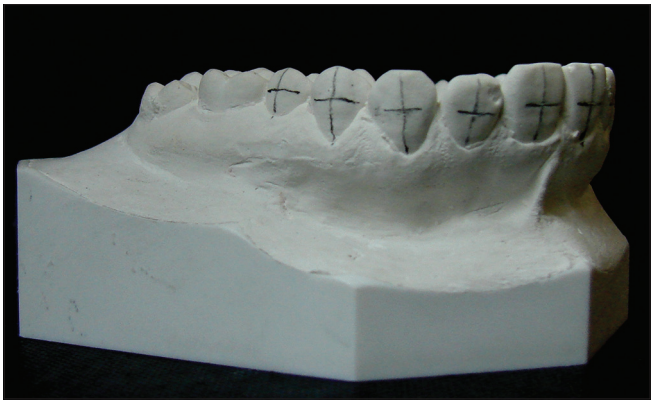

Figure 4: Models marked with facial axis of clinical crown and facial axis point

Figure 6: Models with brackets attached

Tables 1-4 show measured values: The mean, minimum and maximum, SD of the normative data individually for each tooth.

The correlation between mandibular canine inclination and mandibular first and second premolar inclinations was highly significant statistically ($P < 0.001$). The correlation between mandibular first and second premolar inclinations was also highly significant statistically ($P < 0.001$).

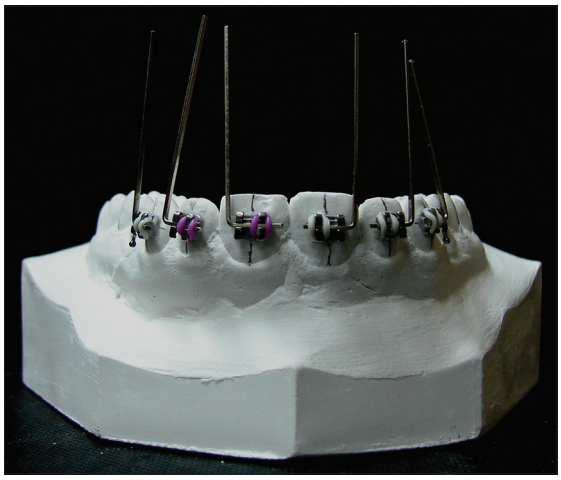

Figure 7: Measurement of expression of torque

Table 1: The normal angulation of maxillary teeth

Teeth	Side	Angulation Mean±SD	Range	
			Minimum	Maximum
Central incisor	Right	3.07±1.92	0.00	8.00
	Left	3.23±1.76	0.00	7.00
Lateral incisor	Right	5.70±4.38	−3.00	12.00
	Left	6.25±3.28	0.00	12.00
Canine	Right	4.30±4.28	−4.00	10.00
	Left	4.32±4.47	−5.50	11.00
First premolar	Right	1.40±1.85	0.00	5.50
	Left	0.78±1.74	−3.00	6.50
Second premolar	Right	2.38±2.17	0.00	8.00
	Left	1.77±2.07	−2.50	6.50

SD – Standard deviation

Table 2: The normal angulation of mandibular teeth

Teeth	Side	Angulation Mean±SD	Range	
			Minimum	Maximum
Central incisor	Right	0.23±1.74	−4.00	6.00
	Left	0.13±1.75	−5.00	3.50
Lateral incisor	Right	−0.9±2.05	−5.00	3.00
	Left	−0.37±2.48	−6.00	6.00
Canine	Right	0.9±3.57	−7.00	8.00
	Left	1.8±3.53	−6.00	10.00
First premolar	Right	0.35±2.47	−6.00	6.00
	Left	0.97±2.02	−2.00	6.00
Second premolar	Right	0.51±1.89	−6.00	5.00
	Left	1.70±2.78	−6.00	7.00

SD – Standard deviation

The correlations of the tooth inclinations between maxillary and mandibular teeth are presented in Tables 5 and 6.

