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Revista Mexicana de Ortodoncia

Vol. 2, No. 1 • January-March 2014
pp 9-17

ORIGINAL RESEARCH

Relationship between facial golden ratio and malocclusion in Mexican patients who attended the Orthodontics Clinic at Facultad de Odontología de la Universidad Tecnológica de México during 2009 with facial aesthetics criteria evaluated with Marquardt mask

Relación entre la proporción áurea facial y la maloclusión en pacientes mexicanos con criterios faciales estéticos evaluados con la máscara de Marquardt que acudieron a la clínica de Ortodoncia de la Facultad de Odontología de la Universidad Tecnológica de México durante el 2009

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ABSTRACT

Objective: To establish the frequency of patients selected as attractive showing the golden ratio on their faces according to the Marquardt mask and a class I molar relationship. **Methodology:** Observational research, transversal, retrospective and comparative study. Were collected 65 pictures (19 male and 46 female) from pre-orthodontic treatment patients at UNITEC Orthodontics Clinic with attractive faces according to beauty criteria established by the authors. Molar class was also evaluated among patients. **Sample size:** discretionary. **Sample type:** non-probabilistic. The pictures were shown to UNITEC Orthodontics graduate students who were given an evaluation sheet on which they graded patients from the least to the most attractive on a 1 to 5 scale. A study group was made from the results. Paint Shop Pro sc09960 version 7 was used to analyze the images by placing a Marquardt Mask on top of the patient's picture. **Results:** Out of the 65 pictures, 64.6% were described as attractive (42 patients) while 35.4% were found not attractive (23 patients). Out of the attractive patients, 57.1% were well proportioned according to the Marquardt Mask and 42.9% were not proportioned. **Conclusions:** The authors concluded that attractive patients are not always well proportioned. They also don't present an Angle class I molar relationship.

RESUMEN

Objetivo: Establecer la frecuencia con que los pacientes atractivos seleccionados muestran una proporción áurea (según la máscara de Marquardt) en sus rostros y clase molar I. **Metodología:** Investigación observacional, estudio transversal, retrospectivo y comparativo. Se reunieron 65 fotografías (19 hombres y 46 mujeres) pretratamiento ortodóncico de los pacientes de la Clínica de Ortodoncia de la UNITEC con rostros atractivos, de acuerdo a los criterios de belleza de los autores de esta investigación. De estos se evaluó también su clase molar. **Tamaño de la muestra:** por conveniencia. **Tipo de muestra:** no probabilístico. Las imágenes fueron mostradas a estudiantes del postgrado de Ortodoncia de la UNITEC, a quienes se les dio un formato con escala del 1-5 en donde calificaron desde el paciente menos atractivo hasta el más atractivo. A partir de estos resultados formamos nuestro grupo de estudio. El programa Paint Shop Pro Dsc09960 Versión 7 se utilizó para analizar las imágenes; en él colocamos la imagen del paciente y encima de ésta, la máscara de Marquardt. **Resultados:** De las 65 fotografías, 64.6% fueron consideradas atractivas (42 pacientes), y el 35.4% no fueron atractivas (23 pacientes). De los pacientes atractivos, el 57.1%, estaba proporcionado según la máscara de Marquardt y el 42.9% no se encontraba proporcionado. **Conclusiones:** Se concluyó que los pacientes atractivos no siempre estarán proporcionados, ni tampoco presentarán una clase molar I de Angle.

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Key words: Golden ratio, Marquardt mask, Angle molar relationship.
Palabras clave: Proporción áurea, máscara de Marquardt, clasificación molar de Angle.

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INTRODUCTION

One of the main objectives in current orthodontics is aimed to correct every alteration that implies a deviation of what are considered aesthetic dentofacial normal values. Obviously, this implies the establishment of such normal values which in turn, may present variations due to different kinds of diverse conditions. Among the most preferred are the social and cultural conditions, closely linked to the susceptible population for receiving orthodontic treatment in a given area.

In spite of criteria differences amongst different populations as well as orthodontic professionals, in recent years there seem to be a certain tendency to follow a series of aesthetic ideals established mainly in the western developed countries. These are facts that affect not only the orthodontic treatment objectives but those of many other medical disciplines related to aesthetics and whose professions are being taken to levels of complexity never imagined before.

