



REPUBLIC OF TURKEY
MARMARA UNIVERSITY
INSTITUTE OF HEALTH SCIENCES

**ORAL-HEALTH RELATED QUALITY OF LIFE, SELF-ESTEEM
AND BULLYING AMONG PATIENTS RECEIVING
ORTHODONTIC TREATMENT; COMPARISON BETWEEN
LABIAL AND 2D-LINGUAL ORTHODONTIC APPLIANCES**

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DEPARTMENT OF ORTHODONTICS

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BEYAN

Bu tezin kendi çalışman olduğunu, planlamasından yazımına kadar hiçbir aşamasında etik dışı davranışımın olmadığını, tezdeki bütün bilgileri akademik ve etik kurallar içinde elde ettiğimi, tez çalışmasıyla elde edilmeyen bütün bilgi ve yorumlara kaynak gösterdiğimi ve bu kaynakları kaynaklar listesine aldığımı, tez çalışması ve yazımı sırasında patent ve telif haklarını ihlal edici bir davranışımın olmadığını beyan ederim.

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III. ABBREVIATIONS

- 2D : 2 Dimension
- 3D : 3 Dimension
- OHIP-14 : Oral Health Impact Factor-14
- VAS : Visual Analog Scale
- SE : Self Esteem
- QoL : Quality of Life
- OHRQoL : Oral Health Related Quality of Life
- HRQoL : Health Related Quality of Life
- AAO : American Association of Orthodontists
- CAD/CAM : Computer-Aided Design/Computer-Aided Manufacturing
- TARG : Torque Angulation Referencing Guide System
- CLASS : Custom Lingual Appliance System
- IOTN : Index of Treatment Need
- NHS : National Health System
- DHC : Dental Health Component
- AC : Aesthetic Component
- PDL : Periodontal Ligament
- SS : Stainless Steel
- Ni-Ti : Nickel Titanium

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“Oral-health related quality of life, self-esteem and bullying among patients receiving orthodontic treatment; comparison between labial and 2d-lingual orthodontic appliances”

Name of the student: Nikolaos Karpitsaris

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1. SUMMARY

Aim: The aim of this study is to investigate the changes related to oral health related quality of life, self esteem, oral impacts and bullying among patients receiving lingual and labial treatment, with the help of questionnaires.

Material and Methods: Our study is based on questionnaires, with 34 patients, divided in two groups. The first group consisted of 17 patients undergoing treatment with buccal fixed orthodontic appliances and the second group consisted of 17 patients with 2D lingual fixed orthodontic appliances. Patients’ mean age was 15.38 years. The mean treatment time was 7±1 months. All the questionnaires were given to the patients during their appointments at the clinic of Orthodontic department, approximately every 4-5 weeks. Each patient was at the levelling and alignment period. All of the data were collected by the use of the four questionnaires: OHIP-14, Rosenberg self-esteem scale, Visual Analog Scale (VAS) and a questionnaire used for bullying.

Results: Both treatment modalities improved the quality of life and the self-esteem of patients, but patients treated with labial brackets had faster improvement of their quality of life. The oral impacts that were caused got improved throughout treatment, with lingual treatment causing more oral impacts. Orthodontic treatment resulted in fewer bullying episodes at bullied-patients, however, more research and longitudinal studies need to be conducted to fully examine this relationship.

Conclusion: Both orthodontic treatments improve the quality of life, self-esteem and the pre-existing bullying levels, while lingual treatment results in the appearance of more oral impacts.

Key words: Quality-of-life, Oral-impacts, Bullying, Self-confidence, Questionnaires

“Ortodontik tedavi gören hastalarda ağız sağlığı ilişkili hayat kalitesi, öz saygı ve hastaların gördüğü zorbalık; labial ve 2d lingual ortodontik aparey karşılaştırması.”

Öğrencinin ismi: Nikolaos Karpitsaris

Danışman: Associate Professor Dr. Çağla Şar

Bölüm: Ortodonti Anabilim Dalı, Marmara Üniversitesi

2. ÖZET

Amaç: Bu çalışmanın amaç lingual ve labial tedavi gören hastalarda ağız sağlığı ile ilişkili hayat kalitesi, özgüven düzeyi, tedavinin oral etkileri ve maruz kalınan zorbalık düzeyi ile ilgili değişiklikleri anketler yardımıyla araştırmaktır.

Gereç-Yöntem: Çalışmamızda 2 gruba ayrılan 34 hastaya anket yaptırılmıştır. İlk grup bukkal sabit ortodontik apareyler ile tedavi edilen 17 hastadan, ikinci grup ise 2D lingual sabit ortodontik apareyler ile tedavi edilen 17 hastadan oluşmaktadır. Hastaların yaş ortalaması 15,38’ dir. Ortalama tedavi süresi 7±1 aydır. Anketler hastalara ortodonti kliniğinde yaklaşık 4-5 haftada bir yapılan seanslar sırasında verilmiştir. Tüm hastalar seviyeleme ve hizalama sürecindedir. Tüm veriler OHIP-14, Rosenberg Özgüven Skalası, Görsel Analog Skalası ve zorbalık ölçmek için kullanılan kendi kendine yönetilen anket’ten yararlanarak elde edilmiştir.

Bulgular: Her iki tedavi yöntemi de hastaların hayat kalitesini ve özgüvenini arttırmıştır, ancak labial braketlerle tedavi edilen hastaların hayat kalitelerindeki artışta daha hızlı bir gelişme gözlenmiştir. Tedavi sırasında oral bölgede oluşan etkiler, tedavi süresince daha iyi bir hal almış, bu etkilerin lingual tedavide daha belirgin olduğu gözlenmiştir. Akran zorbalığına maruz kalan hastalarda ortodontik tedavi sonucu zorbalık miktarının azaldığı görülmüştür, ancak bu ilişkinin uzun dönemli çalışmalar ve araştırmalar ile daha kapsamlı olarak araştırılması gerekmektedir.

Sonuç: Her iki ortodontik tedavi yöntemi de, hastaların yaşam kalitesini, özgüvenini ve tedavi öncesindeki akran zorbalığı seviyesini iyileştirmiştir. Ortodontik tedavi sırasında oluşan oral etkilerin lingual tedavide daha belirgin olduğu bulunmuştur.

