THE PREVALENCE OF BOLTON DISCREPANCY IN ROMANIAN TEENAGED ORTHODONTIC PATIENT

Anca Stefania Mesaros[1], Roxana Oancea[2], Aranka Ilea[3]

Abstract

The patients present themselves in the dental office demanding a perfect Smile. The orthodontic specialists have a role in creating this perfect Hollywood smile by orthodontic treatment. However, to do this, there is a need to do a thorough assessment of each case in order to place a correct diagnosis and present the proper treatment plan. The presence of a Bolton discrepancy changes the treatment plan. The present study wishes to determine the prevalence of Bolton discrepancy in a group of Romanian teenaged population. Measurements were done of dental casts for 50 patients and questioners regarding the preferences in the therapeutic approach of Bolton Discrepancy cases were distributed to Orthodontists. The results revealed a high prevalence of Bolton discrepancies among the studied population as well as a lack of consensus for a protocol in management of such patients by the orthodontists, an individualized approach being preferred.

Keywords: orthodontic therapy, teenager patient, Bolton discrepancy

Introduction

Aesthetics has been, is and will continue to be a concern of modern man, having its origins since antiquity.

Since ancient times, teeth have been elements of beauty, youth, power, not only through their presence, but also through their integrity. There are some researches that prove the existence of certain practices of human dental care, most often of a religious and social nature. [1]

Aesthetics is defined as the science that studies the category and laws of an art, a form of reception of beauty, concerning the essence of art, the relations with the reality and the method of artistic creation. [2]

Dental aesthetics derives from the study of dental and facial morphology, representing a branch of aesthetics as a whole. There are no rigid and objective rules regarding dental aesthetics, subjectivism having here a major role, which is perceived differently by each individual. [3-5]

Dental aesthetics always represent a challenge for the dentist in trying to create smiles as close as possible to perfection, but also naturally. The smile represents a means of communicating with people around and can add a pleasant or less pleasant note to a conversation.

Orthodontists, like doctors of other specialties, have taken on this duty of improving dental aesthetics, by trying different ways to achieve the expected results, but working only with the patient's biologically available material. It is necessary to consider various new measurements, individualizations and knowledge to fully meet current needs and requirements.

Orthodontic treatment not only involves the alignment of teeth, but also a whole complex of phases with unique challenges and features. An important phase is the finishing, characterized by a multitude of details needed to reach the desired result.

In many situations, this end point is difficult to reach, requiring some biomechanical forces to achieve an orthodontic solution. Much of these situations arise from the error of diagnosing dental annomalies at the start of treatment as early as the initial diagnosis phase.

The analysis of the required or offered space in orthodontics is an important step in deciding how to achieve that space by eventual extraction.

Consequently, in order to gain a functional occlusion, mandibular and maxillary teeth should be proportionate in size.

Bolton's analysis is an important stage of any orthodontic treatment and is used by simply measuring mesio-distal dental diameters. In 1958, Wayne A. Bolton laid the foundation for this analysis, four years later, he continued to explain the importance and clinical applicability of his Orthodontic analysis. In present times, it is one of the most popular methods for determining tooth size abnormality[5].

[1]Department of Dental Propaedeutics and Aesthetics, Faculty of Dentistry, "Iuliu Hațieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania

[2]Department of Preventive Dentistry, Faculty of Dentistry, "Victor Babes" University of Medicine and Pharmacy, Timișoara, Romania

[3]Department of Oral Rehabilitation, Faculty of Dentistry, "Iuliu Hațieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania

E-mail: mesaros.anca@umfcluj.ro, roancea@umft.ro, aranka.illea@umfcluj.ro

The overall Bolton ratio is the percentage obtained by summing the widths of the 12 mandibular teeth divided by the sum of the widths of the 12 maxillary teeth and should be 91.3 ± 0.26 per cent. Anterior ratio is the percentage obtained by summing the widths of the six mandibular anterior teeth divided by the sum of the widths of the six maxillary anterior teeth and should be 77.2 ± 0.22 per cent (Bolton, 1958, 1962)[6,7]. The original analysis, done by Bolton, was performed on 55 patients with excellent occlusion, including 44 orthodontically treated (non-extraction) and 11 untreated subjects. A ratio smaller than 91.3% would mean the mandibular teeth are smaller than normal. Anterior analysis follows the same principle. Having a different ratio than normal is referred to as Bolton Discrepancy. A standard deviation of more than 2 yields a significant discrepancy.