The Intraarch Correlations of Teeth Angulation in Maxilla and Mandible

The results of the intraarch correlations of the angulation of the teeth in the maxilla and mandible are described in Tables 7 and 8, respectively. The correlation data showed significant correlation in the angulation of the maxillary central incisors with lateral incisors and lateral incisor with canine ($P < 0.05$). There was no significant correlation between inclinations of maxillary incisors with angulation of canines and premolars. The correlation between angulation of canine and first premolars and first and second premolars was significant ($P < 0.001$). The correlation data also showed significant correlation in the angulation of the mandibular central incisors with lateral incisors and lateral incisor with canine and first premolar was significant ($P < 0.05$). The correlation between angulation of the first and second premolars was significant ($P < 0.05$).

Measurement of Expression of Torque

The brackets were attached to maxillary and mandibular incisors and canines. The expression of torque is the measurement of the deviation of the full slot wire ([0.018 × 0.025], [0.0215″ ×0.0275″]) ligated in the bracket slot by the torque angle gauge.

Table 3: The normal inclination of maxillary teeth (in degree)

Teeth	Side	Inclination Mean±SD	Range	
			Minimum	Maximum
Central incisor	Right	6.48±3.99	00.00	15.00
	Left	6.30±3.90	00.00	14.50
Lateral incisor	Right	5.70±4.10	00.00	12.50
	Left	6.00±4.29	00.00	14.50
Canine	Right	−3.63±4.13	−13.00	2.00
	Left	−2.37±3.78	−12.00	4.00
First premolar	Right	−6.73±4.67	−12.50	3.00
	Left	−5.23±4.44	−12.50	00.00
Second premolar	Right	−7.00±4.41	−12.50	00.00
	Left	−5.60±4.94	−13.00	00.00

SD – Standard deviation

Table 4: The normal inclination of mandibular teeth

Teeth	Side	Inclination Mean±SD	Range	
			Minimum	Maximum
Central incisor	Right	2.55±3.68	−3.50	12.00
	Left	2.78±3.66	−4.00	9.50
Lateral incisor	Right	1.16±3.64	−8.00	10.50
	Left	0.7±3.80	−8.00	7.50
Canine	Right	−5.63±4.25	−12.00	3.00
	Left	−6.15±4.49	−12.50	2.00
First premolar	Right	−12.13±2.92	−18.00	−5.50
	Left	−12.77±3.10	−18.00	−6.00
Second premolar	Right	−14.58±3.64	−19.00	00.00
	Left	−14.98±3.65	−19.00	00.00

SD – Standard deviation

Table 5: The intraarch correlations of the teeth inclination of the maxillary arch

	Central incisor	Lateral incisor	Canine	First premolar	Second premolar
Central incisor					
Pearson correlation	1	0.872	0.667	0.250	0.090
Significance (*P* value)	-	0.000***	0.000***	0.182 NS	0.635 NS
Lateral incisor					
Pearson correlation	0.872	1	0.795	0.309	0.094
Significance (*P* value)	0.000***	-	0.000***	0.097 NS	0.623 NS
Canine					
Pearson correlation	0.667	0.795	1	0.371	0.245
Significance (*P* value)	0.000***	0.000***	-	0.044*	0.191 NS
First premolar					
Pearson correlation	0.250	0.309	0.371	1	0.817
Significance (*P* value)	0.182 NS	0.097 NS	0.044*	-	0.000***
Second premolar					
Pearson correlation	0.090	0.094	0.245	0.817	1
Significance (*P* value)	0.635 NS	0.623 NS	0.191 NS	0.000***	-

*$P<0.05$; **$P<0.01$; ***$P<0.001$. NS – Nonsignificant

Table 6: The intraarch correlations of the teeth inclination of the mandibular arch