Anahtar kelimeler: Yaşam kalitesi, Oral-etkiler, Zorbalık, Özgüven, Anketler

3. INTRODUCTION AND AIM

Malocclusion and dentofacial deformities are highly prevalent and can influence physical, social, and psychological functioning, thus playing an important role in social acceptance and interactions (Rusanen *et al.*, 2010)(Silvola *et al.*, 2012). Esthetics are important in people's lives, and facial appearance has a profound influence on personal attractiveness and self-esteem because it affects health and reverberates in social, affective, and professional relationships (Capellozza *et al.*, 2001)(Johal *et al.*, 2015)(Melo *et al.*, 2013)(de Souza *et al.*, 2013).

Since the advent of lingual orthodontic appliances in the 1970s, recent years have witnessed a marked increase in the demand for lingual orthodontic appliances among orthodontic patients seeking esthetic improvement (Fritz *et al.*, 2002). Several seminal studies indicated that lingual appliances can provide treatment outcomes comparable to those achieved with labial appliances (Gorman GC., 1988). Lingual orthodontic appliances enjoy esthetic advantages (Fujita, 1978) and they can produce comparable treatment outcomes as labial fixed appliances and therefore are an alternative treatment modality for patients to consider. Nevertheless, orthodontic treatment leads to a number of consequences, which also are important to consider in evaluating treatment modalities. There has been growing interest in understanding not just the symptoms experienced during treatment (eg pain), but also the oral impacts of orthodontic treatment, such as the influence on quality of life. To this end, many oral health-related quality of life measures have been used to assess oral impacts (Cunningham and Hunt, 2001)(O'Brien *et al.*, 1998). The measures differ in their underlying theoretic framework, number of items and scoring methods. All measures assess key oral impacts such as oral discomfort, pain, speech, disturbances etc. The patients rate their oral impacts experienced on a 100-mm long visual analog scale (VAS) after the brackets placement.

Patient-centered approaches have been receiving increasingly more attention in recent years. It is important to determine the nature of the complaints that cause patients to seek treatment and to what degree these affect patients' quality of life (QoL). Interest in the idea of quality of life is growing rapidly. More than 1000 new

articles are indexed each year under this heading. The term health-related quality of life (HRQoL) has been used to describe an individual's assessment of how the following factors affect his or her well-being: experience of pain/discomfort, physical function, psychology,), and social function (such as interactions with others). When these considerations focus on orofacial concerns, oral health-related quality of life (OHRQoL) is assessed.

The concept of oral health-related quality of life (OHRQoL) describes the patient-perceived impact of orofacial conditions and effect of dental interventions. It is a broad and comprehensive concept which is widely influenced by physical health, psychological state, social relationship, environment and so on. In order to evaluate it objectively, measuring instrument (OHIP-14) covering seven specific domains were originally developed and examined by Slade GD. As a sensitive assessment tool, it can not only help clinicians to assess patient's current oral state but also work as an indicator to help researchers to supervise changes in oral health-related quality of life. For this reason, this proven approach has drawn increasing attention from research workers and clinicians in oral-related discipline. Subsequently, it was widely used by Scholars from several branches of stomatology. In order to investigate the effects of orthodontic treatment on "OHRQoL," most researchers monitored various time points during fixed orthodontic appliance therapy such as 1 week, 1 month, 3 months, 6 months and 12 months. The advantages of this method are its simplicity for clinicians to decide when to evaluate the oral condition of patients, its convenience for research workers to record the complicated data and its sensitivity to reflect details at some point.

The short form of the oral health impact profile (OHIP-14) consists of 14 items covering 7 domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicaps. Each item is scored on a 5-point scale: 0, never; 1, hardly ever; 2, occasionally; 3, fairly often; and 4, very often or every day. Total OHIP-14 score can range from 0 to 56, and domain scores can range from 0 to 8. A higher score represents poor OHRQoL.

The term self-esteem is used to describe a person's overall sense of self-worth or personal value. Self-esteem can involve a variety of beliefs about the self, such as the appraisal of one's own appearance, beliefs, emotions, and behaviours. There has been

a growing acceptance of the positive relationship between improvement in aesthetics and psychological profile.

The Rosenberg Self-Esteem Scale is a widely used self-report instrument for evaluating individual self-esteem. This scale consists of 5 positive and 5 negative items sequenced in a randomized manner. Items 1-2-4-6-7 are scored as follows: 3, strongly agree; 2, agree; 1, disagree; and 0, strongly disagree. Items 3-5-8-9-10 are scored as follows: 0, strongly agree; 1, agree; 2, disagree; and 3, strongly disagree. The final scores range from 0–30, where 0–15 represents low self-esteem, 15–25 represents normal self-esteem, and 25–30 represents high self-esteem.

Bullying is described as a situation in which a person is exposed repeatedly and over time to negative actions by at least 1 other person. In children who are bullied about dentofacial features, orthodontic treatment can have a major impact on their oral health-related quality of life (OHRQoL).

We plan to take advantage of all these, to evaluate how patients are affected during orthodontic treatment and evaluate the differences that might occur regarding the two treatment methods.

4. LITERATURE REVIEW

4.1 General Information

4.1.1 What is Orthodontics?

Orthodontics is that specialty of dentistry which deals with the study of the craniofacial complex and its growth, examines how the occlusion develops and how the dentofacial abnormalities can be treated. It includes the three main tissue systems, which are the craniofacial system, the dentition and the jaw mastication.

4.2 Occlusion And Malocclusion

4.2.1 Occlusion related to malocclusion

Orthodontics addresses with the treatment and the management of malocclusion. In most of the cases, a malocclusion does not represent a state of disease, but it is rather a variation from what people generally consider ideal. Therefore, it is important for an orthodontist to be able to define ideal occlusion, as this is the basis for proper diagnosis and accurate treatment planning.

4.2.2 Classification of malocclusion

We can define malocclusion as a deviation from the ideal, that might be considered functionally or aesthetically non-satisfactory. Numerous ways have been

used to describe malocclusion, ranging from indices of outcome and need of treatment to specific classifications. It is not the same like a disease process, when only the presence of a specific feature classifies the presence of the disease. Here, a wide variety of occlusal characteristics are needed to constitute a malocclusion.

