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Original Article

Dentistry Section

Occlusal Contact Points, Areas and Bite Force Distribution in Angle's Class I, II and III Patients using T-scan

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ABSTRACT

Introduction: Number of occlusal contacts and uniform bite force distribution during maximum intercuspation are determinants of a good functional occlusion. Distribution of posterior contacts in the three malocclusion groups along with force distribution has been a topic of research.

Aim: To quantify the number of occlusal contacts and areas, bite force distribution in Angle's Class I, II, III subjects using T-scan and to identify the centre of force trajectory.

Materials and Methods: This cross-sectional, observational study was conducted in the Department of Orthodontics, SRM College, Chennai, Tamil Nadu, India, from June 2018 to December 2018. Total 45 subjects in the age group of 18 to 24 years were divided into three groups of 15 subjects each based on Angle's classification of malocclusion with teeth in normal line of occlusion. T-Scan system sensor and software were used to record and store data. The collected data were analysed with IBM Statistical Package for the Social Sciences (SPSS) software version 23.0. The descriptive statistics were performed, followed by Analysis of Variance (ANOVA). Post hoc Tukey test was done to find the difference between the groups. Chi-square test was done for the categorical data and the Paired t-test for determining the significant difference between the bivariate samples in paired groups. Level of significance was set at $p<0.05$.

Results: Out of three study groups, mean contact points ($p<0.001$), contact areas ($p<0.001$) and bite forces ($p=0.0032$) were statistically highly significant in Angle's class I group when compared to the other groups. Statistically, the right and the left side differences in force distribution of the three groups were significant with the forces predominantly being higher on the right side.

Conclusion: Subjects with Angle's Class I molar relation had greater contacts, contact area and better bite force distribution. There was preference to the right side in bite force distribution in all the three groups. Centre of force trajectory was concentrated between first and second molars in all the groups.

Keywords: Centre of force trajectory, Dental occlusion, Digital occlusal analyser

INTRODUCTION

Centric occlusion refers to the occlusal position of the mandible in which the cusps of the teeth of both arches fully interpose themselves with the fossae of teeth of the opposing arch [1]. The favourable occlusion is when tooth contacts are small, arranged symmetrically and occlusal forces directed vertically along the long axis of the tooth [2-4]. If a tooth supracontact occurs during maximal intercuspation or lateral excursive movements of the mandible then it is known as occlusal interference and this leads to traumatic occlusion.

Bite force is defined as "the force applied by the masticatory muscles in dental occlusion" [5]. Literature proves that the maximum bite force depends on the number of teeth present, the number of occlusal contacts and contact areas. Reduced bite force is often associated with malocclusion [5]. Bite force is conventionally measured using bite gauge where one or two transducers are placed between the teeth in occlusion but thickness of the transducers result in increase in vertical dimension and there is considerable separation of the dentition leading to inaccuracies in the recordings [5,6]. The evaluation of occlusal contacts can be effectuated either qualitatively with wax, articulating paper, foils and silk strips or quantitatively with the T-scan system and photo-occlusion [7-11].

T-scan system III can accurately quantify the number of occlusal contacts [7-9]. Though class I dental relationship as described by Angle has been hailed to be perfect due to increased number of contacts and equitable distribution of load on both sides of dental arch, proof for the same is not available in the literature [6]. Finishing orthodontic occlusion in dental class II molar relation has been accepted but canine relationship of class I is still considered mandatory [12]. Significance of finishing an orthodontic treatment in class I molar and canine relationship has not been investigated thoroughly. Therefore, aim of the study was to measure the number of occlusal contacts, contact areas, bite force distribution in Angle's class I, II and III subjects and identify the centre of force trajectory during maximum intercuspation. According to null hypothesis there is no difference in the number of occlusal contacts, contact areas and bite force distribution between Angle's class I, II and II subjects.

MATERIALS AND METHODS

This cross-sectional, observational study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, SRM Dental College, Ramapuram, Chennai, Tamil Nadu, India from June 2018 to December 2018. The study was approved by the Institutional Research Ethics Committee (SRMDC/IRB/2016/MDS/No.104). Informed consent was obtained from every participant and prior to recording, they were asked to practise required mandibular movements.