Dentofacial aesthetics has been the primary center of attention among the most prominent orthodontists for the past 50 years, although the way to approach it has been adapted to the characteristics of each epoch.[1]

Thus, orthodontic treatment which initially pursued a correct alignment of the teeth varied and widened its objectives to other neighboring structures both skeletal and soft tissues.

Currently, the great influence of the media as transmitters of aesthetic fashions and trends is decisive in the behavior of the consumer society, which makes people become more careful with its aesthetic appearance since, conscious or unconscious, they know that the image they offer to the rest of society has a direct proportional impact to their own social value.[2]

Physical beauty has been one of the major concerns of the mankind and it really is a difficult concept to define due to the subjectivity of the observer as well as to the fact that this is a concept in constant evolution or change in function of the different eras and cultures, fashions, etc.[3]

The so-called golden ratio or divine proportion are terms that express a set of theories, based on the mathematical, geometrical and physical laws, closely related to concepts of harmony and beauty for mankind, both in terms of their visual perception as to its psychological acceptance.

This proportion –denominated by the Greek with the symbol phi (φ)– has a value of 1:1 and seems to have very significant biological implications.

In fact, there are many natural phenomena that follow the principles of proportionality of the golden proportion, the golden triangle or the golden rectangle. At the same time, it seems to be linked to the guidelines for growth and optimal function. Because of all this, it can be used as a guide or support with regard to objectives of harmony and balance to perform treatment plans. Probably, these proportions represent what we would like to achieve once orthodontic treatment of the corresponding malocclusion is completed.

It is, therefore, a kind of philosophy about aesthetics that presents a few guidelines, but does not impose rigid rules that can be used as a panacea of the problem.

There seems to be an agreement between the general population's concept about acceptable facial aesthetics and that of orthodontists based on normal occlusion. While there are notable differences between subjects considered having harmonious and balanced dentofacial aesthetics, the analysis of many of their features shows the presence of the abovementioned golden proportion, both dental and facial from the frontal and anteroposterior plane.[4]

As to the teeth, it can be observed that the mesiodistal size of the lower central incisors keeps the same proportion with the upper central incisors. Similarly, such relationship is maintained between the distance from the distal right lateral incisor to the distal left lateral incisor in relation to the central incisors in the upper arch; the same is true between the width of the first premolars and the lateral incisor. This relationship can often be altered in any of the three types of malocclusion. An adequate maxillary arch form will also exhibit the same relationship between the intercanine width and the intermolar width, measured from mesial of the upper right first molar to mesial of the left molar. The same thing happens in the mandible between the distance that connects the canine's distal surface in relation to the one that connects the buccal grooves of the first mandibular molars. Finally, the same relationship is observed between the maxillary intercanine width and that of the lower incisors. All this refers to dental arches considered normal, harmonious and balanced.

Regarding the soft tissue aesthetics, both on the frontal view as well as the profile, the presence of the golden proportion may be observed among the most representative parts of what usually is the center of attention of any interlocutor, that is, eyes, nose and mouth. While analyzing the frontal projection of the face, it can be observed in relation to the transverse dimensions of the

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abovementioned organs, that if you take the width of the base of the nose as a unit (1, 0), the mouth inter-corner and the lateral vertex of the eyes, they keep a golden proportion with each other.

In orthodontics, Ricketts was the first to mention that the analysis of an attractive face should be measured mathematically and he claimed for the use of the golden proportion in that area. He observed dozens of photographs of models in magazines to select pairs of distances that represented the golden proportions in beautiful faces. By doing this, he developed a study using 10 attractive faces and defined several facial proportions; however there were claims from other authors regarding the sample. Rickett's articles seemed to be the base for orthodontic and oral surgery publications concerning facial aesthetics.

More recently, Baker, Woods and Shell were unable to establish a correlation between changes in the golden proportions and changes in aesthetics after an orthodontic treatment. They concluded that having golden proportions had little or no influence over the degree of facial aesthetics.

Moss and his team used a 3D scanning technique for analyzing different male and female features in models from both genders. They concluded that these features had nothing to do with whether a face is proportioned or not.[5]

Marquardt's mask is designed on the basis of a perfect decagon which gives us an idea of a strictly proportioned facial image from the golden rule: 1,618 *(Figure 1)*.