It would be ideal for Bolton's analysis to become a routine for the orthodontic treatment so that the results offered are used in the final treatment plan. It is recommended that it begin with the determination of the severity and location of the discrepancy, in order to decide whether or not to gain space in the opposite arch.

The aims of our study are to search for the prevalence of Bolton Discrepancies on a group of Romanian teenaged orthodontic patients and to emphasize the importance of the analysis for a correct orthodontic treatment.

Material and methods

The study group consisted of 50 pairs of cast models (25 from each gender), mandibular and maxillary models from patients who presented themselves in the dental practice for their initial orthodontic visit between October and December 2016 and which met the inclusion criteria:

- age between 12-18
- natural permanent dentition without any caries, fillings, prosthetics
- no extractions or stripping procedures prior to their visit in our office
- no genetic syndroms, facial dismorphism
- no facial trauma
- no surgeries in the oral region

The exclusion criteria were:

- People who do not integrate in the age range to whom the study is addressed
- Persons who have restorative or prosthetic works at the anterior teeth
- Temporary or mixed Dentition
- People who have a history of extraction or stripping
- People with facial, congenital, post - traumatic or post - surgical abnormalities

Mesio-distal diameters of anterior teeth were measured using a digital caliper for both upper and lower jaw models (Fig 1).

Fig nr 1- Dental casts and digital caliper.

Also, a simple multiple-choice questioner on therapeutical procedures used for the management of Bolton Discrepancy was also administered to 100 orthodontists.

Data was analyzed and interpreted doing a simple descriptive statistics using the Microsoft Excell Software and SPSS 13th edition software.

Results

The study showed that 70 percent of the studied population was presenting a Bolton discrepancy. Between the patients with Bolton discrepancy, 63,3% were female and 74% of the affected population was of mandibular excess. (Fig 2).

