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Original Article

Peers' Perception Regarding Golden Proportion/ Golden Ratio: A Questionnaire Based Survey

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Abstract

Introduction: The previous studies evaluated the perception of laypersons to symmetric alteration of anterior dental aesthetics. However, no studies have evaluated the knowledge regarding the golden perception. These questionnaires determine the knowledge regarding the golden perception is observed by dental professionals.

Materials and Methods: A questionnaire-based survey was formulated and circulated in peer groups of dentistry. Profile photographs were intentionally altered with a software-imaging program and basic and advanced questionnaires were formed. Statistical analysis of the responses resulted in the establishment of threshold levels of perception for each group.

Results: There are certain areas in which statistically significant difference is found between orthodontist and others regarding perception of Golden proportion in their respective fields.

Conclusions: Basic knowledge regarding golden proportion is the need of the hour to change the perception of dental professionals and result in a more educated and informed approach in the treatment of each patient.

Key words: Aesthetics, Golden proportion, Peers perception

INTRODUCTION

Since time immemorial, nature has developed various patterns and processes with interesting characteristics. They have been used as an inspiration for a significant number of innovative models that can be extended to solve complex engineering and mathematical problems. One such exceptional pattern is Golden Ratio: An irrational number that appears frequently as an esthetic standard in art, architecture, and nature. Its distinctive mathematical properties lead to some interesting applications in many branches of science including human anatomy. The Golden proportion is considered as the most pleasing composition to human vision; however, it is not limited to esthetic beauty but its existence can also be in natural world through the body proportions of living beings, the growth patterns of many plants, insects, and also in the model of enigmatic universe. The properties of Golden section can be instituted and integrated in the pattern of mathematical series and geometrical patterns.[1]

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Analysis of attractiveness of faces has long been a topic of research. The literature has identified many different factors that can be related to attractiveness. Here, in this study, we will analyze perception about the role of symmetry and Golden ratio in the determination of attractiveness of a face by focusing on the geometry of a face using actual faces. We found there are some differences in the criteria used by males and females to determine attractiveness.[2]

The purpose of this study was to determine whether asymmetric and symmetric anterior dental discrepancies and extraoral profile discrepancies are detectable by various groups of evaluators, and the extent of their knowledge and comprehension on concept of Golden ratio.

These data are invaluable in designing complex, interdisciplinary treatment plans, and to evaluate each scenario at dental professional level, possessing a comprehensive understanding of Golden ratio.

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MATERIALS AND METHODS

Different groups of raters were used in this study. For the same, questionnaire was made in the pattern of Google form and circulated to various groups of dental fraternity to evaluate and acquire their perception concerning "Golden section." All dentists were registered members under Dentist Act, 1948 in Dental council of India, including various region of India. They were selected randomly and Google form was sent to 150 individuals who were actively involved in members' association at different level. An ethical committee approval and patient consent are not applicable for questionnaire-based survey.

Variables

The different groups rated extraoral profile photographs and intraoral photographs on the account of need of correction of profile and teeth, respectively (from no need to severely needed); additionally sharing their number of years of experience and expertise in various fields of dentistry. The extraoral profile photograph of subject was intentionally altered using Dolphin Imaging Software 2D (version 11.8) to create various skeletal discrepancy [Figure 1]. Lateral cephalogram X-ray was digitized and its tracing overview was superimposed on extraoral profile photograph. These alterations were chosen based on their frequency and clinical significance to the face. The intraoral photographs include different degree of crowding and irregularities present in both dental arches which can be easily comprehended through intraoral frontal photographs [Figure 2].

The others questions were in form of thorough knowledge of Golden ratio.

Questionnaire

1. Years of Experience:
   - <5 years
   - 5–10 Years
   - More than 10 Years.
2. Area of Expertise:
   - Orthodontics
   - Prosthodontics
   - General dentist
   - Oral and Maxillofacial Surgeon
   - Any Other Please Specify.

Basic (B1) Category

3. Rate extraoral photographs based upon need of correction in facial profile (no Need to severely needed) Figure 1.
   - A,B,C,D,E
   - D,C,A,B,E
   - E,A,C,B,D
   - C,B,D,A,E
4. Rate intraoral front photograph based on need for correction of teeth (no need to severely needed) Figure 2.
   - B,C,A,D
   - C,B,A,D
   - A,C,D,B
   - A,B,C,D
5. The Golden ratio is claimed to appear in many fields, such as cosmology, theology, arts, architecture, botany, and others.
   - True
   - False
   - Do not Know.
6. The American mathematician, Mark Barr, has chosen Phi as the symbol for the Golden ratio. Phi is named after which of the following Greek sculptors?
   - Philips
   - Phidias
   - Phiviles
   - Phixels.
7. At present, the Golden ratio is symbolized by the Greek letter phi. Sometimes, it is also represented by another Greek letter. Which letter is it?