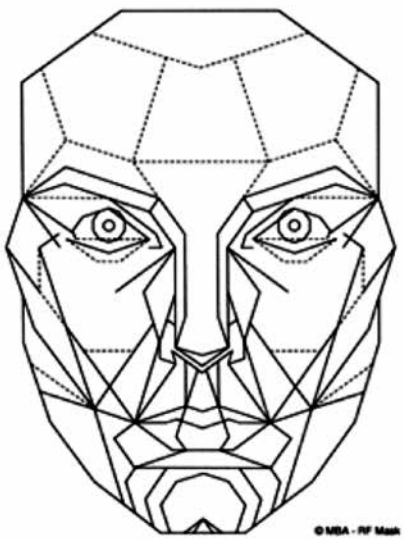

Figure 1. Marquardt's mask.

USES OF MARQUARDT'S MASK

The Marquardt's beauty analysis (Marquardt's mask) is dedicated to research of human visual aesthetics in a very proactive way, including its biological and mathematical basis, as well as the use of the results of this research to develop and provide information and technology to analyze and improve human visual attractiveness *(Figure 2)*. It focuses more on an adaptation of this technology and the format for specific uses for direct applications in areas where attraction is a human factor or parameter (i.e., the areas interested in human visual attractiveness) such as medicine, dentistry, psychology, anthropology, biology, anthropometry, arts, the cosmetic of makeup and fashion, as well as for direct use by the individual consumer.

The Marquardt's beauty analysis considers that this information and technology might empower individuals to have a greater and clearer understanding of attraction and its role in our society. Additionally, this understanding might give each one of us a more positive sense of attraction control and, ultimately, of our own lives and destiny.[6]

GENERAL OBJECTIVE

To establish the frequency in which the selected attractive patients show a golden proportion (according to Marquardt mask) on their faces and class I molar relationship.

To determine the dental relations that the selected group of patients with facial golden proportions have. To compare the obtained results of the golden proportion on each face with their molar relationship

Figure 2. Marquardt's mask applied to frontal photographs.

and to measure how frequently a beautiful face is proportioned and has a dental class I.

MATERIAL AND METHODS

The study was conducted in the premises of the Technological University of Mexico during the school period 2009-2010.

Extraoral frontal and profile photographs were collected from 65 Mexican patients (46 women and 19 men) from the files of the Orthodontics Clinic. From that sample a group of photographs of attractive patients was selected and from this group, intraoral photographs and lateral models were also assessed to determine their molar class. The age rank was 18 to 35 years old for both men and women.

The images were shown to the students of the postgraduate program in orthodontics at the Technological University of Mexico by means of a projector, in the meeting allocated for «Seminar»; the students were given a format with a scale of 1-5 where they rated the patients from less attractive to more attractive.

About 15 photographs per day were shown to the students for 5 days. From these results the study group was formed. Patients allocated in number 2 and up entered in this group.

The study group was analyzed by means of the Paint Shop Pro Version 7 DSC09960 program in which we put the patient's image and on top of this, Marquardt's mask.

For each patient regardless of whether their facial structure was proportioned or not, pre-orthodontic treatment molar class was assessed. These data were obtained from the files.

With this study we determined if an attractive person is proportioned and also has an Angle Class I.

DATA RECOLLECTION

Nearly 65 photographs (46 women and 19 men) were collected from the files of the Orthodontics Clinic. These were selected on the basis of a pleasant and attractive facial appearance according to the criteria of the researchers.

From this selection, images were shown to the students of the postgraduate program in Orthodontics at the Technological University of Mexico through a projector in the meeting allocated for «Seminar», the students were given a format with a scale of 1-5 where they rated patients from less attractive to more attractive. On the basis of these result the study group was formed.

The study group was analyzed using the Paint Shop Pro Version 7 DSC09960 program in which the patient's image was placed and on top of it, Marquardt's mask.

ANALYSIS PLAN

An Excel database was structured and transported to the statistical package SPSS version 15. The database was subjected to a descriptive analysis where the percentages that exist in relation to whether an attractive patient is proportioned or not were clarified.

PILOT STUDY

During the placement of the Marquardt mask in the program Paint Shop Pro DSC09960 Version 7 due to the fact that some photographs had darker hues there were problems for the localization and superimposition of the mask tracings over the photograph's structures; therefore some pictures had to be clarified in the same program for a better measurement.

The patient's molar classification by means of intraoral photos allowed an easy visual assessment of their molar positions.

RESULTS

The results of this investigation were as follows: from 150 photographs assessed of orthodontically untreated patients who came to the Orthodontics clinic at UNITEC, 46 were women (71%) and 19 were males (29%) *(Figure 3)*, 65 photographs were selected, forty-five percent had a class I molar relationship, twenty-three percent were class II and thirty-two percent were molar class III *(Figure 4)*.

