Review Article

Tooth-size Discrepancy – An important diagnostic tool to measure the outcome of Orthodontic Treatment Completion: A Review

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Abstract:

Final finishing occlusion of an Orthodontic treated patient often become challenging due to presence of pretreatment tooth tissue discrepancy (TDS). Earlier proper diagnosis of Tooth tissue discrepancy and planed the treatment accordingly will minimize this problem to a great extant. This article emphasis's the significance, methods of screening of tooth size discrepancies and previous study references upon this tropic in national and international context.

Introduction:

A tooth-size discrepancy (TSD) is defined as a disproportion among the mesio-distal widths of maxillary and mandibular teeth of individual[1]. Orthodontic treatment comprises different phases, and each segment presents unique characteristics and challenges. The orthodontic "finishing" phase is recognized for the multitude of details necessary to achieve an excellent result. In some cases, the finishing phase is very difficult, requiring the production of complicated biomechanical forces to reach a satisfactory orthodontic solution.

If a patient has a significant tooth size discrepancy (TSD) between the arches, orthodontic alignment of the teeth into ideal occlusion may not be possible[2]. In order to achieve a good occlusion with the correct overbite and over-jet, the maxillary and mandibular teeth must be proportional in size. The mesio-distal widths of teeth were first formally investigated by G.V. Black[3] in 1902.

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He measured a large number of human teeth and set up tables of mean dimensions, which are still used as references today.

Many authors studied tooth width in relation to occlusion following Black's investigation. The best known study of tooth-size disharmony in relation to treatment of malocclusion was by Bolton[4] in 1958. He evaluated 55 cases with excellent occlusions. Bolton developed two ratios for estimating TSD by measuring the summed mesio-distal (MD) widths of the mandibular anterior teeth to the corresponding maxillary anterior teeth.

Bolton concluded that these ratios should be 2 of the tools used in orthodontic diagnosis, allowing the orthodontist to gain insight into the functional and aesthetic outcome of a given case without the use of a diagnostic setup. In a subsequent paper[5], Bolton expanded on the clinical application of his tooth size analysis. Bolton's standard deviations from his original sample have been used to determine the need for reduction of tooth tissue by inter-dental stripping or the addition of tooth tissue by restorative techniques.

Smith et al.[6] stated that specific dimension relationships must exist between the maxillary and mandibular teeth to ensure proper inter-digitations, overbite and overjet. Within certain limits, this would seem self-evident. But still among orthodontists, opinions vary widely concerning the frequency of significant TSD and the need to measure it in clinical practice.

This review therefore aims:

- To evaluate the different methods of measurement of TDS and their significance on finishing of Orthodontic Treatment.

- To evaluate the different study those measure the TDS in different population.

- To evaluate the different study those measure the TDS in our Bangladeshi population.

Significance of measuring TDS:

Without the proper mesio-distal tooth size ratio between the maxillary and mandibular teeth, correct coordination of arches would be difficult[7] Tooth size discrepancies is an often overlooked problem in retention[8].

Ballard[9] reported that 90% of the casts of 500 patients he examined had tooth size discrepancies. When the maxillary anterior teeth are too large in relation to the mandibular anterior teeth, clinical manifestations may be one of the several problems, such as: (1) deep overbite (2) greater overjet, or (3) combinations of greater overbite and overjet, (4) crowded anterior segment or (5) out of proper occlusion buccal segment. On the other hand, if the mandibular anterior teeth are too large in relation to the maxillary teeth, compensations on tooth positions include, (a) end to end relationship of teeth (b) spacing in the maxillary anterior segment (c) mandibular incisor crowding and (d) improper occlusion of posterior teeth[10].

Methods of Measuring TDS:

Bolton[4] describe the formula to calculate the tooth size discrepancies between upper and lower teeth will be calculated as below

= [(sum of mesio-distal width of mandibular six anterior teeth) ÷ (sum of mesiodistal width of maxillary six anterior teeth)] ×100%.]