	Central incisor	Lateral incisor	Canine	First premolar	Second premolar
Central incisor					
Pearson correlation	1	0.841	0.539	0.312	0.425
Significance (*P* value)	-	0.000***	0.002**	0.093 NS	0.019*
Lateral incisor					
Pearson correlation	0.841	1	0.617	0.329	0.469
Significance (*P* value)	0.000***	-	0.000***	0.076 NS	0.009**
Canine					
Pearson correlation	0.539	0.617	1	0.486	0.501
Significance (*P* value)	0.002**	0.000***	-	0.006**	0.005**
First premolar					
Pearson correlation	0.312	0.329	0.486	1	0.736
Significance (*P* value)	0.093 NS	0.076 NS	0.006**	-	0.000***
Second premolar					
Pearson correlation	0.425	0.469	0.501	0.736	1
Significance (*P* value)	0.019*	0.009**	0.005**	0.000***	-

*$P<0.05$; **$P<0.01$; ***$P<0.001$. NS – Nonsignificant

Table 7: The intraarch correlations of the teeth angulations of the maxillary arch

	Central incisor	Lateral incisor	Canine	First premolar	Second premolar
Central incisor					
Pearson correlation	1.000	0.416	0.258	–0.033	–0.102
Significance (*P* value)	-	0.022*	0.169 NS	0.861 NS	0.592 NS
Lateral incisor					
Pearson correlation	0.416	1.000	0.503	0.172	–0.070
Significance (*P* value)	0.022*	-	0.005**	0.363 NS	0.715 NS
Canine					
Pearson correlation	0.258	0.503	1.000	0.512	0.405
Significance (*P* value)	0.169 NS	0.005**	-	0.004**	0.026 NS
First premolar					
Pearson correlation	–0.033	0.172	0.512	1.000	0.644
Significance (*P* value)	0.861 NS	0.363 NS	0.004**	-	0.000***
Second premolar					
Pearson correlation	–0.102	–0.070	0.405	0.644	1.000
Significance (*P* value)	0.592 NS	0.715 NS	0.026*	0.000***	-

*$P<0.05$; **$P<0.01$; ***$P<0.001$. NS – Nonsignificant

Table 8: The intraarch correlations of the teeth angulations of the mandibular arch

	Central incisor	Lateral incisor	Canine	First premolar	Second premolar
Central incisor					
Pearson correlation	1.000	0.435	–0.023	–0.099	0.197
Significance (*P* value)	-	0.016*	0.905 NS	0.604 NS	0.296 NS
Lateral incisor					
Pearson correlation	0.435	1.000	0.302	0.014*	0.155
Significance (*P* value)	0.016*	-	0.105 NS	0.943 NS	0.414 NS
Canine					
Pearson correlation	–0.023	0.302	1.000	0.480	–0.035
Significance (*P* value)	0.905 NS	0.105 NS	-	0.007**	0.855 NS
First premolar					
Pearson correlation	–0.099	0.014*	0.480	1.000	–0.016*
Significance (*P* value)	0.604 NS	0.943 NS	0.007**	-	0.933 NS
Second premolar					
Pearson correlation	0.197	0.155	–0.035	–0.01*	1.000
Significance (*P* value)	0.296 NS	0.414 NS	0.855 NS	0.933 NS	-

*$P<0.05$; **$P<0.01$; ***$P<0.001$. NS – Nonsignificant

The error in expression of torque was calculated as:
Torque value (manufacturer's) − (Expression of torque + normative measurement)

Torque value is the amount of torque as claimed by the manufacturer, is shown in Table 9.

Normative measurement is the inclination of the tooth as measured using the torque angle gauge.

Results for Expression of Torque

The error in the torque expression was calculated for each tooth on either side of the arch. The error in the torque expression

among the three sets of brackets in each individual tooth was statistically compared by one-way ANOVA. $P = 0.05$ was considered as statistically significant.

The measurements of expression of torque are shown in Tables 10 and 11. The measurements of error in expression of torque are shown in Tables 12 and 13.