Of the 65 photographs, 42 patients were considered attractive (65%), and 23 patients were not attractive (35%), this was assessed on the basis of the surveys of graduate students *(Figure 5)*.

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From the total sample of attractive patients (42 patients), 23 patients were proportioned according to Marquardt mask and 19 patients were not *(Figure 6)*.

From the total sample of proportioned attractive patients, 14 were class I, five were class II and five were in class III. From the non-proportioned attractive patients, eight were class I, two were class II and eight were class III *(Figure 7)*.

DISCUSSION

At present, an orthodontic treatment is considered successful if a perfect Angle molar class I is obtained, and in addition, an orthognathic straight profile.

Of course, this does not imply that there may be a wide range of attractive patients who do not present a perfect class I molar, or an orthognathic straight profile so one might say that there are several shades of class I that ultimately are attractive….or not?

The purpose of this study was to demonstrate that attractive and proportioned patients (measured with the mask of Marquardt), might not always have a perfect molar class I.

The results obtained from this study show that from the total number of patients (65), the ones considered attractive represented a 65% of the sample. From those patients considered attractive, 57% was proportioned according to Macquardt's mask and 43% was not proportioned *(Figure 8)*. From the group of proportioned patients, 14 presented a class I molar relationship, five were class II and five were class III.

From the group of un-proportioned patients, eight had a class I molar relationship, two had a class II and eight patients were class III *(Table I)*.

It is observed that attractive patients are not always proportioned according to the normal values established by different authors,[1,6-8] nor do they present a class I molar relationship.

In a study by Pancherz and his collaborators, facial beauty is compared to skeletal morphology; they found that attractive patients have an increased ANB and Witts, and that they also present a much more convex profile than the non-attractive ones. This leads to the conclusion that facial beauty is highly subjective and that is not always necessary to establish a specific value in order to say that a person is beautiful or not.[9]

In orthodontics, facial aesthetics is related to golden proportions apparently in an ideal human face.

In the study conducted by Kienkens, Kujipers and their associates, in which they measured facial proportion according to the normal values established by Ricketts, they found that only four out of 19 measurements established in the study had a relationship with the actual «facial aesthetics».[5]

Being attractive has become a concern during childhood and adolescence since there is major influence from media that has entered our lives to produce a «standard» imposed by them of what «must be» attractive and provide perceptions of health, beauty and vigor combined with concepts of intelligence, wealth, achievements and happiness.

Sforza, Laino and their team state that «children with non-attractive faces are considered less intelligent and more isolated in relation to more attractive children».

A beautiful face is considered successful and therefore, children and parents seek medical attention to modify non-attractive facial features.[7]

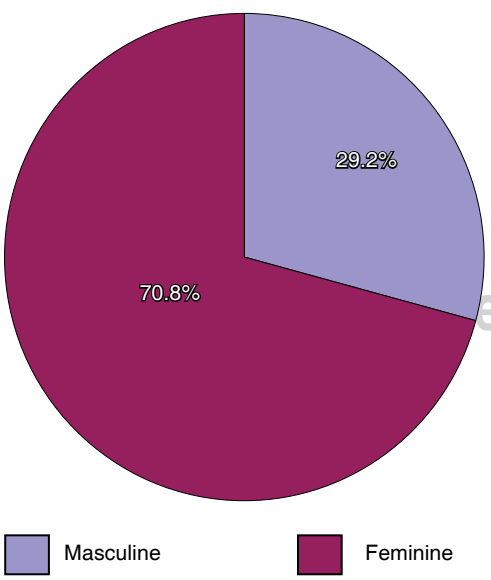

Figure 3. Total number of patients by gender.

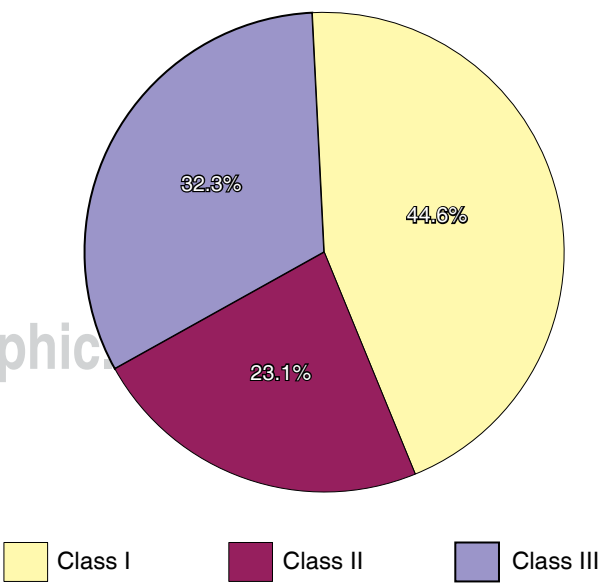

Figure 4. Total number of patients according to their molar relationship.