Figure 1: (a-e) Rate Extra oral photographs based upon need of correction in facial profile (no Need to severely needed)

Figure 2: (a-d) Rate Intra oral front photograph based upon need for correction of teeth (no need to severely needed)

- Sigma
- Delta
- Tau
- Lambda.

8. In what way is the Golden ratio, phi, related to the Fibonacci sequence?
   - The ratio of two adjacent numbers in the Fibonacci sequence is exactly phi
   - There is no similarity
   - They were discovered by the same person
   - The ratio of two adjacent numbers in the Fibonacci sequence is approximately phi.

9. Do you think does Golden proportion exist in human anatomy?
   - True
   - False.

10. Rule of Third is the face can be horizontally divided into thirds. From the hairline to the glabellar line (eyebrows) is 1/3, the brow to the base of the nose 1/3, and the base of the nose to the chin one-third.
    - True
    - False.

11. Rule of fifth uses width of the eye from corner to corner as a point of measurement; the face can be vertically divided into fifths. Starting from the very outside edge of one ear to the other the face ideally would be 5 eye widths apart. The width of the base of the would be a fifth.
    - True
    - False

12. The golden ratio is also known by many other names. Which of the following names is NOT one of those?
    - The golden mean
    - The golden integer
    - The golden number
    - The golden proportion.

13. The structure of which human body part is in accordance with Golden proportion?
    - Face
    - Lungs
    - Heart
    - All of Above.

14. Does Golden proportion influence Smile esthetics?
    - Yes
    - No
    - Don't Know.

15. Do you consider Golden proportion during any procedure?
    - Yes
    - No.

Advanced (A1) Category

16. What concepts should be considered while using Golden ratio as an aid for dental treatment?
    - Gender and age of patient
    - Understanding patient's desires and expectation
    - Concepts that create harmony between smile and facial esthetics
    - All of the above.

17. Which type of smile should be used to plan esthetic dental treatment?
    - Commissure smile
    - Cuspid or social smile
    - Complex smile
    - All of the above.

18. Which points must be considered while planning vertical changes of teeth in esthetic zone?
    - Occlusal maxillary plane and head inclination while assessing patient's smile
    - Mandibular function
    - Inter incisal angle
    - (a) and (c)
    - All of the above.

19. Which is the factor of paramount importance to achieve an attractive young smile?
    - Vertical positioning of maxillary incisors
    - Gingival design
    - Levels of gingival exposure
    - Tooth color and shape.

20. For clinicians to achieve ideal design of incisal contour in the esthetic zone, the step between central and lateral incisors must range from,
    - 1–1.5 mm for women and 0.5–1 mm for men
    - 0.5–1 mm for women and 1–1.5 mm for men
    - 0.5–1 mm for both
    - None of the above.

21. When viewed facially, the width of each anterior tooth is 60% of the width of the adjacent tooth.
    - Yes
    - No.

22. What is RED proportion?
    - Real Esthetic Dental proportion
    - Recurrent Esthetic Dental proportion
    - Recurring Esthetic Dental proportion
    - None of the Above.

RESULTS

Total 102 faculties from different fields have participated and filled the questionnaire form online. Out of 102, 58 were orthodontist and 44 were others (six prosthodontist, 24 general dentist, three oral and maxillofacial surgeons, and 11 others fields of dentistry). Since, the number of faculties other than orthodontists was small; they were grouped under "Others" category to compare with "Orthodontist" group.

According to years of experience, there is no statistically significant difference found in all three categories, rather, limited only to two questions where statistically significant difference is found in <5 years' experience (*P* value 0.018) and more than 10 years' experience (*P* value 0.032) [Tables 1 and 2]. These data do not resemble overall data so it is not to be considered to have any effect according to years of experience.

There are certain areas in which statistically significant difference is found between "Orthodontists" and "Others" regarding perception of Golden proportion in their respective fields. We have considered only those categories where minimum three questions are true from each participant, otherwise to be considered in false category [Tables 3-9].

Table 1: The Golden ratio is also known by many other names. Which of the following names is NOT one of those?

	False	True	Total
Years of Experience			
<5 years	17	11	28
5–10 years	32	6	38
More than 10 years	21	15	36
Total	70	32	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
6.872	2	0.032	

Table 2: Do you consider Golden proportion during any procedure?

	False	True	Total
Years of Experience			
<5 years	4	24	28
5–10 years	18	20	38
More than 10 years	14	22	36
Total	36	66	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
8.362	2	0.018	

Table 3: The Golden ratio is claimed to appear in many fields, such as cosmology, theology, arts, architecture, botany, and others

	False	True	Total
Area of Expertise			
Orthodontist	4	54	58
Others	14	30	44
Total	18	84	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
10.693	1	0.001	

Table 4: The American mathematician, Mark Barr, has chosen Phi as the symbol for the Golden ratio. Phi is named after which of the following Greek sculptors?