DISCUSSION

In most of the preadjusted edgewise appliance systems,[11,12] the torque prescription in the individual brackets is based on the normal inclination of the tooth, treatment goals like overcorrection[12] and interbracket torque, that is, torque difference between neighboring teeth.[12] However, the latter two criteria are dependent on the validity of the first and it was assumed that there is a relatively small variation in the mean torque/inclination measurements for persons with normal occlusion. However, many studies in the literature reported wide variations in the inclination and angulation of teeth among individuals with normal occlusion.[3,4,13]

Dellinger[3] measured third-order angulations from positioner set ups and Morrow[14] studied angular changes of the facial surfaces in treated and untreated cases as well as extracted teeth. Both the investigators recorded measurements by means of an optical comparator with the conclusion that in ideal occlusion, facial tooth angulations show large SDs in the measurements. Vardimon and Lambertz[4] evaluated third-order angulations in the human dentition. The study was in close agreement with Andrews torque values except those of the upper incisors, which were more upright.

Thus, this study was designed to evaluate angulation and inclination in the study models of normal occlusion individuals of the North Indian population and to compare the actual expression of torque of brackets of three different manufacturers on the study models.

All the data were recorded directly from study models by means of a specially designed angular device [Figures 2 and 3]. Some instruments had been used previously by different authors including Andrews for the measurements and were mentioned in the literature.[15-17] The instrument used in the present study was developed on the same principles in the Unit of Orthodontics, Oral Health Sciences Centre, PGIMER, Chandigarh.

Table 9: Torque values claimed by the manufacturer

Teeth	Nu-edge	Mini-diagonal	Gemini
Maxillary central incisor	12	12	14
Maxillary lateral incisor	8	8	7
Maxillary canine	0	0	0
Mandibular central incisor	–1	–1	–1
Mandibular lateral incisor	–1	–1	–1
Mandibular canine	0	0	0

Table 10: Actual expression of torque in maxillary teeth

Teeth	Side	Mean±SD		
		Nu-edge	Mini-diagonal	Gemini
Central incisor	Right	4.67±4.64	5.80±3.99	7.20±4.11
	Left	4.60±4.71	5.47±4.30	7.60±4.54
Lateral incisor	Right	0.00±0.00	2.87±4.33	1.57±4.99
	Left	–1.30±5.43	0.87±4.43	–0.03±5.14
Canine	Right	4.72±5.17	4.03±4.76	4.00±5.06
	Left	1.63±3.61	1.97±3.55	1.73±3.90

Table 11: Actual expression of torque in mandibular teeth

Teeth	Side	Mean±SD		
		Nu-edge	Mini-diagonal	Gemini
Central incisor	Right	–3.30±4.71	–2.87±3.99	–2.90±3.95
	Left	–3.50±4.26	–2.57±3.95	–4.30±4.60
Lateral incisor	Right	–2.27±3.99	–1.33±3.80	–1.40±3.73
	Left	–1.43±3.83	–1.27±3.46	–1.67±3.69
Canine	Right	4.43±5.79	5.07±4.27	5.47±4.78
	Left	5.53±4.22	5.20±3.67	5.73±4.27

The Actual Expression of Torque

The anticipated results of treatment are not always achieved by using preadjusted edgewise appliances. This has been ascribed to various factors like inaccurate bracket placement, variations in the tooth structure, and variations in maxillary/mandibular arch relationships, tissue rebound and mechanical deficiencies of edgewise orthodontic appliances.[18] As with any other product, the manufacturing of brackets allows for an acceptable variation in their size and characteristics including dimensional accuracy and torque consistency.[19] Orthodontic brackets have two additional mechanical limitations, that is, play between the arch wire and bracket slot and the force diminution.[20] The

Table 12: Errors in torque expression of different types of brackets in maxillary teeth

	Nu-edge		Mini-diagonal		Gemini		Significance (*P* value)
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	
Right central incisor	1.50±2.15	0-8.5	1.10±0.71	0-2.5	1.03±1.38	0-5.5	0.667
Left central incisor	1.70±1.61	0-4.5	1.67±0.67	0-2.5	1.03±1.40	0.5-6	0.338
Right lateral incisor	1.77±1.85	0-7	1.37±0.63	0-2	1.40±1.49	0-6	0.696
Left lateral incisor	2.13±2.47	0.5-7	1.67±0.77	0.5-2.5	1.53±2.00	0-8.5	0.376
Right canine	1.87±1.70	0-5.5	1.33±0.65	0-2.5	1.23±1.12	0-5	0.326
Left canine	1.67±0.86	0-3	1.03±0.83	-0.5-2	1.00±1.28	0-5	0.893