Sample size calculation: Sample size calculation was done using a priori computed sample size determination and for an alpha error of 0.05 and for a power of 95%, sample size determined was 42 subjects. It was increased to 45 with 15 in each group [Table/Fig-1].

Inclusion criteria: Patients within the age group of 18 to 24 years were included in the study. The study sample was divided into three groups based on Angle's classification of malocclusion [13].

Exclusion criteria: Patients with missing teeth, restorations, temporomandibular joint symptoms like pain, clicking sounds were excluded from the study.

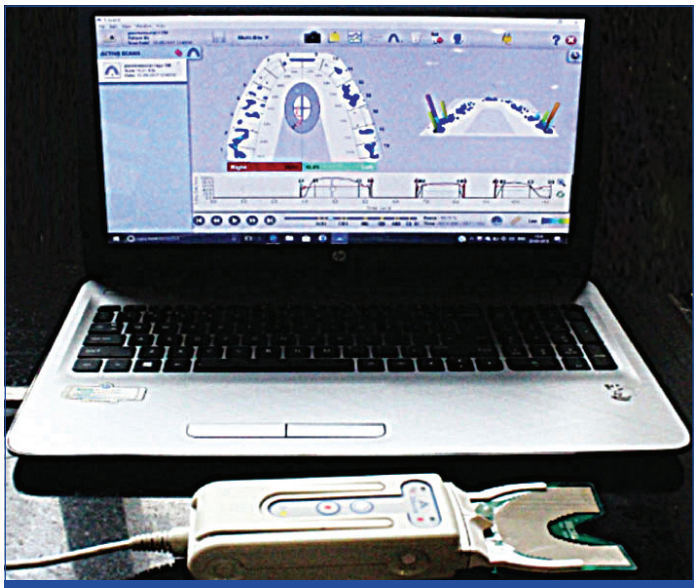
Group A included patients with Angle's Class I molar relation with an overjet of 2 mm with teeth in line of occlusion, canine relation was

Input	Tail (s)	Two
	Effect size d	1.455295
	An error probability	0.05
	Power (1-3 error probability)	0.95
	Allocation ratio N2/N1	1
	Non centrality parameter 8	3.850348
Output	Critical t	2.055529
	df	26
	Sample size group A	14
	Sample size group B	14
	Sample size group C	14
	Total sample size	42
	Actual power	0.959476

[Table/Fig-1]: Sample size calculation.
t-tests -Means: Difference between two independent means (two groups); Analysis: a priori: Compute required sample size

class I. Group B included patients with Angle's Class II molar relation with an overjet of not more than 5 mm and arch length discrepancy of not more than 2 mm, canine relation was class II. Group C included patients with Angle's Class III molar relation with positive overjet and teeth in line of occlusion, canine relation was class III.

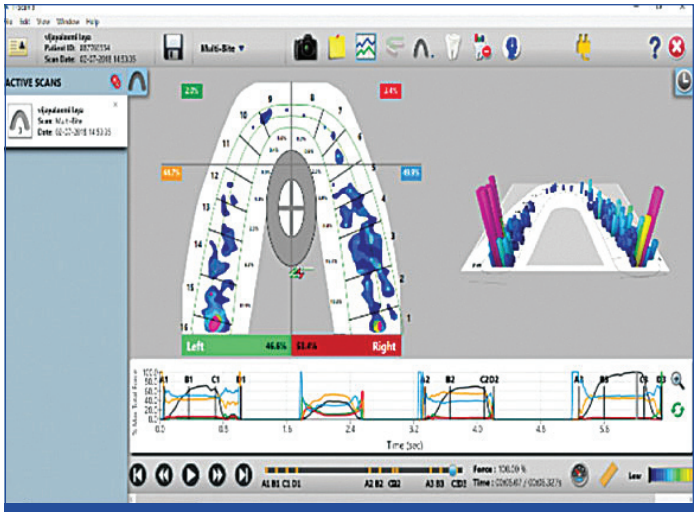
The T-Scan III (Tekscan Inc., South Boston, Mass) system includes intraoral U-shaped sensor film fitting into a scanner in the evolution handle and the scanner is connected to a software (version 9.0) loaded computer [Table/Fig-2]. Sensor foil is 60 μ thick, has X, Y coordinate system and 1500 sensitive receptor points. The same film is reusable for about 20 times for single subject and available in two sizes to fit individual dental arch. Patients were seated upright on the dental chair; recording was done with patient in sitting position with head posed in natural head position following the studies of Sonnesen L and Bakke M, Kerstein RB et al., [14,15]. When patients occluded on pressure sensitive film there was an elastic deformation that would be recorded by a computer software. The recorded data was in the form of two or three dimensional graphics and colour coded to denote the intensity ranging from least forces in blue to highest in pink [Table/Fig-3]. Patients were given rest between recordings to avoid fatigue of muscles.