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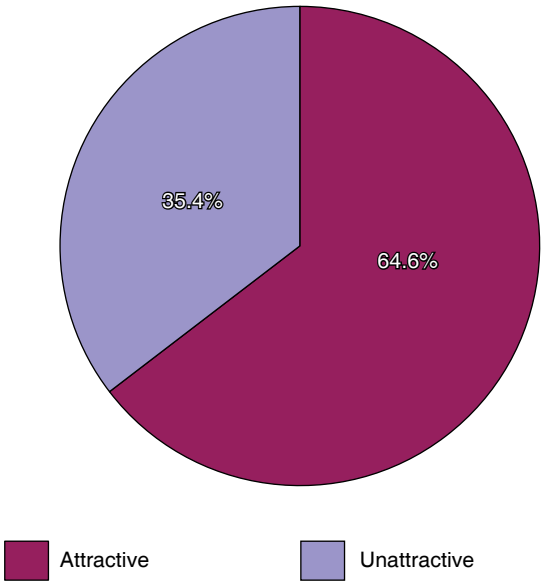

Figure 5. Total number of patients according to their degree of attractiveness.

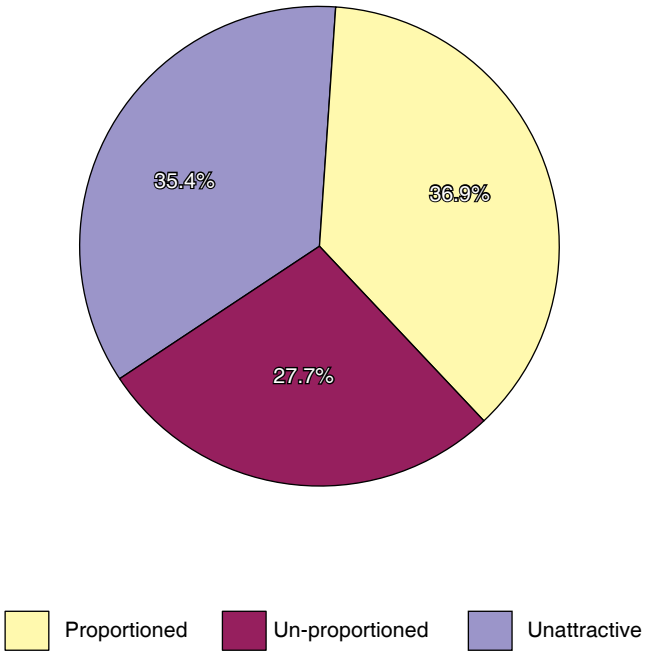

Figure 6. Total number of patients by degree of proportion.

Table I. List of patients according to their degree of proportion-molar class.

		Molar class			
		Class I	Class II	Clase III	Total
Degree of proportion	Proportioned	14	5	5	24
	Not proportioned	8	2	8	18
Total		22	7	13	42

The importance of dental irregularities in facial aesthetics has been described by many authors. Some of them assess aesthetics by manipulating photographs through the computer and they discovered that faces with aligned teeth are significantly more attractive than those who do not possess this feature.[1]

The most common parameter for assessing anteroposterior features is Angle's classification. Some authors support their dental measurements and molar relationship or their overjet as independent parameters and it is a belief that the molar relationship does not reflect on the face, so they take overjet as the most appropriate measurement to evaluate facial aesthetics.[10]

One of the main problems found while conducting this investigation was not finding male patient's photographs that met the inclusion criteria. Another problem was that we did not find similar studies in the literature and besides, when the Marquardt mask was placed in the Paint Shop Pro Dsc09960 Version 7 program, since some photographs had darker hues, there were problems for locating and superimposing the tracing of the mask over the structures in the photographs; therefore, some photographs had to be lightened.