*$P<0.05$; **$P<0.01$. SD – Standard deviation

Table 13: Errors in torque expression of different types of brackets in mandibular teeth

	Nu-edge		Mini-diagonal		Gemini		Significance (*P* value)
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	
Right central incisor	1.167±1.29	−1-5	1.73±0.84	−1.5-3	1.10±0.66	0.5-2.5	0.157
Left central incisor	1.47±1.24	−1-3.5	2.27±0.99	1-4	1.27±1.24	−5-2.5	0.056
Right lateral incisor	1.10±0.76	−1-3	1.70±0.88	−1.5-3	1.23±1.75	−0.5-7	0.373
Left lateral incisor	1.40±1.12	−1-4.5	1.77±0.77	−1-3	1.17±0.69	−1-2.5	0.186
Right canine	1.87±3.13	−13-1	1.37±0.87	−2.5-2	0.63±0.69	−2-1	0.221
Left canine	1.03±0.67	−2.5-2	1.43±0.75	−2-2	0.43±0.45	−1-1	0.000

*P<0.05, **P<0.01. SD – Standard deviation

amount of play plus the amount of force diminution can be added to or subtracted from the torque, tip, rotation and height parameters inherent for each bracket to deliver the teeth to the desired positions.[21] This allows treatment goals to be achieved with maximum efficiency.

The factor of play between archwire and bracket slot in this study was minimized with the use of full slot arch wires. There was no factor of force diminution as the study was carried out on study models. The data shows that different models within the same group had different expression of torque for the same bracket prescription. There was also a large range in expression of torque.

Thus, the same prescription and same manufacturer brackets expressed torque differently on teeth of different individuals independent of each other. This is because of the fact that the clinicians treat individuals and not the averages.[3]

Ideally, the SWA appliance should not show any deviation on the normal occlusion models, thus causing no disturbance in the occlusion. However, the expression of torque was nil in only a very few teeth. Thus, the preadjusted edgewise appliance prescription based on Andrews[2] normative data may not be applicable for all population groups and also for all the individuals within the same population group.[19]

Thus, customized brackets with different torque values for individual teeth need to be made or wire bending is necessary to achieve the optimum treatment goals.[3,18,22]

The Error in the Expression of Torque

In an ideal case, the torque value as claimed by the manufacturer should be equal to the sum of normative measurement and expression of torque. The deviation gives the error in expression of torque.

This study showed no significant differences in the errors in expression of torque by Roth brackets and three different manufacturers except for the mandibular left canine. This suggested that different bracket systems with bases contoured to the tooth anatomy expressed same amount of torque.

However, the result showed a large range in the error in expression of torque within the groups. The same bracket kit evaluated on 15 different models showed an average error of 1.0-2.0° for different teeth. Though the average was less, the range showed an error in the labial tooth surface contour[23] could be the factors responsible for wide variation in errors within the groups. Facial contours from occlusal to gingival varied in different teeth of the similar type. Ideally, the prescribed torque would be expressed when the bracket is placed at the exact height stipulated. Thus the change in vertical height in the bracket placement would result in change in the expression of torque.[17] Furthermore, adaptation of the base of bracket to the tooth surface may be one of the important factors in error of torque expression.

CONCLUSIONS

The following conclusions can be drawn from the present study.

1. There was a highly significant intraarch correlation of teeth angulation and inclination in the maxillary and mandibular arch.
2. The errors in torque by the different sets of preadjusted brackets were not significant, but there was a large range of errors within the groups.
3. The amount of torque claimed by any manufacturer is different from that actually expressed. Teeth of different individuals have different torque requirement. Thus, wire bending is necessary for ideal finishing of a case or custom made preadjusted brackets should be used for individualized torque requirements.
4. The study of the relation of the adaptation of bases of brackets of different shapes and thickness with torque needs to be done more thoroughly. Research in future is required to reveal the best suited shapes and sizes of bases for optimum performance of preadjusted appliances.

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