[Table/Fig-2]: T-scan evolution handle with digital sensor connected to a desktop installed with T-scan software via an Universal Serial Bus (USB) port.

Occlusal Contact Points

Occlusal contacts were measured from the number of pixels that appeared during occlusion. Posterior occlusal contacts were derived from the occlusal images comprising of four teeth on either side, two premolars and two molars both left and right sides. The anterior



[Table/Fig-3]: T-scan software version 9.0 depicting the digital data for multibite closure of a patient.

occlusal contact was derived from contacts from the central incisor region. Occlusal contact points of all the four posterior teeth were added to derive total posterior teeth contact points in all the cases in right and left side.

Occlusal Areas

Occlusal contact points were multiplied by 1.04 mm^2 to obtain occlusal surface area. For anteriors with anterior occlusal points and for posterior occlusal areas with posterior occlusal points [16].

Bite Force Distribution

The first occlusal contact frame in the tool bar gave the initial tooth contact and the maximum occlusal playback frame gave the maximum intercuspation or maximum bite force during the three successive closures. Force outliers represented the bite force of any individual teeth which recorded the highest forces among others. The Centre of Force Trajectories (COF) provided the summation of bite forces of all the teeth.

STATISTICAL ANALYSIS

The collected data were analysed with IBM SPSS software version 23.0. The tabulated results showed that the values were normally distributed, and the descriptive statistics were performed, followed by ANOVA. Post-hoc Tukey test was done to find the difference between the groups. Chi-square test was done for the categorical data and paired t-test for determining the significant difference between the bivariate samples in paired groups. In all the above mentioned statistics, the probability value of 0.05 was considered as significant level.

RESULTS

Contact points: [Table/Fig-4] reveals that greater number of contact points were observed on right side than left for all the groups and posteriorly than anteriorly for all groups. There was a significant difference in the number of contact points and areas between the three groups on right and left sides and posteriorly and anteriorly.

Contact areas: In [Table/Fig-5] occlusal contact areas were analysed and showed a statistically significant difference ($p<0.001$). Contact areas were higher in both right and left side for group A when compared with group B and C [Table/Fig-6]. It was also highest for group A in the total posterior region.

Post hoc Tukey results for contact points and areas are given in [Table/Fig-7]. Comparison between group A and B and, A and C for contact points and areas were significant for both right and left side but same parameters for groups B and C ($p=0.973$ and 0.525 respectively) were not significant for the right side. In contrast group B was found to have significantly higher contact

Contact points	Groups	Mean	SD	ANOVA					
				Sum of squares		df	Mean square	F-value	p-value
Right	A	70.20	8.002	Between groups	7158.711	2	3579.356	65.234	<0.001**
	B	45.47	5.730	Within groups	2304.533	42	54.870		
	C	41.80	8.231	Total	9463.244	44			
Left	A	55.53	7.717	Between groups	2816.400	2	1408.200	28.901	<0.001**
	B	42.73	5.750	Within groups	2046.400	42	48.724		
	C	36.53	7.318	Total	4862.800	44			
Posterior	A	109.33	11.94	Between groups	10176.400	2	5088.200	44.168	<0.001**
	B	82.33	9.084	Within groups	4838.400	42	115.200		
	C	74.133	10.97	Total	15014.800	44			
Anterior	A	18.00	5.64	Between groups	1702.178	42	851	48.559	<0.001**
	B	5.867	3.96	Within groups	736.133	2	17.527		
	C	4.200	2.24	Total	2438.311	44			
Total	A	125.7	11.048	Between groups	18764.311	2	9382.156	76.743	<0.001**
	B	88.200	10.136	Within groups	5134.667	42	122.254		
	C	78.333	11.914	Total	23898.978	44			

[Table/Fig-4]: Comparisons of contact points in total, right, left, posterior, anterior regions using ANOVA for groups A, B and C.
Level of significance at 0.05; **p≤0.001 was highly significant; SD: Standard deviation; df: degree of freedom

Contact areas (mm^2)	Groups	Mean	SD	ANOVA					
				Sum of squares		df	Mean square	F-value	p-value
Right	A	73.00	8.32	Between groups	7741.571	2	3870.785	64.147	<0.001**
	B	47.18	6.14	Within groups	2534.370	42	60.342		
	C	43.54	8.60	Total	10275.941	44			
Left	A	57.75	8.02	Between groups	3082.752	2	1541.376	29.030	<0.001**
	B	44.44	5.98	Within groups	2230.061	42	53.097		
	C	37.85	7.68	Total	5312.814	44			
Posterior	A	113.64	12.73	Between groups	10936.502	2	5468.251	42.777	<0.001**
	B	85.64	9.43	Within groups	5368.931	42	127.832		
	C	77.16	11.50	Total	16305.432	44			
Anterior	A	18.72	5.86	Between groups	1842.508	2	921.254	48.653	<0.001**
	B	6.10	4.10	Within groups	795.280	42	18.935		
	C	4.36	2.33	Total	2637.788	44			
Total	A	130.7	11.49	Between groups	20365.239	2	10182.619	75.729	<0.001**
	B	91.62	10.71	Within groups	5647.339	42	134.460		
	C	81.39	12.51	Total	26012.578	44			

[Table/Fig-5]: Comparisons of contact areas in total, right, left, posterior, anterior regions using ANOVA for groups a, b and C.
Level of significance at 0.05; **p≤0.001 was highly significant; SD: Standard deviation; df: Degree of freedom

Groups compared	Dependent variable		Mean difference	Standard error	p-value
A and B	Contact points	Right	8.533333	1.553286	<0.001**
		Left	4.2	1.05349	<0.001**
	Contact areas (mm^2)	Right	8.9088	1.621631	0.003**
		Left	4.3408	1.102681	<0.001**
A and C	Contact points	Right	6.933333	1.553286	<0.001**
		Left	5.066667	1.05349	<0.001**
	Contact areas (mm^2)	Right	7.2384	1.621631	<0.001**
		Left	5.2456	1.102681	<0.001**
B and C	Contact points	Right	2.333333	0.81312	0.973
		Left	3	714772	0.003**
	Contact areas (mm^2)	Right	2.436	0.848897	0.525
		Left	3.132000.	0.744365	<0.001**

[Table/Fig-6]: Post-hoc tukey tests for statistical significance for contact points and contact areas (mm^2) in the right and left, posterior and anterior regions between group A and group B, group A and group C, and group B and group C.
**p<0.001 was considered highly significant

points (p=0.003) and area (p<0.001) when compared to group C on the left side [Table/Fig-6].

Bite force distribution: There was a statistically significant increase in the relative bite force percentage between the groups A, B and C on left side with p-value of 0.001. Though there was difference in the bite force percentage in the right side it was not significant [Table/Fig-7]. When the bite force distribution was analysed in the posterior region there was no significant difference between the groups (p=0.851).

When intergroup comparison was done [Table/Fig-8], it was clear that group A had increased bite force distribution in the left posterior region when compared to B and C (p=0.001 and 0.045, respectively). Similarly, force distribution was significantly increased on the right side in group A more than group B and C (p=0.006 and 0.014, respectively). There was significant difference in the bite force levels on the left side between groups A and B but not with C (p=0.013).

The first molars in both the sides displayed the highest contact points and areas in all the three groups and were significant p<0.001 [Table/Fig-9]. Second molars exhibited a similar pattern on the right side with highest contact points and areas for group A. Relative bite force distribution was higher in group B in the first molar region in left side and it was significant (p=0.041). In the second molar region, bite force was higher in group A on the right

Relative bite force (%)	Groups	Mean	SD	ANOVA				
				Sum of squares		df	Mean square	F-value	p-value
Right	A	56.480	5.12	Between groups	386.082	2	193.041	6.586	0.104
	B	49.960	5.09	Within groups	1231.129	42	29.313		
	C	50.626	5.98	Total	1617.211	44			
Left	A	48.860	2.34	Between groups	225.544	2	112.772	4.548	0.001**
	B	43.420	5.17	Within groups	1041.333	42	24.794		
	C	45.540	6.48	Total	1266.877	44			
Posterior	A	90.640	4.418	Between groups	17.026	2	8.513	0.162	0.851
	B	91.387	9.377	Within groups	2205.597	42	52.514		
	C	89.88	7.107	Total	2222.623	44			
Anterior	A	9.273	4.426	Between groups	68.103	2	34.052	1.208	0.309
	B	7.433	6.999	Within groups	1184.080	42	28.192		
	C	6.287	3.998	Total	1252.183	44			

[Table/Fig-7]: Comparisons of relative bite force (%) in right, left, posterior, anterior regions using ANOVA for groups A, B and C.
**p≤0.001 was highly significant; p>0.05 was nonsignificant; df: degree of freedom

Groups	Relative bite force (%)	Mean difference	Significance
A and B	Left anterior	-8.4	<0.001**
	Left posterior	-6.28	<0.001**
	Total right	6.52	0.006**
	Total left	-5.44	0.013*
A and C	Total right	5.85333	0.014*
	Left posterior	5.6	0.045*

[Table/Fig-8]: Post-hoc tukey tests for statistical significance for relative bite Force (%) between group A and group B, group A and group C, group B and group C.
**p≤0.001 was highly significant, *p≤0.05 was significant; Group A: Class I molar relation; Group B: Class II molar relation; Group C: Class III molar relation

side and group B on the left side but the differences were not statistically significant (p=0.086 and 0.703, respectively). Contact point and relative bite force were noted down for four teeth in the posterior region two premolars and two molars and mean value was arrived at to find the posterior right and left contact points and areas. The paired t-tests showed a significant difference between the posterior right and left side; contact points, areas and bite force distribution were significantly higher in the right side in group A (p<0.001) whereas for other two groups (B and C), though there was a general right side preference none of the parameters except bite force distribution in group B was statistically significant (p=0.043) [Table/Fig-10].

Variable	Side	Groups	Mean	SD	ANOVA				
					Sum of squares		df	Mean square	F-value	p-value
II Molar contact points	Right	A	19.53	5.68	Between groups	847.778	2	423.889	22.464	<0.001**
		B	12.20	3.66	Within groups	792.533	42	18.870		
		C	9.20	3.29	Total	1640.311	44			
	Left	A	14.20	3.42	Between groups	220.044	2	110.022	8.743	<0.001**
		B	11.13	3.94	Within groups	528.533	42	12.584		
		C	8.80	3.23	Total	748.578	44			
I Molar contact points	Right	A	26.86	3.46	Between groups	617.244	2	308.622	17.055	<0.001**
		B	18.33	2.94	Within groups	760.000	42	18.095		
		C	19.93	5.79	Total	1377.244	44			
	Left	A	21.13	2.77	Between groups	220.311	2	110.156	13.234	<0.001**
		B	16.93	2.21	Within groups	349.600	42	8.324		
		C	16.06	3.51	Total	569.911	44			
II Molar contact areas (mm^2)	Right	A	19.69	6.33	Between groups	800.497	2	400.249	18.007	<0.001**
		B	12.73	3.82	Within groups	933.567	42	22.228		
		C	9.60	3.44	Total	1734.064	44			
	Left	A	14.89	3.58	Between groups	246.252	2	123.126	8.969	<0.001**
		B	14.20	3.42	Within groups	576.550	42	13.727		
		C	11.13	3.94	Total	822.802	44			
I Molar contact areas (mm^2)	Right	A	28.04	3.61	Between groups	672.757	2	336.378	17.055	<0.001**
		B	19.14	3.07	Within groups	828.351	42	19.723		
		C	20.81	6.05	Total	1501.108	44			
	Left	A	22.01	2.92	Between groups	672.757	2	336.378	17.055	<0.001**
		B	21.13	2.77	Within groups	828.351	42	19.723		
		C	16.93	2.21	Total	1501.108	44			
II Molar relative bite force (%)	Right	A	18.84	5.88	Between groups	175.411	2	87.706	2.601	0.086
		B	15. 42	6.39	Within groups	1416.458	42	33.725		
		C	14.17	5.067	Total	1591.869	44			

II Molar relative bite force (%)	**Left**	A	11.78	3.29	Between groups	14.265	2	7.133	0.355	0.703
		B	13.07	2.61	Within groups	842.923	42	20.070		
		C	12.86	6.51	Total	857.188	44			
I Molar relative bite force (%)	**Right**	A	19.61	5.08	Between groups	33.770	2	16.885	0.451	0.640
		B	20.04	6.95	Within groups	1572.828	42	37.448		
		C	21.62	6.17	Total	1606.598	44			
I Molar relative bite force (%)	**Left**	A	17.12	3.65	Between groups	157.030	2	78.515	3.449	0.041*
		B	20.67	6.42	Within groups	956.113	42	22.765		
		C	16.40	3.68	Total	1113.143	44			

[Table/Fig-9]: Comparisons of contact points, contact areas (mm^2), relative bite force (%) of I and II molar in the right and left, posterior regions using ANOVA for groups A, B and C. **p≤0.001 was highly significant, *p≤0.05 was significant, p>0.05 was nonsignificant; SD: Standard deviation

Right and left		Paired differences				
		Mean	Std. Deviation	t-value	df	p-value (two tailed)
Contact points	A	14.667	1.185	5.079	14	0.001**
	B	2.733	5.391	0.739	14	0.913
	C	5.267	10.033	2.033	14	0.061
Contact areas (mm^2)	A	15.253	11.631	5.079	14	0.001**
	B	2.744	5.68	1.871	14	0.054
	C	5.683	10.473	2.102	14	0.054
Relative bite force (%)	A	13.060	10.296	4.913	14	0.001**
	B	1.100	6.682	0.638	14	0.043*
	C	5.086	10.782	1.827	14	0.089

[Table/Fig-10]: Paired t-tests showing the differences between Right and Left total contact points, contact areas (mm^2) and relative bite force (%) In groups A, B and C. **p≤0.001 was highly significant; *p≤0.05 was significant; p>0.05 was nonsignificant; SD: Standard deviation

Initial contact: In group A, the initial contact during maximum intercuspation were in the second molars 73.3%. Group B had 60% of the samples with their initial contacts in the first molars and group C had multiple tooth contacts in 53% and 40% in the second molars [Table/Fig-11,12].

Initial contacts		Groups			Total
		A	B	C	
2^{nd} molars	Count	11	6	6	23
	% within classes	73.3%	40.0%	40.0%	51.1%
1^{st} Molars	Count	3	9	1	13
	% within classes	20.0%	60.0%	6.7%	28.9%
Others	Count	1	0	8	9
	% within classes	6.7%	0.0%	53.3%	20.0%

[Table/Fig-11]: Number of samples exhibiting initial tooth contacts in groups A, B and C.

	No. of valid cases	Chi-square tests	Value	df	Asymp. sig. (2-sided)
Initial contacts	45	Pearson chi-square	22.841	4	0.0005**
		Likelihood ratio	23.572	4	0.001**

[Table/Fig-12]: Chi-square test to assess association of samples for initial contacts in groups A, B and C and their significance. **p≤0.001 was highly significant; SD: Standard deviation; df: Degree of freedom

The null hypothesis that there is no statistically significant difference between the contact points, areas and bite force distribution between the three malocclusion groups is rejected.

DISCUSSION

T scan-III, a digital analyser of relative bite force, measures the force as a percentage value and not in numerical value with standard units. Determining the relative force levels will differentiate whether force on one tooth is equal, higher or lesser than the adjacent tooth in the dental arches [14].