What we tried to analyze taking into consideration the Marquardt mask has not been studied in any thesis until now. We invite students to continue with this research, analyzing attractive Mexican patients compared to their morphology, skeletal features and facial profile since we found that the concept of «attractive person» varies among cultures and leads to the same conclusion «beauty is subjective».

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CONCLUSIONS

In this study the frequency of attractive patients that show a golden proportion on their faces and molar

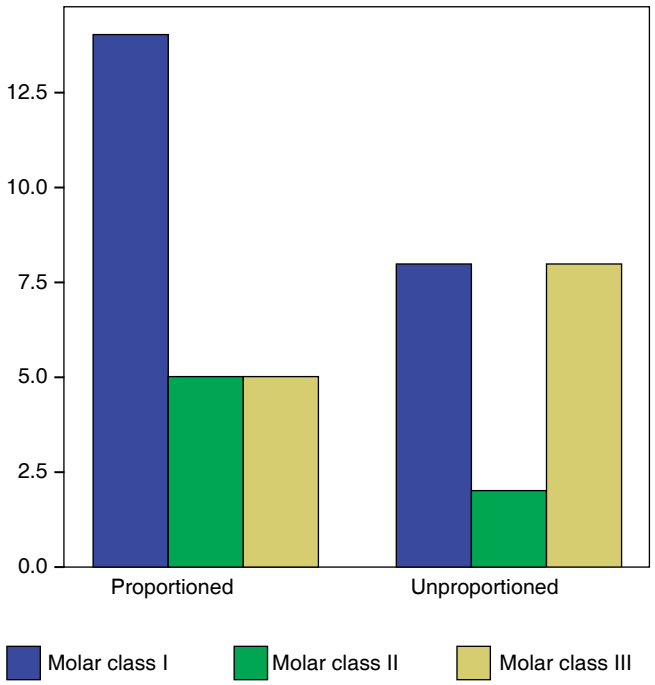

Figure 7. List of patients according to their degree of proportion-molar class.

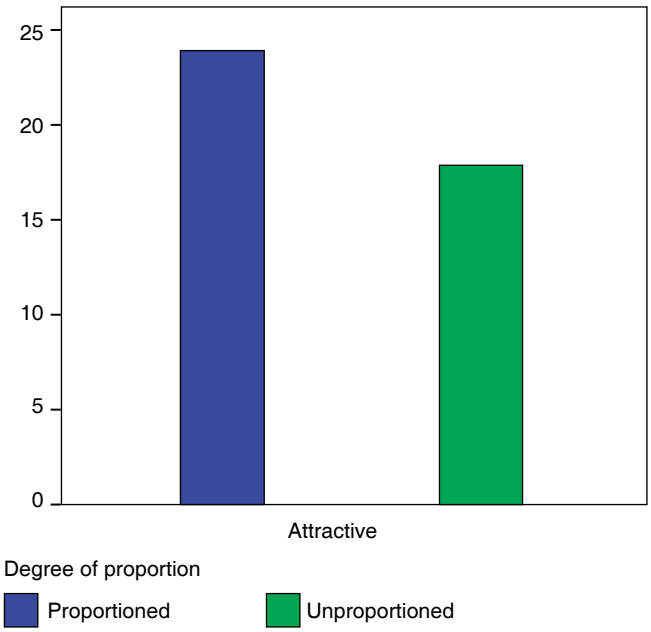

Figure 8. List of patients according to their degree of attractiveness-degree of proportion.

class I, was determined and Angle classifications that the group of patients with facial golden proportions exhibit were also determined. Afterwards the obtained results of golden proportions of each face were compared with their dental classification and how often a beautiful face is proportioned and has molar class I, was measured.

The hypothesis is rejected on account of the results that show that of the total number of patients considered attractive, *i.e.* 42 patients, 23 patients were facially proportioned (57%), and 19 patients (43%) were not proportioned. Additionally, from the total number of proportioned attractive patients, 14 patients presented a molar class I, 5 a class II, and 5 a class III molar relationship.

Due to the fact that in this research the sample size was small, this study could have certain limitations in the interpretation of the results; therefore it is recommended to carry out further studies. It is important to mention that beauty is independent of skin color or ethnicity, and that it is related to the harmony and balance that exist in facial structures. We can find beautiful faces with different types of occlusions so it may be concluded that the orthodontist must perform treatments that improve the harmony of facial structures regardless of each patient's Angle's classification.

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Addendum

Marquardt's mask placement over the photographs to determine facial proportion.