In The Class Room

What is Bolton’s Analysis?

Dr. P. S. Dinesh

Introduction
Tooth size and proportion are important factors to be taken into consideration in Orthodontic diagnosis and treatment planning. Many malocclusions occur as a result of abnormalities in tooth size. Just like ‘The Golden proportions’ form an integral part of cosmetic dentistry, the Bolton analysis is a key factor in the Orthodontic diagnosis and treatment planning. The Bolton’s Analysis helps in determining disproportions in the size between maxillary and mandibular teeth.

Bolton’s Analysis
The Bolton’s Analysis was introduced by Bolton in 1958. It determines the ratio of the mesiodistal widths of the maxillary teeth to the mandibular teeth. It shows whether there is any tooth size discrepancy between the upper and lower teeth. Bolton’s Analysis is recommended only in the permanent dentition, after the eruption of all the permanent teeth (6-6). It is done on the study models and not in the patients mouth. In the Bolton analysis we have to determine the overall and anterior ratios using a formula introduced by Bolton.

Determining The Overall Ratio

Sum of Mandibular 12
The mesiodistal width of all teeth mesial to the mandibular second permanent molars (6-6), is measured and summed up (Second and third molars are excluded). This can be done using a divider and a ruler, and the individual teeth mesiodistal width is measured between their contact points on the study model.

Sum of Maxillary 12
The mesiodistal width of all the teeth upto the maxillary first molars (6-6) is measured and summed up. The overall ratio is then assessed.

Overall Ratio
According to Bolton, the sum of meso-distal widths of the mandibular teeth anterior to the second molars is 91.3% the meso distal width of the maxillary teeth mesial to the second molars.

The overall ratio is determined using the formula

$$\text{Overall Ratio} = \frac{\text{Sum of Mandibular} \times 12(M - D)}{\text{Sum of Maxillary} \times 12(M - D)} + 100 = 91.3 \pm 0.26$$

If the overall ratio is less than 91.3%, it indicates maxillary tooth material excess. The maxillary teeth are relatively too large compared to the mandibular teeth. On account of the importance for the canine relations as well as for overbite and overjet relationships, a further analysis is performed to evaluate the ratio between the six upper and lower anterior teeth (anterior ratio).

Determination of Anterior Ratio
The sum of the meso distal width of the mandibular anterior should be 77.2% of the meso distal width of the maxillary anterior. The anterior ratio is determined using the formula

$$\text{Anterior Ratio} = \frac{\text{Sum of Mandibular}6 \times 100}{\text{Sum of Maxillary}6}$$
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If the anterior ratio is less than 77.2%, it indicates maxillary anterior excess and if the anterior ratio is more than 77.2%, it indicates mandibular anterior excess (the total width of the lower six anterior teeth is relatively too large or maxillary anterior deficiency such as a peg shaped lateral incisor).

In normal occlusion relationships and good incisor position tooth size discrepancies are often the cause of rotations, space formations, crowding and incorrect intercuspation. Disharmony between the width of upper and lower teeth can be improved by

1. Extractions
2. Intercapral sinking
3. Expansion procedures, if it can be performed, in selective cases, depending on the cortical plate thickness and age.
4. In some cases, by increasing the mesio distal tooth size of the disproportionate tooth.

The relevance of anterior ratio value is greatly reduced in the following situations. Severe labio version/ proclination of lower incisors. Abnormally large mesio distal width of the incisors; especially upper anteriors/ central incisors.

EXCESSIVE MESIO DISTAL TOOTH MATERIAL

Maxillary Arch

Causes
1. Increased Overbite
2. Increased overjet
3. Crowding in the maxillary arch
4. Spacing in the maxillary arch
5. Lingual version/proclination of upper incisors
6. Labio Version/Proclination of lower incisors

MANDIBULAR ARCH

Causes
1. Reduced Overbite
2. Reduced overjet
3. Crowding in the mandibular arch
4. Spacing in the maxillary arch
5. Labio version/proclination of the upper incisors
6. Lingual version/proclination of lower incisors

Identification of the etiology will help us in determining the treatment planning for that specific case.

SUMMARY

Ideal Relationship of maxillary and mandibular tooth widths according to Bolton.

Refer to the tables for the average values for the overall and anterior ratio (Values are in mm).

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After calculation of the Bolton ratio, the arch with the relatively smaller tooth material is determined and the actual figure corresponding to the arch tooth size is located in the table.

The ideal value for the size of the opposing teeth is read off from the accompanying column.

The difference between the actual value and the ideal value (according to the table) for the relatively enlarged tooth material represents in mm the amount of excess tooth size in the arch.

EVALUATION CHART FOR THE BOLTON ANALYSIS

Conclusion

Bolton’s ratio forms an integral part in the diagnosis and treatment planning in orthodontics. Depending on the overall and anterior ratio, the decision to extract or disc or
expand or buildup can be taken. If the discrepancy is too large, an extraction decision can be made, if it is a minor one, expansion can be attempted. In case of hypoplastic upper lateral incisors, we may need to do the buildup first to restore it to the ideal proportion. The Andrew’s six keys of occlusion even though developed much later, is much dependant on the Bolton’s ratio. The study of the Bolton’s Analysis will help us in estimating the overbite and overjet relationships that will likely obtain after the treatment is finished and also understand the effects of contemplated extractions and on posterior occlusion and incisor relationships. Before I sum up a word of caution, Bolton’s Analysis predictions donot take into account the sexual dimorphism in maxillary cuspid widths. Since maxillary cuspids are disproportionately larger in men than in women, an ideal overbite and overjet, as defined by Bolton, is less apt to be achieved in men, especially with relatively wider canines, than ideal. It also has got limited scope in cases with severely proclined lower anteriors and unusually wide upper incisors.

Dr. P. S. Dinesh did his masters from the International university of health sciences, St Kitts & Nevis, West Indies in the year 2003. He is based in Trichur, Kerala, where he has his own practice along with his wife Dr. Sumitra for the last 16 years. He has conducted more than 40 workshops and Hands on programmes on the Prosthetics edge to appliance & fixed Orthodontics, in and outside Kerala, for the last 3 years. He also holds a Ministry of Health Dental licence in the United Arab Emirates and is a visiting consultant to a private medical centre in Ajman, UAE.

Clinical manifestations of Bolton’s Discrepancy.

Peg shaped lateral incisors.

Missing maxillary lateral incisor.

Abnormally increased width due to gemination.

Increased mesiodistal width of lower right molar prosthesis.

Missing mandibular incisors.

Pictures Courtesy: Dr. Akshay Raithi