However, we can identify certain features for the purpose of classification, which allows better communication and offers us a basis to be used for diagnosis. The classification method to be used needs to be simple, reliable and objective.

4.2.3 Malocclusion

Abnormalities of the craniofacial complex affect the quality of life and have negative social and psychological effects on an individual. Orthodontic treatment offers correction of these abnormalities in the face caused by dental or skeletal discrepancies to achieve functional, aesthetic and psychosocial improvements. (Zhou *et al.*, 2014). There are controversial views on the criteria for assessing the types and the severity of malocclusions.

The classification by Angle is the most commonly accepted to quantify and evaluate malocclusions. Angle suggested that the first upper molars were the key to occlusion and that upper and lower molars had to be correlated in a way that the mesio-buccal segment of the upper molar occludes in the buccal groove of the lower molar. (Proffit, William R., Henry W. Fields, 2007).

4.2.4 Prevalence of malocclusion

Malocclusion itself has been described as a disease of Western societies, and for sure within polygenic developed societies, specific occlusal traits like crowding are more commonly found. Indeed, from data collected by studies of population, it is very common that one or more traits of malocclusion is present. In the USA, we can notice

irregularity of in most of the adults. Only 34% have mandibular incisors that are well aligned and 45% maxillary incisors that are well-aligned. In addition, 20% of the Americans, have a noticeable deviation from the ideal jaw relationship in the sagittal plane, with 2% of these being at the limit for orthodontic correction (Proffit *et al.*, 1998). Regarding the UK, the last Child Dental Health Survey found that 35% of 12 year old children showed a definite need for orthodontic treatment on aesthetic or dental health grounds, which was increased to 43% when the children that were already in treatment were included. Another factor that has an important bearing on malocclusion is ethnicity. We can claim that Class II problems are more common in northern European white populations, whereas class III malocclusion is more common amongst Japanese and Chinese societies. Amongst Afro-Caribbean populations, most common trait is anterior open bite, whereas in Caucasians you face a greater percentage of increased overbite.

4.2.5 Etiology of malocclusion

We should consider malocclusion as a condition that does not represent a single entity and is indeed developmental. It is the number of occlusal traits that are summed up and are relatively complex, demonstrating multifactorial inheritance. Despite the fact that in specific cases, some factors and pathologies can be defined as being the cause of a malocclusion; in the majority, the etiology of malocclusion is less clear. In each individual, there is a quite close interaction between environment and genetics during development and growth of both the dentition and jaws.

4.3 Modern Orthodontics

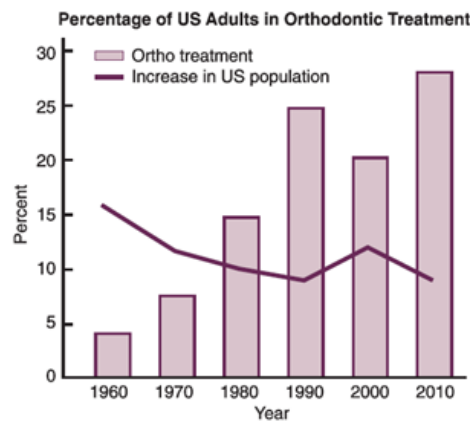
The advances and the progress of technology have a huge impact on the orthodontic field as well, especially the last twenty years. We are able to work with

digital x-rays, dental images in 3D dimension, that allow us to work more efficiently and have a more precise look at the tooth's structure. In addition, the Cone Beam tomography can provide a 360 degrees scan with a full set of x-rays, creating 3D images for each tooth. Less radiation is also a matter of paramount importance. The digital scanners give us the opportunity to take teeth impressions digitally instead of the conventional way. This allows us to save time, be more accurate and keep a digital record of every patient just a few minutes after we scan the patient's mouth. Moreover, CAD/CAM and wire bending by robots is a newly used technology that enables orthodontist to achieve a totally precise bonding of the braces especially with lingual wires that are bonded at the back of the teeth.

4.3.1 Who seeks treatment?

A patient with malocclusion or with a deviation from a normal situation, does not mean that will seek for orthodontic treatment. There are some patients that recognize that have a problem, others feel that they are in need of treatment but they cannot afford or receive a treatment.

The need and the demand for orthodontic treatment varies and depends on cultural and on social conditions. In urban areas, more children are going to the orthodontist and become possible orthodontic patients, than in rural areas. The income of the family plays an important role and proves that a family with higher income can afford an orthodontic treatment. As a result, they obtain better facial appearance and improved dental conditions which in the end are related to better social position (Fig. 4.1).



From the mid-twentieth century when almost no adults received orthodontic treatment, to the present time when adults comprise 25% to 30% of the total treatment population, there has been an almost steady rise in the number of adult patients. This does not at all parallel the percentage increase in the total population. In the 1980s, a "baby bust" period, the increasing number of adult patients was the major source of the overall increase in orthodontics, while in the 1990s, a "baby boom" period, the number of adult patients increased a little but most of the growth was treatment of children. There has been a further increase in treatment of adults in the first decade of the twenty-first century.

Figure 4.1 : Percentage of US adults in orthodontic treatment

4.3.2 Benefits of orthodontic treatment

When we deal with a medical intervention, we should have a clear list of benefits for the patient and these benefits should overcome any possible risks. It is definite that a patient who receives orthodontic treatment can have important cosmetic advantages. However, it has been difficult to adequately prove the belief which is widely assumed that treatment can improve the oral health and psychological well-being of an individual.

Some of the benefits of orthodontic treatment include:

1. Improvement of caries and periodontal disease
2. Prevention of the dysfunction of temporomandibular joint
3. Improved masticatory efficiency
4. Speech improvement
5. Trauma prevention
6. Psychological benefits

The World Health Organization defined health as “a state of complete physical, social and mental well-being and not merely the absence of disease and infirmity”. Therefore, a malocclusion is not a state of disease, however when being treated, its benefits affect the mental and social well-being of an individual. There are some occlusal traits, like increased overjet, which can lead to reduction in self-esteem and can possibly be a reason for teasing.

Regarding more severe malocclusions related to facial disfigurement, as for example cleft lip and palate, they have been proven to have a profound psychological impact. However, there is little evidence supported by longitudinal studies, showing that the psychological health of an individual can be improved by orthodontic treatment (Kenealy *et al.*, 2007). More recent work has focused on what kind of impact the malocclusion can have on an individual's quality of life. Increased overjet and general spacing are found to have some negative impact in young adolescents and their families (Johal *et al.*, 2007), whereas the main trait that can affect an adult's individual quality of life is mostly severe problems related to skeletal pattern.

4.3.3 The evolution of bracket systems

I. The standard edgewise appliance :

A couple of years before he died, Angle, by using his experience and knowledge obtained from his inventions, set out an appliance to overcome past problems and provide orthodontists with a better chance of delivering ideal treatments. Initially, he had placed the slot of the fixed appliances vertically, but he then found out that by placing the slot horizontally he could obtain a better control of the teeth. This control was achieved by the rectangular wire in a rectangular slot, which provided a three-dimensional control of the position of the tooth. The archwire was held at its place by a ligature.

This standard edgewise appliance was every orthodontist's choice until the 1970's, but two major disadvantages were the main drawback of this method:

- a. Time-consuming bending on archwires. Even experienced doctors, needed hard work, lots of hours and additional time.
- b. Undertreated cases that were the result of the extreme skill needed. As a consequence, most of the cases were finished with a compromised result and not ideally with ideal occlusal relationships.

II. The straight-Wise appliance :

Until the 1970's the edgewise mechanics were dominating in the field of orthodontics. Lawrence Andrews introduced a technique that could reduce the amount of wire bending required. After studying a large number of occlusions, that were considered to be ideal, 120 in number, that were not treated with orthodontics before, he published the six keys that according to him were the keys of occlusion. These keys have been a useful guideline for orthodontists and dentists in order to diagnose, plan and treat patients to achieve good results. These keys that had been described by Andrews include:

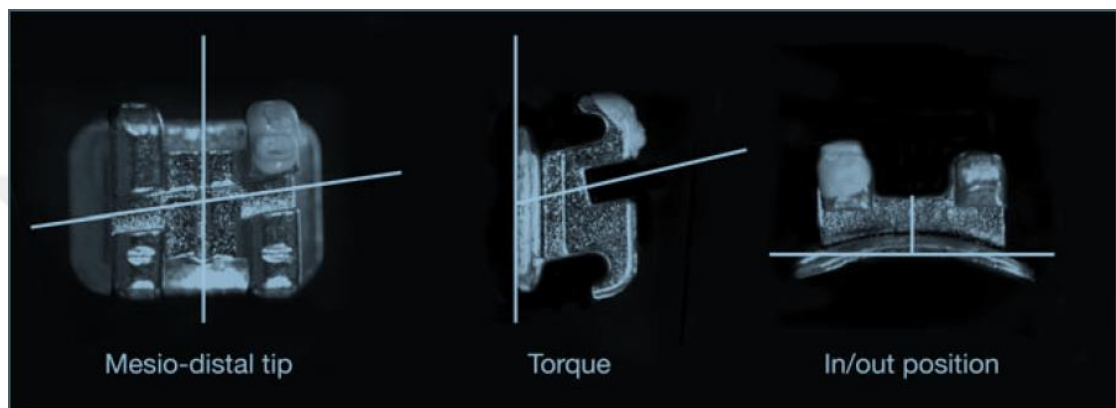
- a. Correct molar relationship
- b. Correct crown inclination
- c. Correct crown angulation
- d. No rotations
- e. No spaces
- f. Flat occlusal plane

By the help of these keys, he introduced an edgewise bracket system which took orthodontics one step further. This "straight-wire" appliance is still the most popular to be used. Unlike the standard-edgewise system, that require bends for each tooth individually, in the pre-adjusted edgewise appliance each tooth has a customized bracket. Andrews included a number of characteristics:

- a. pre-angulated slots
- b. bases of bracket with correct torque and inclination

- c. correct in/out position which was achieved by the distance of bracket base-bracket slot

The advantage of this system was that : i) the necessary work was done by the prescription of the bracket, reducing by this way the required wire bending and that ii)space closure by teeth sliding was easier, since the archwire sits in a passive way in the slot after alignment (Fig. 4.2).



Pre-adjusted Siamese edgewise brackets showing twin design and contoured base. The bracket prescription will position the tooth in three dimensions, generating mesiodistal tip, torque and in/out positioning.

Figure 4.2 : Pre-adjusted brackets

In order to obtain different levels of force and to change the mechanics, further new kind of appliances were developed. If placed properly, these could improve the position of the teeth (McLaughlin and Bennet, 2015).

4.3.4 Prescription of brackets

After Andrews introduced the straight wise appliances in 1970, there have been many modifications to improve the treatment outcome and to have a better esthetic result by reducing the corrections needed to be done by orthodontists. Torque values, slot sizes, tipping of the teeth, were considered to be the major changes. In 1979, Roth in his bracket system, did some modifications of torque, tip, in-out movements,

rotations. His way of thinking was that he wanted to overcorrect the position of the teeth before the debonding of the brackets (Kattner and Schneider, 1993). In 1998, McLaughlin, Bennet and Trevisi, introduced the MBT bracket prescription. Their target was simpler system use and better consistent results.

The differences among these systems are:

1. The palatal root torque in the brackets of the upper central incisors (Roth: 12 degrees, and MBT: 17 degrees)
2. The palatal root torque in the brackets of the upper lateral incisors (Roth: 8 degrees, and MBT: 10 degrees)
3. The lingual crown torque in the brackets of the lower incisors (Roth: -1 degrees, and MBT: -6 degrees)
4. The tip in the brackets of upper canines (Roth: 13 degrees, and MBT: 8 degrees) (Moesi *et al.*, 2013).

These differences in clinical terms are still open for debate and require further investigation to be considered proven.

At the study of Mittal *et al.*, they investigated whether there is difference in the torque values of the mandibular and maxillary anterior teeth, after the use of Roth and MBT bracket system. The sample was 40 patients, laser was used to scan the cast models and they measured the inclinations of the teeth. No statistical difference was found in both prescriptions, regarding the torque values of the teeth.

In 2012, Talapaneni *et al.*, compared the changes among Roth and MBT systems, in the sagittal and vertical plane. They used 30 patients who needed four bicuspid extractions. Talapaneni came to the conclusion that MBT had an advantage compared to Roth system. The main reason was the increased anchorage need and the proclination of anterior teeth during space closure that was seen in Roth system compared to MBT (Talapaneni *et al.*, 2012).

4.3.5 Principles of archwire selection

The selection of archwires is very important, since the wire, when placed in the slot, is able to move teeth and produce the effect that the bracket systems incorporates. The first archwire to be used produces movement to the teeth by using the elastic energy that is stored in it. These initial wires are flexible wires and are used in order to correct crowding and to level and align the teeth. Light but continuous force is the key point, being the most effective way to cause tipping and translation of misaligned teeth.

After crowding and rotations are relieved, rectangular flexible wires are used to move the teeth in the buccolingual direction, producing a torqueing effect. This is crucial in order to make sure that the root and crowns attain the correct position in the alveolar bone and mouth. Furthermore, if the position of the root is not correct, what can be seen is root recession or root dehiscence. During this stage, it is important to allow some kind of play between the slot and the wire in order to reduce binding and friction.

Rigid wires are used next in order to proceed to stage of sliding. This takes place after the correction of the buccolingual inclinations and of the crowding. Teeth slide along the wire, which gives a better shape to the arch. The rigidity of these wires enables the use of functional appliances or inter-arch elastics, the correction of curve of Spee, the decrease in the amount of relapse etc.

For the best torque expression, the vertical dimension of a rectangular wire should be at least 16” when a 18-slot bracket system is used and at least 19” when a 22-slot bracket system is used.

4.4 Orthodontic Brackets

4.4.1 Buccal brackets: How do brackets work?

The key point is the continuous pressure that is applied over a period of time to move the teeth slowly in the desired direction. While teeth are moving, there is a change in the shape of the bone as pressure is applied.

Brackets themselves are small appliances, bonded directly to the tooth's surface with a special bonding agent or they can be attached to the orthodontic bands. The orthodontic bands are cemented around the teeth that they wrap, in order to play the role of the anchor for the brackets. Orthodontic bands are not used in all of the patients, in some patients just buccal tubes can be used (Fig. 4.3).



Figure 4.3 : Orthodontic band

The brackets behave like handles, holding the wires. There are many types of brackets such as stainless steel, ceramic, plastic which are usually selected because they are not as obvious as the metal ones. Occasionally, brackets can be cemented to the back surface of the teeth, in order to provide invisible treatment.

The arch wires guide the movement of the teeth by being attached to the brackets (Fig. 4.4).



Figure 4.4 : Orthodontic archwire

Separators are fit between teeth in order to create adequate space prior to band placement (Fig. 4.5).



Figure 4.5 : Elastic separators

The ligatures, either metal or elastic, hold the wire to the bracket (Fig. 4.6).



Figure 4.6 : Elastic ligatures

Coil springs might be placed between the brackets to pull or push, close or open spaces between the teeth (Fig. 4.7) (Fig. 4.8).



Figure 4.7 : Coil spring



Figure 4.8 : Push-coil

Elastics, or rubber bands, can be worn by the patient between upper and lower teeth in order to move the upper teeth against the lower ones so that a good occlusion and intercuspation is achieved (Fig. 4.9).



Figure 4.9 : Rubber bands

4.4.2 Lingual brackets

4.4.2.1 Brief history

1967-1968 : The Japanese orthodontist dr. Fujita used for the first time lingual brackets

1970 : Dr. Kurz used plastic brackets on the lingual surface of the teeth, creating the first “true lingual appliance”

1976: First generation of Ormco lingual brackets created and “task force” group founded by Ormco , consisted of prominent orthodontists of that time (Kur, William, Alexander and others)

1990 : Seventh generation of Ormco lingual brackets

1992 : European society of lingual orthodontics was founded

1994 : Self-ligating lingual brackets were developed by Rouchin

1998 : The first university lingual programme was founded at university of Paris

2002 : The first customized lingual brackets were introduced together with robotic bending by dr. Wiechmann

2004 : World society of lingual orthodontics was founded

4.4.2.2 Evolution of lingual orthodontics

The 1970's has been a great decade for orthodontics. Due to the development of straight wire technique , the demand for orthodontic treatment had increased. As a result, more and more adults were seeking treatment. This increasing demand for treatment brought bigger concerns to the field of orthodontics.

The main concern of the patients was and still continues to be esthetics. In order to be able to deal with this increasing concerns of the patients, initially plastic brackets

were introduced. These, however, showed big problems when they were used and new alternatives were searched.

In 1968, Dr. Kurz, orthodontist and assistant professor at the UCLA School of Dentistry realized that the number of adult patients in his private orthodontic practice was increasing. Due to the fact that he had many “famous” patients, esthetics was one of his major concerns in order to offer the best service possible. The reason for the birth of the lingual bonded appliance was one particular patient that because of her work refused conventional labial appliances and demanded an appliance that could not be seen.

Dr. Kurz developed the first lingual appliance after much consultation from colleagues and it consisted of plastic brackets bonded to the lingual surface of the anterior teeth and metal brackets that were bonded to the lingual aspect of the posterior teeth. He named this appliance as a “true lingual appliance” (Fig. 4.10).

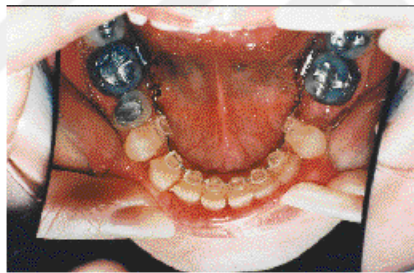


Figure 4.10 : Dr. Kurz’s “True Lingual Appliance”

The first impression of Dr. Kurz was that there was a high bonding failure rate especially because of the high occlusal forces on the maxillary incisors. Moreover, the brackets were irritating the patient’s tongue, finally being described as uncomfortable. The solution that Dr. Kurz found to this problem was smoothing the surface of the brackets and the results was improved acceptance by patients with much less discomfort.

It was rather expected that owing to commercial reasons , interest for this new approach and appliance was high, both by clinicians and companies, that were trying to develop some version of lingual appliance. It was found that the problems related

to this appliance remained. More specifically, discomfort, pain and irritation and high bonding failure rate were still present.

The interest from the public was growing and the new appliance was presented at the news, television and radio, as the new invisible braces. The task force group which was found byOrmco, presented the new appliance to the public. All these led to the demand of this appliance by the patients that were also excited by the new perspectives.

The normal consequence of this, was the increasing competition among companies. All companies were trying to have a lingual appliance available to present to the public. Even dentists demanded more information and training at the new technique and the courses that were delivered by the lingual task force were rapidly growing in size and number.

However, after some years the interest for commercial reasons and the enthusiasm for lingual treatment waned. The new mission of the task group, which was now limited to three people, was to find out the reasons for that decrease in the desire for lingual therapy and suggest solutions to the problems.

The problems that they found out were :

1. Before actually being completely tested, the lingual treatment was offered to patients.
2. There were inadequately trained orthodontists who were also treating large number of patients. As a result, this was a reason that created a bad reputation for the lingual therapy, from mouth to mouth among patients.
3. Expectations for the treatment were high and immediately demanded from the profession.

Among the solutions being suggested were, smaller classes organized by the most experienced lingual practitioners, longer courses with all the means available (typodonts, hands-on component), continuing education, support by meetings, journals and study clubs.

Continuing education programs were offered in Europe and Japan, with Mexico, Denmark ,South America following their examples. Enthusiasm for lingual therapy was strong again.

4.4.2.3 Summary of the progress of lingual brackets- From generation 1 to generation 7

Generation 1- 1976

The first appliance that was introduced by Ormco together with dr.Kurz. At the maxillary anterior area of canine to canine, it had a flat bite plane. At the mandibular incisor and premolar brackets, there were no hooks (Fig 4.11)

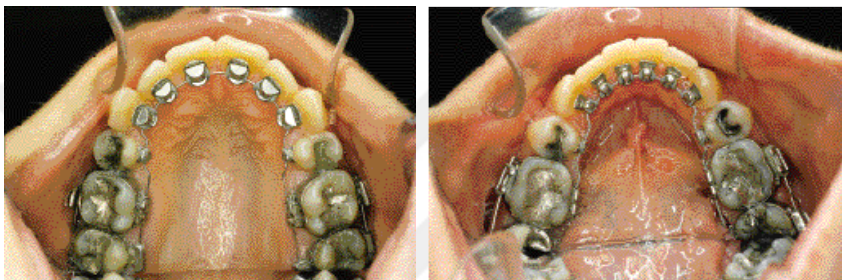


Figure 4.11 : Generation 1 – Lingual braces

Generation 2- 1980

All the canine brackets had now hooks (Fig. 4.12).



Figure 4.12 : Generation 2 – Lingual braces

Generation 3- 1981

All the anterior and premolar brackets had hooks (Fig. 4.13).



Figure 4.13 : Generation 3 – Lingual braces

Generation 4- 1982

The hooks were optional based on the needs of the treatment. Inclined planes on the incisors' brackets were placed (Fig. 4.14).



Figure 4.14 : Generation 4 – Lingual braces

Generation 5- 1985

The inclined plane became bigger and extended to the canine area. The hooks were optional and a transpalatal bar attachment from the molars was available.

Generation 6- 1987

The inclined plane on the incisors became more square. The hooks were elongated and the transpalatal bar attachment from the molars ,was optional.

Generation 7- 1990

The inclined plane of the lower incisors became bigger and the inclined plane of the maxillary teeth was heart-shaped. Better shape of the brackets was present , which provided better control of rotation and angulation.

4.4.2.4 Difficulties and solutions during development of lingual therapy

Some of the difficulties that appeared during the development of lingual orthodontics and their solutions, are:

1. Speech difficulties-tissue irritation

The initial generations of lingual brackets used to be irritating to the tongue and used to cause problems to the speech of the patient. The newer generation of brackets has been redesigned with smoother surfaces. This results in much less tongue irritation and increased comfort by the patient.

2. Impingement of gingiva

The first generation of lingual brackets had a base which was broad and used to extend towards the gingival margin. As a result, proper oral hygiene by the patient could not be achieved. After redesigning the brackets, the base extends less towards the gingival margin and more towards the incisal and mesiodistal part of the tooth. Through this, it is possible to maintain good oral hygiene by having self-cleansing brackets and increased bonding strength as well.

Extra attention should be paid to the lower anterior teeth which are close to the submandibular salivary glands. The lingual surface of that teeth, is vulnerable to accumulation of dental calculus, so the brackets' base is placed 1.5-2mm away from the gingival margin.

3. Occlusal interference

One of the initial problems that orthodontists faced, was the high forces directed towards the brackets, especially in the upper anterior teeth. The new generation of brackets included an inclined plane, located incisally to the slot, in order to redirect the forces.

4. Appliance control

The control of the appliance has been one of the major concerns since the lingual treatment was introduced. A bigger degree of accuracy could be obtained by the use of high tensile metal. The placement of the molar bands provided also better control from the buccal and lingual posterior sides. Nowadays, the transpalatal bars, either from the first or the second molar, are used for better stability.

5. Adaptation of base pads

The quality of the treatment is affected by the accurate construction and placement of the base pads. This is the reason why, for each tooth, individual bracket bases were constructed.

6. Placement and bonding of the appliance

The first lingual appliances were bonded directly, making it difficult for a bracket to be bonded accurately. As a result, during alignment, changes in the tip, torque and tooth height values could be observed. The initial system to be used was the Torque Angulation Referencing Guide System (TARG). The TARG system was using some landmarks as references, but still was not adequate. The next system to be used was the Custom Lingual Appliance System (CLASS). In this system, a set-up of the ideal occlusion is prepared and indirect bonding is done. After this, the brackets are transferred to the initial malocclusion in order to prepare the trays.

7. Placement of the wire

Initially, it was difficult to insert the wire in the molar tubes. The tubes were widened in the mesial part and redesigned.

8. Ligation

Initially, when the crowding was excessive, placement of the wire was impossible. After the introduction of the vertical slot it was possible that the wire could be inserted even at the initial stages of alignment. In addition, in order to allow stable ligation with elastic or metal ligatures, hooks have been designed to give us this opportunity for stable ligation.

9. Attachments

The initial gingival hooks were placed very close to the gingival margin, making it difficult for the patient to have a good hygiene. These hooks were redesigned and made smaller in size and away from the gingival margin.

4.4.2.5 Reasons to go lingual

1. Your patients want it.

Year by year, more and more patients seek for invisible orthodontic treatment. Due to friends and internet, dental awareness nowadays is high.

2. Small, comfortable.

Today especially with computerized lingual orthodontics, you can do minimal teeth movements quite simply.

3. Very affordable today.

Competition among companies is good for the range of the prices, since there are many companies offering the same product. So, price is also an important parameter regarding the final choice of the appliance. It is also possible to have 2d braces at a good affordable price.

4. Year by year it becomes easier and easier for the orthodontist and the staff.

There are a lot of seminar and courses every year being organized by the companies for continuing education. There are also users' meetings where you can attend and discuss possible problems you face or seek for advice. They do not leave you alone and unhelped, because they also want successful treatments. Successful treatments are something good for their businesses as well. The main belief is that there is no worse advertisement than a disappointed patient and a disappointed doctor.

5. Your clinic will become unique.

Most of the clinics do not provide this kind of treatment, this can be your way to put your clinic above.

6. You can do a 3D control as in buccal orthodontics.

As in buccal orthodontics you can get proper, inclination, angulation and torque.

7. It is not as slow it used to be.

It can be fast and as effective as buccal treatment.

8. Minimal teeth movement.

Many patients need just minimal invasion and lingual orthodontics is a useful tool to this direction.

9. Smile naturally with lingual orthodontics

4.4.2.6 Warning the patient

The patients, before starting, should be warned about some important things about their treatment:

- Speech difficulties, 2-4 weeks even more according to the patient
- Tongue irritation
- Strict oral hygiene

4.4.2.7 Biomechanical concerns in lingual orthodontics

In order to be able to understand how lingual orthodontics work, we should first have basic biomechanical knowledge about lingual orthodontics and orthodontics in general.

Firstly, we should understand what really moves teeth. It is not the wires or the brackets that move teeth. What really moves teeth is the moment of forces, where F is the force at the point of force application and D is the distance of the CR from the point of force application (Figure 4.15).

$$\text{Moment} = \text{Force} \times \text{Distance}$$

$$M = F \times D$$

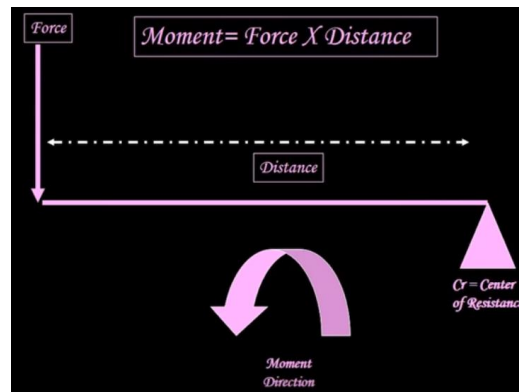


Figure 4.15 : Lingual force illustration

Today in orthodontics, for biological and periodontal reasons, we want the force to be as minimum as possible. As a result, if we want the moment to be big and at the same time the force to be small, we should have a large distance.

We can do that, by enlarging the interbracket distance, by enlarging the wire that passes between the two brackets and by other mechanical ways.

4.4.2.7.1 Short arch perimeter

One of the major problems of the lingual orthodontics, is the short arch perimeter, which is almost 40% less than the buccal perimeter. For the same number of teeth being bonded, we need much more amount wire in labial orthodontics (Figure 4.16).



Figure 4.16 : Short arch perimeter lingual

4.4.2.7.2 Horizontal moment of forces

For properly bonded teeth, once you locate the bracket behind the tooth, the distance between the lingual bracket and the CR is bigger than the distance between the buccal bracket and the CR. As a result, when we have the same horizontal force, the moment in lingual orthodontics is 40-60% bigger than in buccal orthodontics (Figure 4.17).

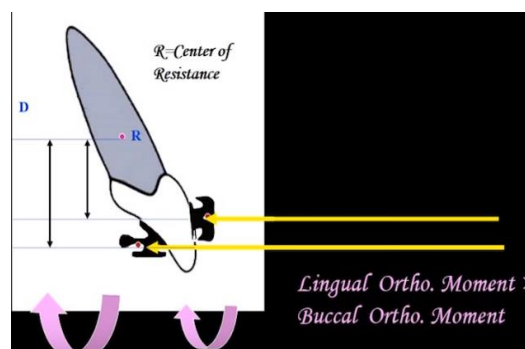


Figure 4.17 : Horizontal moment of forces

4.4.2.7.3 Rotations in lingual orthodontics

In buccal orthodontics, the distance of bracket-CR is bigger, so the moment of rotation is bigger. In lingual orthodontics, the opposite is happening since the distance of bracket-Cr is much smaller, creating a small moment of rotation.

We come to the conclusion, that it is more difficult to do rotation movement in lingual orthodontics (Fig. 4.18).

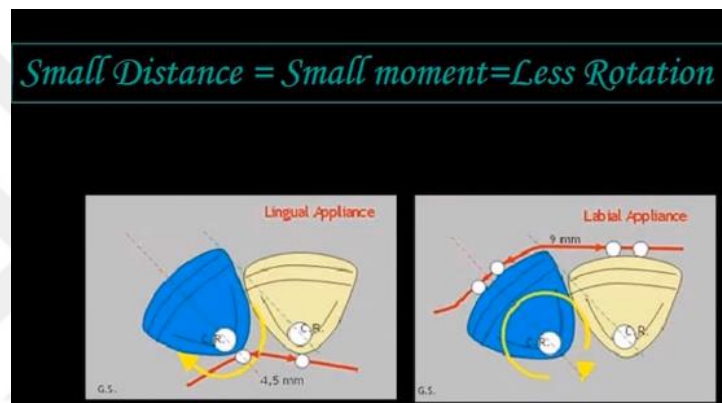


Figure 4.18 : Rotations in lingual

4.4.2.8 Types of lingual brackets

Since the 1970's lots of different types of lingual brackets have been developed:

- Big
- Small
- With straight-wire prescription
- No straight-wire prescription
- 2D
- 3D – Cad/Cam

With most of the brackets we can do minimal teeth movement like i) up and down, ii) in and out, iii) right and left.

When we say minimal teeth movement, it does not mean that we have minimal treatment options. We can do all these movements, like teeth upright, gingival line levelling, extrusion, intrusion etc. The control of all these movements depend not only on the brackets, but on the way you plan the case, on the way you place the brackets and the wire bending skills of the orthodontist.

For 3D control we need a bracket that can control the root torque of every tooth in a very desired prescription. So, there are these brackets that can achieve those minimal movements and these brackets that can achieve an accurate movement of root torque. The desired torque can be achieved by the help of two types of bracket prescription:

- a) Torque-in-slot, where only the center of the bracket base and the clinical crown are aligned.
- b) Torque-in-base, where the center of the archwire slot, the center of the bracket base and the center of the clinical crown are aligned.

4.4.2.9 2D lingual system

One of the most famous lingual systems that is used quite often by orthodontists is the 2D lingual system. Its main characteristics are:

- 2D lingual brackets
- Lingual archwires
- Light wire mechanics
- Low friction and light forces
- Direct or indirect bonding

This system provides us with:

- Comfort for the patient

- 2D control
- Esthetics
- Easy management
- Low cost

4.4.2.9.1 Opening-closing 2D brackets

Opening and closing the 2D brackets is very easy and it can be done with a modified Haideman spatula or with a special explorer (Fig. 4.19). What is really important, is that we open the bracket with mechanical deformation by directing the force towards the bracket base in order to avoid debonding. Closing the bracket clips is easy, we can do it with a Weingart or band remover, using at the same time a cotton roll for protection of the patient's lips and soft tissues. Finally, it is advisable to close only one clip per time.

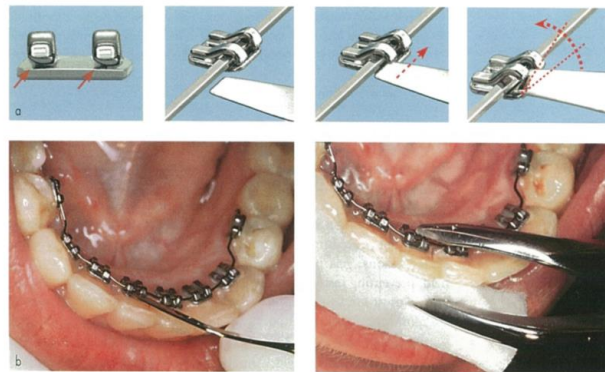


Figure 4.19 : Haideman spatula

4.4.2.9.2 2D Bracket categories

There are several types of 2D braces that can be used at each case and at each patient, according to our needs. These include:

- Medium twin: It can be used on all teeth. It is indicated for relapse cases that do not require the use of power chains.
- Medium twin with gingival hook: Indicated for more complex treatments where the use of chains and elastics is needed.
- Large twin: It is used when more rotational control is needed on wide teeth (central incisors)
- Narrow single: At existing severe crowding or rotation where space is limited for a standard bracket.
- 2D plus bracket: Existing rectangular slot that enables the use of torque on single teeth.
- Molar tubes

4.4.2.9.3 Advantages of 2D lingual braces

Some of the most important advantages of the 2d lingual braces are:

- They are like self-ligating system, no ligation needed
- Brackets can be used for all teeth, there is no bracket prescription
- They allow vertical insertion of the wire
- Allow the use of thin power chains
- 2d-plus brackets give you the option of torque if needed

4.4.2.9.4 Instruments used for lingual orthodontics

The majority of the instruments that are used for lingual orthodontics are the same like the ones being used in labial orthodontics. Specifically:

- Reverse hold tweezer (Fig. 4.20)

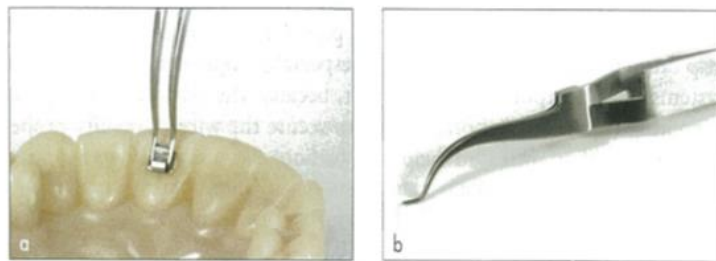


Figure 4.20 : Reverse hold tweezer

- Lingual weingart, smaller and thinner (Fig. 4.21)



Figure 4.21 : Lingual weingart

- Lingual mosquito (Fig. 4.22)

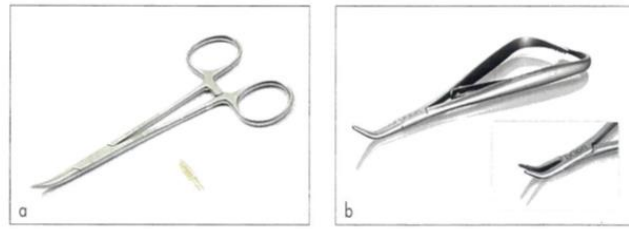


Figure 4.22 : Lingual mosquito

- Lingual cutters (Fig. 4.23)

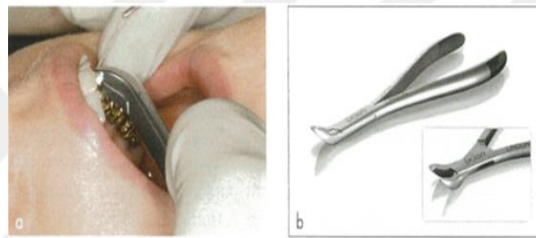


Figure 4.23 : Lingual cutters

- Distal end cutters
- Debonding pliers
- Distal cinch back plier (Fig. 4.24)



Figure 4.24 : Distal cinch back plier

4.4.2.9.5 Indirect bonding

The indirect bonding technique is widely used in lingual orthodontics. It provides accuracy in bracket placement and enables the orthodontist to proceed with the bonding of the braces at a rather difficult area to work at. