CORRELATION OF LOWER THIRD MOLAR ANGULATION AND POSTERIOR SPACE DISCREPANCY WITH MANDIBULAR ANTERIOR CROWDING USING 3D INTRA ORAL SCANNER

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ABSTRACT:

OBJECTIVES:

To objectively determine the correlation of lower third molar angulation and posterior space discrepancy with mandibular anterior crowding digitally using intraoral scanner.

METHODOLOGY:

Cross sectional analytical study conducted at Rehman College of Dentistry (RCD) Peshawar from15th November 2020 till 15th December 2020. Lower third molar angulation and posterior space discrepancy were measured by IC 3.1 measure software, using digital Orthopantomograms (OPG). Digitally scanned models by (CS 3600 intraoral scanner) were analyzed using (CS 3600 3D software). Sample was divided into Control (N=30; perfect alignment), Experimental (N=30; crowding >1mm) groups, based on Little's Irregularity Index. Both lower third molar angulation and posterior space discrepancy (Ganss Ratio) were correlated with lower anterior crowding using Pearson's Correlation. To determine any difference between two groups independent t-test was used.

***RESULTS**:*

Statistically insignificant difference and a weak correlation were found for Ganss ratio and third molar angulation in both control and experimental groups.

***CONCLUSION**:*

Third molar angulation and the retro molar space has no direct effect on the lower anterior crowding.

***KEYWORDS:** Intraoral Scanner, Little's Irregularity Index, Ganss Ratio, Digital Models*

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INTRODUCTION:

Anterior crowding has been reported as one of the most common type of malocclusion[1, 2]. Based on the severity crowding is usually classified as mild, moderate and severe. Van der Linden, has classified crowding according to the time when it appears[3]. Early anterior crowding is mostly related to tooth – arch length discrepancy and retained deciduous teeth[4]. Late mandibular incisor crowding has been reported as a multifactorial problem. The possible etiological factors can be maturation of soft tissues, late mandibular growth, direction of mandibular growth, lack of occlusal and interproximal enamel reduction, low tongue position, posterior arch length discrepancy (lack of retro molar space) and

angulation of erupting third molars[3-5]. Literature reports several studies, to associate the angulation/position of third molars, post orthodontic relapse and effect of extraction and non-extraction protocols on anterior crowding[6-8]. Few studies, found third molars to be one of the most important causative factor responsible for this anterior crowding[4, 6, 9]. However, many others have found insignificant correlation between the third molars and anterior crowding[2]. Kavra TR et al concluded, lack of retro molar space could cause a push on the canines and be responsible for the anterior crowding[4]. Miclotte A et al reported, a positive influence in growing patients on the eruption space and position of third molars when premolars were extracted during orthodontic treatment. Although, this impact on the third molar angulation was insignificant[10]. Fateme A et al concluded, from their study in moderate and minimum anchorage requirement premolar extraction cases, third molar angulation increased significantly by 8.12° and 7.48°, respectively[11]. In non-extraction and maximum anchorage groups the increase in molar angulation was insignificant (2.84° and 0.8°, respectively). According to Cotrin P et al, based on their study suggested, post orthodontic relapse is not influenced by presence or absence of third molars[12]. Study conducted by Sood A et al, revealed no significant relationship existed between mild, moderate and severe crowding groups with molar depth, eruption space and angulation[2]. Most of the studies reported have used panoramic radiographs and Lateral Cephalogram and plaster model[2,4,9]. Intraoral scanner is currently being used in orthodontics and found to be reliable and accurate compared to the alginate impressions and stone models[13]. Saito Y et al recently conducted a study using 3-dimensional laser scanner on age related changes in anterior crowding in normal and post retention phase occlusion. They concluded increase in the anterior crowding was related to change in the inclination of teeth and arch width. The increase was more in Angle Class I crowding group as compared to normal occlusion group[5]. The main purpose of the current study was to objectively determine the relationship of third molar angulation and posterior space discrepancy with mandibular anterior crowding digitally. Although, the impact of third molars on anterior crowding has been a controversial topic and a subject of interest. After pertinent literature search we found no study has been conducted to measure and determine the direct relationship of third molar angulation and posterior space on lower incisor irregularity, using digital technology. Since, the concept of posterior space discrepancy and digital measurement of the relation between third molar and anterior crowding is scare and lacks scientific evidence, it is important to investigate so, we can consider third molars as part of our diagnosis and orthodontic treatment planning as well.

METHODOLOGY:

Current study was conducted at orthodontic department, Rehman College of Dentistry (RCD). Ethical approval was obtained from the ethical review board committee of RCD. Pretreatment intraoral scans (CS3600) and orthopantomograms (OPG's) of 60 patients were included in the study. G power software was used to calculate the sample size using an effect size 0.95, alpha error 0.05, power 0.95 with 1:1 allocation, and mean value 0.717±0.252 and 0.763±0.354[2].

Based on the following criteria patients were selected for the study, age range 15-30 years, presence of bilateral impacted/unerupted and erupted third molars, presence of both second molars in lower arch, crowding ranging between 0-10mm (mandibular lower teeth) as measured by Little's Irregularity Index[14]. The exclusion criteria were patients who have had prior orthodontic treatment, dentofacial deformities, presence of prosthesis/large restorations and retained deciduous teeth in digital OPG.

Little's Irregularity Index was measured on digital models by (CS 3600 3D) software and was subjectively ranked on a scale ranging from 0-10 mm[2]. Based on the irregularity, the sample was divided into two groups (Control: 30=perfect alignment) and (Experimental: 30=>1 mm crowding) as shown in Figure 1. Third molar angulation with reference to the occlusal plane (OP) and posterior space discrepancy (Ganss Ratio) was measured on the digital OPG taken using following parameters (74 KV, 10 mA, 15.1s) by IC measure 3.1 software by the same operator as shown in Figure 2.

Following landmarks and measurements were used in this study:

Landmarks:

- Long axis of mandibular third molar: it was a line that extended from the mid-occlusal point and midpoint of root bifurcation of the third molar.
- Tangent Line (TL): line drawn perpendicular to the occlusal plane touching the distal aspect of second molar.
- Occlusal Plane (OP): line that joined the tips of most superior cusps of the first premolar and tip mesial cusp of the second molar.
- Ramal Point (R): point where the OP plane intersects with the anterior ramus.

Angular and linear measurements used in the study:

- Third molar angulation with OP: angle formed between OP and long axis of the third molar.
- Available space for third molar eruption (A). Measured as a distance between intersection of OP with anterior border of ramus and intersection TL line.
- Third molar crown mesiodistal width (B). Line connecting the most mesial and distal points of the third molar.
- Ganss ratio: Ratio of line A to line B.
- A+B+C+D+E (Figure I)

All the linear and angular variables were analyzed using SPSS IBM v.20 (Chicago, III). Relationship of posterior space discrepancy and molar angulation with anterior crowding was investigated using Pearson's correlation coefficient. Means and standard deviations were calculated for the quantitative variables. P-value <0.05 was considered significant.

RESULTS:

The sample included 34 (56.7%) females and 26 (43.3%) males. Mean age was 19.47±3.59. Frequency distribution of Little's irregularity index is shown in Table 1. Means and standard deviation of control and experimental groups were evaluated and shown in Table 2. Comparisons of values between control and experimental groups are shown. All the comparison made between variables showed insignificant difference in Table 3.

Ganss Ratio:

The mean value was highest for the control group (1.06±0.37) on the left side and lowest for the experimental group on the left side (0.947±0.306). Ganss ratio showed an insignificant difference between control and experimental group. Ganss ratio showed a weak correlation in both experimental and control groups.

Third molar angulation with OP:

The mean value was highest for the experimental group on the right side (125.1±26.6) and lowest (115.8±34.73) for the control group on the right side. Both experimental and control groups showed an insignificant difference. Right and left side molar angulation showed a strong and moderate correlation with both groups.

Table 1: Frequency Distribution of Little's Index

Little's Index	N (%)
Perfect Alignment	30 (50%)
4–6 Moderate Irregularity	13 (21.7%)
7–9 Severe Irregularity	8 (13.3%)
10 Very Severe Irregularity	9 (15.0%)

Table 2: Means and Standard Deviation of Variables for Control and Experimental Group

	Control Group N=30	Standard Error Mean (CG)	Experimental Group N=30	Standard Error Mean (EG)
Ganss Ratio Right	1.01±0.3103	0.56	1.05±0.324	0.59
Ganss Ratio Left	1.06±0.37	0.11	0.947±0.306	0.13
Third Molar Angle With OP Right	115.8±34.73	6.34	125.1±26.6	4.86
Third Molar Angle With OP Left	123.01±20.36	3.71	119.38±32.5	5.95

CG=Control Group, EG =Experimental Group

Table 3: Comparison for Variables Among Control and Study Groups Using Independent t-Test

Variables	T	df	Sig. (2-tailed)	Mean Difference	Std.Error Difference
Ganss Ratio Right	-0.549	58	0.585	-0.04500	0.08194
Ganss Ratio Left	1.260	58	0.213	0.11100	0.08811
Third Molar Angle With OP Right	-1.162	58	0.250	-9.28	7.99
Third Molar Angle With OP Left	0.518	58	0.606	3.63	-25.29

P=<0.05 * Significant, R=0.8 > strong correlation

Table 4: Correlation of Control and Experimental Groups with Third Molar Angulation and Posterior Space Discrepancy

Variables	Control Group	Experimental Group
Ganss Ratio Right	0.34	-0.33
Ganss Ratio Left	-0.03	-0.21
Third Molar Angle With OP (R)	1*	1*
Third Molar Angle With OP (L)	0.55	0.62

Pearson's Correlation (>0.80*)

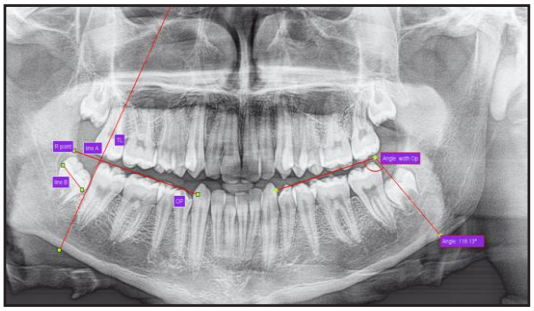

Figure 1: Linear Measurements

OP occlusal plane, Line A, Line B (Ganss ratio); R Ramal Point; TL, ⊥ line drawn from distal aspect of second molar to occlusal plane. Angular measurements; third molar angulation with occlusal plane. Using IC measure 3.1 software.

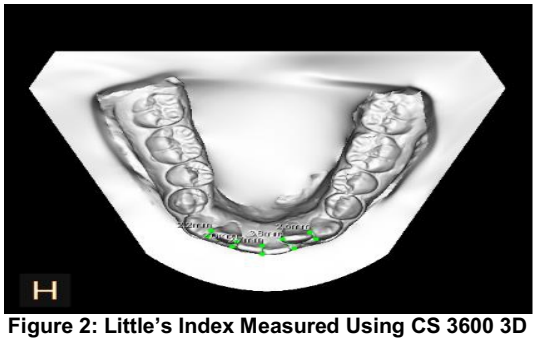

Figure 2: Little's Index Measured Using CS 3600 3D Imaging Software

In the above figure 2+2.2+2.1+3.2+2.4=11.9 reference severe irregularity.

DISCUSSION:

The eruption of third molars and its impact on the anterior crowding has been a subject of interest since many years[4, 7, 15-18]. Therefore, aim of the current study was to determine effects of molar angulation and eruption space on the anterior crowding assessed digitally. In our study sample was divided into control with perfect alignment and experimental groups with crowding >1 mm based on Little's Irregularity Index. As, Little's Irregularity Index is the most commonly used method to measure the anterior crowding[1,8,19,20]. Literature suggests few other methods to measure crowding like Lund storm's and TSALD .These methods have been reported to be more complex and also very not specific in measuring the anterior crowding[21]. Various studies have been reported in literature using lateral Cephalogram, OPG's for third molar angular measurements. OPG's have been found to be better in determining the third molar angulation[18,20]. For Hasewaga, used lateral Cephalogram in their study for measuring the lower molar angulation. Plaster casts are mostly used to measure the crowding[13,21]. In this study we used digital (CS9000) OPG's and intra oral scanned digital models. To evaluate any space discrepancy in the third molar region we used Ganss ratio. In our study comparisons

between control and experimental group showed, greatest mean value of Ganss ratio in control group on the left side. All the ratio values were >1 except the experimental group on the right side. Less value shows a space deficiency that could be responsible for impaction. However, for both groups the comparison showed an insignificant difference and a weak correlation. Although few studies in literature revealed a significant difference of space with anterior crowding[20]. Contrary to our results, study by Sood A et al, showed a significant difference in relation to third molar space on the right side (p=0.049). Although the difference was clinically insignificant[2]. According to Ganss, Olive and Basford, if the ratio is found to be >1, there are chances 70% for the third molar to erupt in the occlusal arch[2,20]. Hence, any value lower than 1 indicate probability of impaction. Therefore, it has also been suggested in the literature if there is adequate space for the eruption of tooth, it will erupt to its normal position, without causing any adverse effect on other teeth. Similarly, Tara et al, conducted a study on the size of anterior teeth and arch length in erupted, impacted and missing third molar. They found a statistically significant difference in all three groups. The arch length and so the arch perimeter was found to be insufficient in the former groups[4]. They concluded that lower third molars can be responsible for anterior crowding and procumbence and should be considered during treatment planning. Contrary to our results, Merin Cherian et al, reported a significant difference of crowding in relation to space. It was reported if space was less there were more chances of anterior crowding[20].

The molar angulation and inter-canine width have been reported to influence the mandibular anterior crowding indirectly[21]. Genest et al, conducted a systematic review and emphasized that the molar angulation only influences the lateral segment. Several studies reported third molar angulation influences only the premolar segment[21]. In our study, comparison of third molar angulation with the anterior crowding showed a clinically insignificant difference and a positive strong correlation. Results of Sood A et al are accordance with our study[2]. Although their control group included Little Index Irregularity 0-3mm. Results of Merin Cherian et al were also similar to our study and they also found no significant difference with anterior crowding and a weak negative correlation of anterior crowding with right and left molar space[20]. Similarly, study conducted by Aron et al revealed a weak correlation between lower molar angulation and space discrepancy with posterior teeth angulation. This could result in less posterior space and increased angulation of posterior teeth[6]. Similarly, Aron et al and other have reported that there is no direct role of posterior space discrepancy and angulation on anterior crowding and post orthodontic relapse. Therefore, the extraction of their molars is not justified in alleviating the crowding[6]. Mandibular incisor irregularity is also a debatable topic. Incisor irregularity seems to be a continuous process. The etiology has been reported to be multifactorial and complex[8]. Many factors including tooth size, arch form, mesially acting and forces from periodontal fibers etc[3,5,8,22].

CONCLUSION:

It is clear from the current study; molar angulation and space discrepancy have no significant effect on lower anterior crowding. Results of our study varied somewhat from other studies; reason could be the difference in measurements. We used intraoral 3D scanner for the little index evaluation and digital assessment of the OPG was performed using IC 3.1 measure software. Previous studies have mostly done measurements using plaster models, and manual tracings on the PG's.

LIMITATIONS:

One limitation of the study is that it did not consider the other etiologies of the anterior crowding. Further studies can be conducted, to assess the correlation in different facial morphologies, arch forms, and various skeletal and dental malocclusions. Also, other research projects can be conducted to determine accuracy and reliability of measurements using various intraoral digital scanned models.

CONFLICT OF INTEREST: None

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