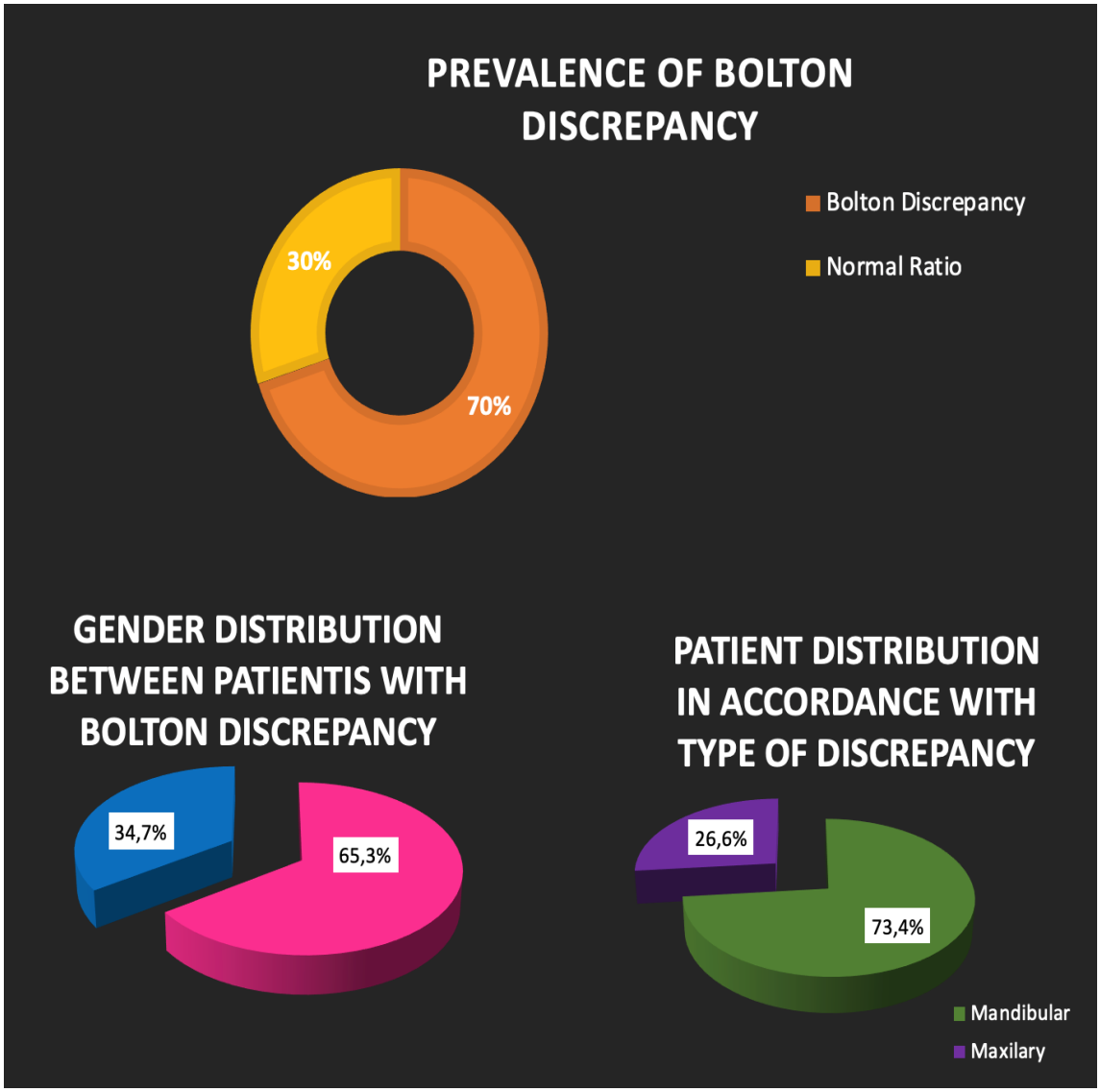


Fig 2. Prevalence of Bolton discrepancy among the studied population.

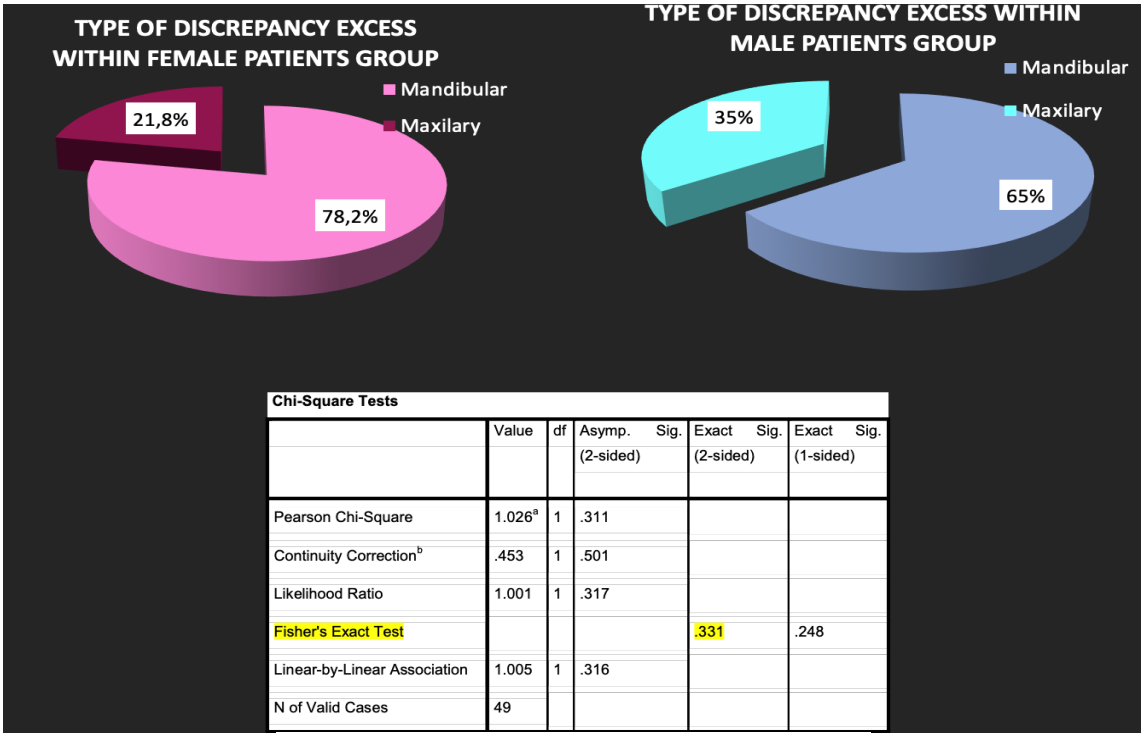
However, there is no statistically significant dependence relationship between the gender of the patient and the type of dental excess presented (Fisher Exact test: p = 0.331> 0.05). (Figure 3).

While assessing the gathered measurements, the mean values of the mesio-distal diameters of each anterior teeth was calculated and it is presented in Table nr.1. For the average values, an average of 79,12% of the anterior Bolton Ratio should be considered to be normal for the studied population.

While assessing the individual values of mesio-distal diameters of frontal teeth on the patients presenting Bolton distrepancy, a significant difference between the distribution classes of values was observed. Figure 4 presents the class distribution of values for teeth 1.1 and 2.1.

Most patients presenting with maxillary dental excess have values between 40.3-52.3 mm, with a Gaussian distribution, with minimum values of 40.3 mm and maximum 53.1 mm.

Most patients with mandibular dental excess have total dimensions of the excess type, located between 31.7-40.7 mm, with a Gaussian distribution, with minimum values of 31.7 mm and maximums of 43.3 mm.



Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.026[a]	1	.311		
Continuity Correction[b]	.453	1	.501		
Likelihood Ratio	1.001	1	.317		
Fisher's Exact Test				.331	.248
Linear-by-Linear Association	1.005	1	.316		
N of Valid Cases	49				

Fig 3. The type of discrepancy excess related to gender.

AVERAGES OF MD DIAMETERS OF FRONTAL TEETH AND BOLTON INDEX OF AVERAGES							
1.3	1.2	1.1	2.1	2.2	2.3	Max	
7,7132	6,4966	8,438	8,5004	6,462	7,6282	45,953	Bolton
4.3	4.2	4.1	3.1	3.2	3.3	Mand	0,7912
6,844	5,812	5,4054	5,3826	5,8124	6,7848	36,323	

Table 1- Averages of mesio-distal diameters of frontal teeth and mean Bolton index value.

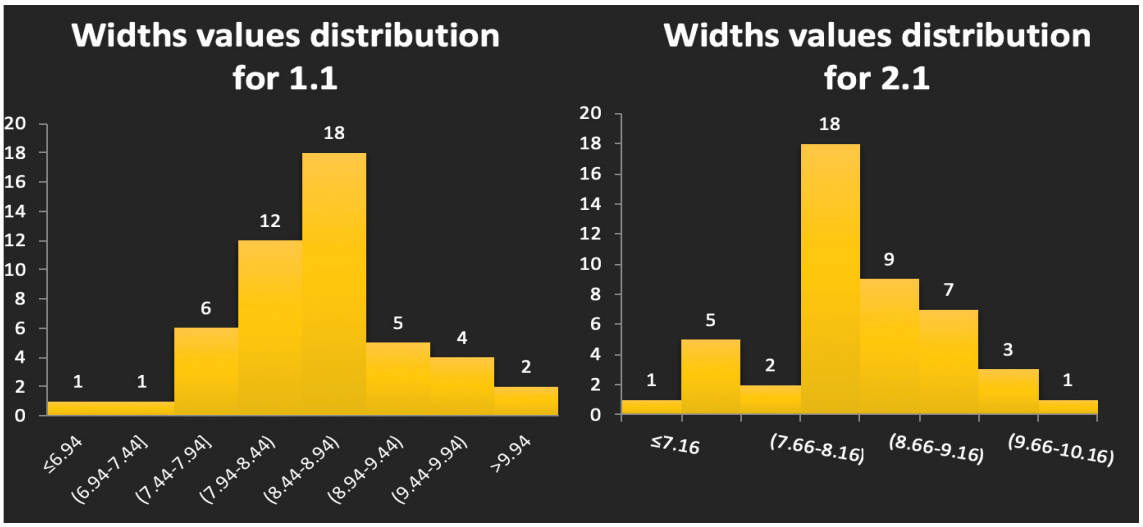


Fig 4. Class distribution of values for 1.1 and 2.1.

While trying to determine the correspondace with the golden ratio of the mesio-distal diameter dimensions of central incisors, an important discrepancy vas found as presented in figure 5.

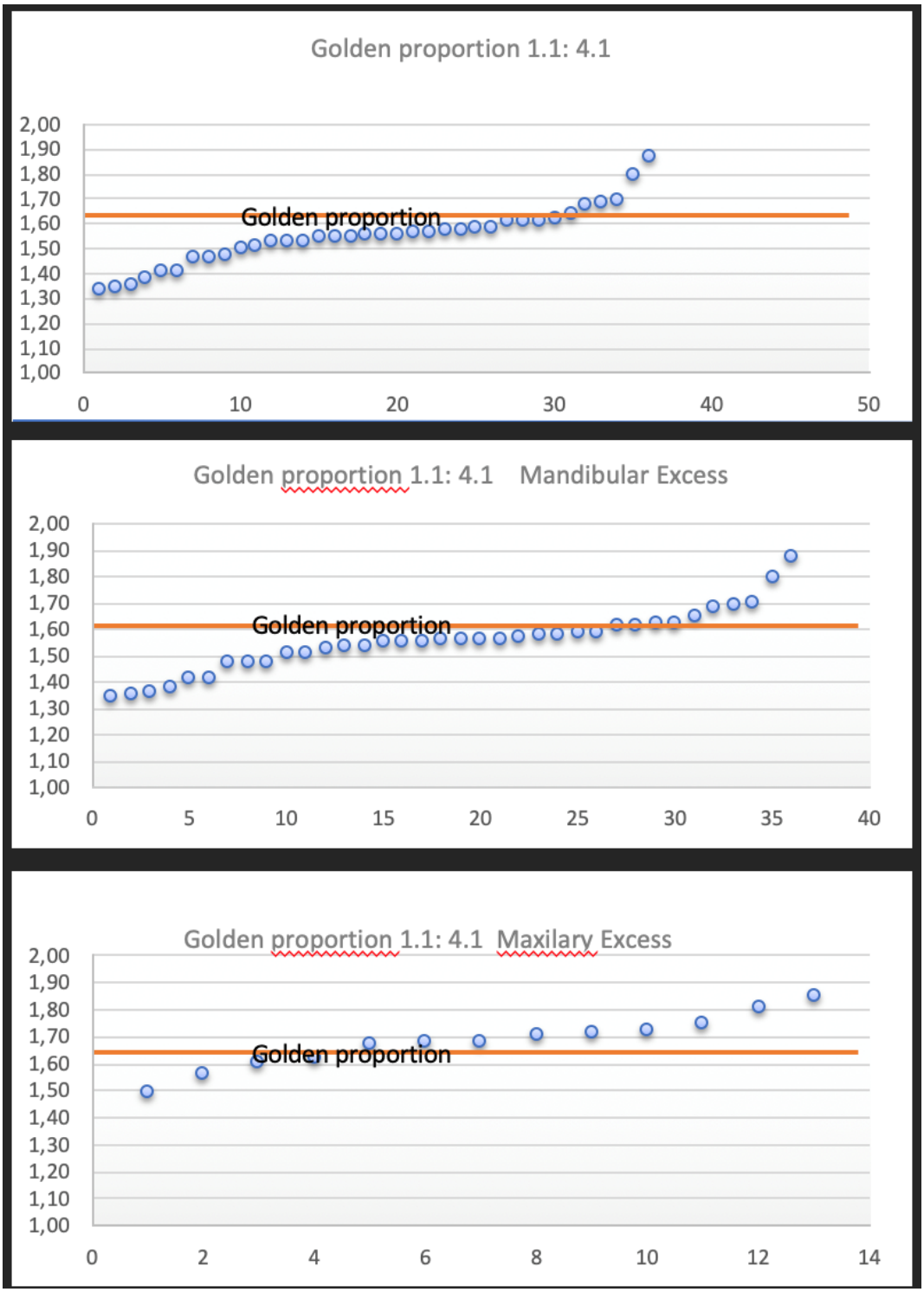


Fig.5.Distribution of individual ratos between dimensions of mesio-distal diameters of upper and lower incisors in regard with the golden proportion ratio.

As shown by the results of the first part of the study, there is a high prevalence of Bolton discrepancies among Romanian teenaged patients. In order to assess the management such cases we distributed a multiple-choice questioner to 100 orthodontists. As seen in Figure 6, there is no specific therapeutic approach for such cases, the percentages between the different approaches being similar. Also, many orthodontists could not specify a therapeutic approach as a general way of management, needing specific information for each case, to individualize treatment, specifications that were not available through our questioner.

However, we could observe that the therapeutic approach is quite different weather we have a maxillary or mandibular excess. If for maxillary excess, most of the orthodontists prefer individual assessment with more details, for the mandibular excess interproximal reduction (stripping) of enamel is preffered, as seen in Figure 7.

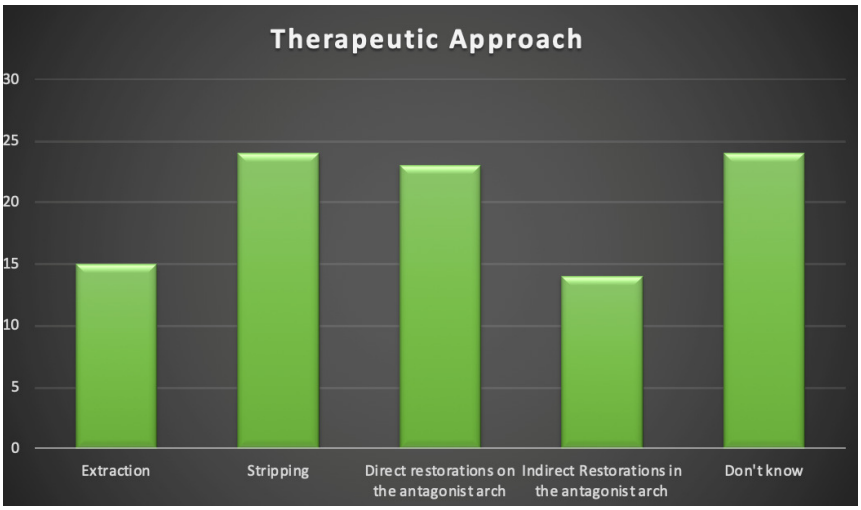


Fig. 6. Different therapeutic approaches preferred by orthodontists.

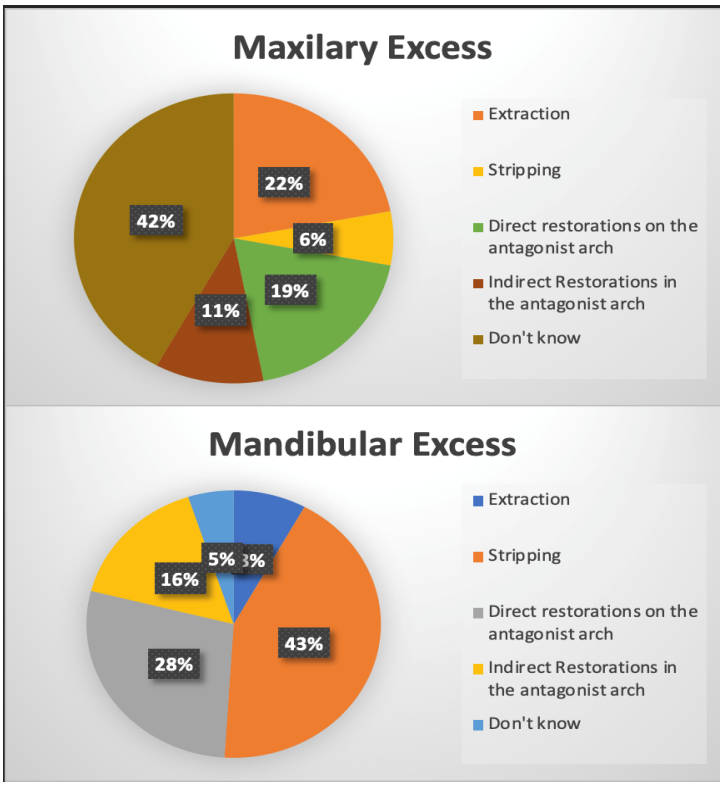


Fig. 7. Preferences in therapeutic approach in regard with Maxillary/Mandibular excess.

Discussions

Bolton suggested that a discrepancy greater than 1 SD may create clinical problems. Most authors define a clinically significant ratio as 2 SD outside Bolton's mean (Crosby and Alexander, 1989; Freeman *et al.*, 1996; Santoro *et al.*, 2000)[1].

Proffit *et al.* (2007) cited by Uysal et all [5] stated that a tooth width discrepancy larger than 1.5 mm creates problems that should be considered in the treatment plan. Most authors assert that a tooth size discrepancy, compared with Bolton's norm, greater than 1.5 mm, or 2 SD, results in difficulties in tooth alignment in the finishing phase of treatment (Crosby and Alexander, 1989; Freeman *et al.*, 1996; Santoro *et al.*, 2000; Araujo and Souki, 2003; Bernabé *et al.*, 2004; Othman and Harradine, 2007). No evidence has been found for the clinical importance of a discrepancy exceeding 2 SD or 1.5 mm and both values seem to be suggestions.

To ensure proper relations between arches and teeth (interdigitation, overbite, overjet), there has to exist a specific dimension for each element. Patients with inter-arch tooth-size discrepancies usually require special finishing (removal or addition of tooth structure). Bolton's analysis should be routinely performed in all orthodontic patients and the results should be properly used in the final treatment plan

The purpose of this study was to evaluate the size of the maxillary and mandibular frontal group, apply the Bolton formula and express its value, respecting the gold ratio, between 1.1 and 1.2, 2.1 and 2.2, 1.1. and 4.1, as well as 2.1 and 3.1, on a batch of subjects selected according to inclusion and exclusion criteria. The data obtained in the study were centralized and expressed in tables and graphs in the results section of the paper.

Female sex compliance for dental treatments, as well as their interest in aesthetics, is also evidenced by the higher number of female patients who presented themselves to the dental office in the prescribed period compared to males.

As regards of the comparison between female and male groups, the results showed that there were significant differences in the female-group size of the dental mesio-distal dimension, implicit also of the anterior Bolton ration, compared to the male group. These results are consistent with literature studies conducted on 228 subjects by Uysal T, Basciftci FA, Goyenc Y. [7, 8], or by 56 subjects by Lombardo L. [9,10].

For male patients, mean sextant values were significantly higher than in females, as confirmed by a Smith SS study on 180 patients. [11]

As a result of the data obtained, there was a greater variability of the mesio-distal size of the mandibular teeth than the maxillary teeth, which contradicts some literature studies. [12]

Analyzing the data obtained from W. Bolton's formula, different classes of malocclusion resulted, each representing differences in the Bolton value calculated from that considered norm. [7] [13-17]

As a result of the statistical tests performed, no difference was observed between the patient's sex and the type of excess, the same result emerging from some studies present in the literature. [18]

With respect to the gold proportion, of the 70 patients, only 13 patients were close to the golden ratio.

Conclusions

- There is no statistically significant dependence relationship between the patient type and the type of excess
- The values of the patients in the study group that had mandibular excess were significantly higher than the maxillary values. And prevalence was higher in the female population.
- According to the results presented, there is a slight discrepancy of the obtained values compared to the ones presented in the literature, such as: in maxillary canines, incisors and mandibular canines, a diameter 0.1-0.3 mm larger, and in the mandibular incisor, with 0.15 mm which would modify the Bolton Ratio in Romanian Population
- In the case of values 1.1, 1.2, 1.3, 2.1, 2.3, 3.2, 3.3 and 4.2, as well as the value of maxilary or mandibular excesses, the female sex in the examined patients group had significantly higher values than the male.
- The choice of therapeutical approach is theoretically dependent on the location of the excess although orthodontists would prefer to make the decision together with the dentist whom reffered the patient

Bolton's original data does not represent all populations, interarch tooth size relationships are population and gender specific and population-specific standards are necessary for clinical assessments.

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Correspondence to:

Roxana Oancea
Department of Preventive Dentistry,
Faculty of Dentistry,
"Victor Babes" University of Medicine and Pharmacy,
E. Murgu 2,
Timisoara,
Romania,
Phone: 0721 335 788,
E-mail: roancea@umft.ro