And to calculate the overall tooth size discrepancies between upper and lower teeth, he[4] proposed the formula will be as below

= [(sum of mesio-distal width of mandibular twelve anterior teeth) ÷ (sum of mesiodistal width of maxillary twelve anterior teeth)] ×100%.]

To compute the data into the above formula, first the mesio-distal diameter of anterior six teeth (four incisors and two canines) and anterior twelve teeth (four incisors, two canines, four premolars and two first molar) on each jaw need to measure and then calculated through the above formula.

The traditional methods of measuring mesio-distal widths of teeth on dental casts can be described as manual methods and have either employed needle-pointed dividers or a Boley gauge (Venire calipers). Recent technological advances have allowed the introduction of digital calipers, which can be linked to computers for rapid calculation of the anterior and posterior ratios and the required correction to produce Bolton's mean ratio. Alternatively, digitized or scanned

images of the study casts can be measured on-screen. Ho and Freer[11] proposed that the use of digital calipers with direct input into the computer program can virtually eliminate measurement transfer and calculation errors, compared with analysis that requires dividers, rulers and calculators, although the same measurement error may be associated with the positioning of the calipers on the teeth. Zilberman et al.[12] also compared the measurement using digital calipers with OrthoCAD. Measurement with digital calipers produced the most accurate and reproducible results, but these were not much improved relative to the results with OrthoCad. Digital calipers seem to be a more suitable instrument for scientific work, but OrthoCAD's accuracy was considered clinically acceptable. Arkutu[13] evaluated commonly used means of assessing a Bolton's discrepancy to the gold standard, which was defined as the measurement with a Venire caliper to 0.1 mm.

Tooth-size Discrepancy (TDS) in other population in Different Study:

The prevalence of tooth-size discrepancies (TSD) in the general population has been quoted as being 5% by recommended litarature[2]. However, the basis for this figure was not explained and it appears to be defined as the proportion of cases that will fall outside 2 standard deviations from Bolton's mean ratios.[5] Recent studies conducted by Gerard et al[14] in 2010 among Irish population 37.9% had a clinically significant mean anterior TSD, which is is higher than the recorded 17.4% in a British orthodontic population in 2007 by Orthoman SA[15]. However, Crosby and Alexander[16] reported that 22.9% of subjects had an anterior ratio with a significant deviation from Bolton's mean (greater than 2 of Bolton's standard deviations). This is clearly a much higher figure than Proffit's recommended 5% prevalence of tooth-size discrepancies (TDS). They also noted that there were a greater percentage of patients with anterior TSD than patients with such discrepancies in the overall ratio. These findings are common to many investigations. In the study conducted by Freeman et al.[17] it is noted that the overall discrepancy was equally likely to be relative excess in the maxilla or the mandible, whereas the anterior discrepancy was nearly twice as likely to be a relative mandibular excess (19.7%) than a relative maxillary excess (10.8%). Santoro[18] and Souki[19] found similar prevalence values to Freeman.[17] Bernabe et al.[20] studied TSD in 200 Peruvian adolescents with untreated occlusions. Importantly, this sample was selected from a school, not

from an orthodontic clinic, so may not have been representative of patients undergoing orthodontic treatment.

Tooth-size Discrepancy (TDS) in Bangladeshi population in Different Study:

A few of such type of study was conducted in our country that is not sufficient enough to establish a country norm or representing the whole population. However among those studies Rahman[21] found the mean value for anterior ratio was 79.4% with standard deviation (±)2.31% and the mean value for man was 79.29% with standard deviation (±)2.58%. In other studies by Ali[22] the overall mean value was 79.34% with standard deviation (±)3.58%. These studies shows some idea regarding tooth tissue discrepancies (TDS) in our population, but things should be remember that those populations subjected to this study are only the patients attending the Orthodontic department of that hospital, not the country representing sample population.

Conclusion:

In sum up, we conclude that every orthodontic pretreatment model should go through this tooth tissue analysis before starting a orthodontic treatment to increase the success rate of final finish with whatever instrument and material is available on that circumstances. And further study upon this tropic in our population should be carried out to establish a country norm. Hope enthusiastic young learner and orthodontist will facilitated the study further.

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