The number of occlusion contacts were found to be higher in group A. The maximum contact points were undoubtedly present in the right posterior region of all the three groups but was highly significant (p<0.001) for group A alone. Similarly anterior contacts were highest for group A. Groups B and C showed consistent patterns in all their samples with considerably lesser contacts in their second molars.

Group A was having higher contact areas than groups B and C in both anterior and posterior regions. Maximum contact points and areas were present in the right side posterior region for all the three groups. This might be due to right side preference in chewing. Tiwari S et al., studied the chewing preferences and found out that chewing preference is on the right side for about 50% of the population with predominant left side brain control [17]. Findings of Garcia VG et al., correlated with the present study indicating that the largest number of contacts occur in the molar region [18]. Jang SY et al., concluded that occlusal and molar contacts were poorer in the class II group than class I [19]. In contrast to the present study Watanabe-Kanno GA and Abrao J concluded that the occlusal contacts were higher in class II malocclusion patients but this can be attributed to their use of impression material for registration [20].

According to Sonnesen L and Bakke M there was no significant difference in the magnitude of bite force among the three malocclusion groups studied [14]. Though the present study assessed only the bite force distribution, it nevertheless showed an increase in group A as compared to the other two groups in right and left sides. Though anterior contacts were less in groups B and C, bite force distribution was not statistically higher in anterior segment in group A implying that cuspids in groups B and C were found to be burdened with excessive force and bite force was not evenly distributed among six anterior teeth.

Bite force seemed concentrated as COF between first and second molars during maximum intercuspation; this correlated with Sonnesen L and Bakke M who concluded that absence of a molar tooth would significantly reduce the maximum bite force [14].

On assessing the occlusal loading of individual teeth in the posterior region, it was found that maximum force distribution was found in the first molar region on both the sides. It was significantly higher in group B on the left side than the other two groups. Though relative bite force distribution was higher for group B on right and left sides in the second molar region, it was not significant. This finding correlates with Woodford SC et al., who studied the occlusal loading of individual tooth and found out that first molars produced highest chewing and biting forces and forces on the second molars and incisors were of shear nature [21]. Ciancaglini R et al., have concluded first molars to be areas of greatest force levels which was confirmed in all three groups in the present study but relative force level is significantly higher in the left first molar region [22]. Bae et al concluded that class-I group had the highest masticatory efficiency which correlates with present study in the highest number of contacts, areas and even bite force distribution in group A [23].

During multibite closure, first tooth to contact antagonist in 73.3% of group A were second molars, first molars in 20% and

remaining 6.7% showed varying patterns of contacts occurring simultaneously in first and second molars and in few cases even in the incisors. Group B had first contact in the first molars in 60%, 40% showing first contacts in second molars. In the case of group C there were simultaneous contacts in the first and second molars and in some premolars of 53% of the samples. Initial tooth contact of second molars is statistically higher in group A than in the other two groups Though this finding correlate with the study by Koos B et al., contradictions are in the literature but it can be attributed to lack of placing the patient's head in natural head position during registration [24,25].

From the findings of the study, it's clear that maximum contacts and areas are present in Angle's class I group and bite force distribution was even when compared to other two groups. The COF was found between the first and second molars indicating that they are the primary posterior teeth to bear the occlusal force among all the groups. Uneven concentration of bite force and reduced number of contacts can be a detriment to the supporting periodontium in class II and III malocclusion groups as skewed distribution of contact might lead to excessive force on the canine and other anterior teeth [20]. Thus, critical importance of achieving Angle's class I molar relation post orthodontically has been proven by the present study.

Limitation(s)

The present study did not classify the samples based on their sex or growth patterns and were limited only to the Southern Indian population groups.

CONCLUSION(S)

Angle's Class I group had the highest number of contacts, contact area and bite force distribution. Angle's class I group had 73% of initial contacts in second molars when compared to other two groups. There was a preference to right side in bite force distribution in all the three groups. Centre of force trajectory was concentrated between first and second molar in all the groups. The results of this study could serve as a reference to attain ideal occlusal contacts during finishing and they can be applied during fixed mechanotherapy to achieve a mutually protected occlusion.

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