	False	True	Total
Area of Expertise			
Orthodontist	29	29	58
Others	34	10	44
Total	63	39	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
7.880	1	0.005	

Table 5: In what way is the golden ratio, phi, related to the Fibonacci sequence?

	False	True	Total
Area of Expertise			
Orthodontist	28	30	58
Others	36	8	44
Total	64	38	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
12.042	1	0.001	

Here, B1 category is termed as basic question category, where it was found that "Orthodontists" had higher perception concerning golden proportion as compared to "Others" with statistically significant value of 0.001 [Table 10]. However, according to the survey of advance questions category (A1), "Orthodontists" do have higher perception than "Others" category, but this difference is not statistically significant.

DISCUSSION

The present study was performed to evaluate whether asymmetric and symmetric anterior dental discrepancies and extraoral profile discrepancies are detectable by various groups of evaluators, to how much extent they are having knowledge on concept of Golden ratio. The results of the present study demonstrated that the orthodontists possess a higher perception toward Golden ratio as compared to others. Orthodontist found Golden proportion to be very useful as it influences smile esthetics.

Researchers from varied areas have been motivated to study the possibility of facial-skeletal measurements to be related with the ideal proportions, such that the esthetics may be scientifically assessed rather than based on subjective judgments.[3-5] Snow[2] stated that symmetry, dominance, and proportion for an esthetically pleasing smile are the three composition elements required to create unity and esthetics in a smile and the concept of Golden percentage is a useful application in the diagnosis and development. Miller[6] stated that the trained and observant eye readily detects what is out of balance, out of harmony with its environment, or asymmetric. Investigation of lay people's self-perception of dental esthetics has focused largely on gross esthetic discrepancies

Table 6: Rule of fifth uses the width of the eye from corner to corner as a point of measurement; the face can be vertically divided into fifths. Starting from the very outside edge of one ear to the other the face ideally would be five eye widths apart

	False	True	Total
Area of Expertise			
Orthodontist	2	56	58
Others	13	31	44
Total	15	87	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
13.585	1	<0.001	

Table 7: Does Golden proportion influence of smile esthetics?

	False	True	Total
Area of Expertise			
Orthodontist	1	57	58
Others	9	35	44
Total	10	92	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
9.926	1	0.002	

Table 8: When viewed from facial, the width of each anterior tooth is 60% of the width of the adjacent tooth

	False	True	Total
Area of Expertise			
Orthodontist	8	50	58
Others	16	28	44
Total	24	78	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
7.084	1	0.008	

Table 9: What is RED proportion?

	False	True	Total
Area of Expertise			
Orthodontist	34	24	58
Others	34	10	44
Total	68	34	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
3.917	1	0.048	

Table 10: Area of Expertise* B1

Crosstab	**B1**		**Total**
	False	**True**	
Area of Expertise			
Orthodontist	0	58	58
Others	8	36	44
Total	8	94	102
Chi-Square Tests			
Chi Square Value	**Df**	**P VALUE**	
11.443	1	0.001	
Area of Expertise* A1			
Crosstab	**A1**		**Total**
	False	**True**	
Area of Expertise			
Orthodontist	1	57	58
Others	4	40	44
Total	5	97	102
Chi-square tests			
Chi-square value	**Df**	***P*-value**	
2.913	1	0.088	

related to debilitatingmalocclusions.[7-9] Few studies have evaluated anterior dental esthetics by investigating a person's perception of minor abnormalities.[10-15] Only one study has established threshold levels for several specific esthetic criteria that can be used readily by orthodontists, periodontists, restorative dentists, and oral and maxillofacial surgeons to aid in treatment planning.[16] However, aforementioned study evaluated symmetric esthetic alterations.

In reviewing the literature for Golden proportion, few studies have dealt with changes in facial esthetics. In one study, Barrer and Ghafari[17] assessed profile silhouettes before and after treatment, assessing these only as either "satisfactory" or "unsatisfactory." Lundstrom *et al.*[18] used orthodontists, orthodontic graduate students, laypeople, and artists to rate changes in facial esthetics in subjects from age 12 to age 18. They used a scoring system of 1–5, with 1 representing very attractive and 5 representing very disharmonious. Here, the change in esthetics was simply taken as the number of categories that each case moved up or down the scale. The same system was used by Kerr and O'Donnell.[19] Dunleavy *et al.* used a variety of judges to assess the effects of orthognathic surgery. In their study, pre- and post-treatment photographs were shown to the judges at the same time. Those subjects who were determined to show changes in appearance were ranked from most to least improved.[20]

CONCLUSION

Orthodontists gave higher perception regarding Golden proportion as compared to others with statistically significant value, but when we surveyed advance questions category (A1), orthodontists do have higher perception than others category, but this difference is not statistically significant.

This is a peer reviewed survey but this can be used a substantial approach for the patient to rate the same photos that were reviewed by the various specialties. This could result in a more educated and informed approach in the treatment of each patient.

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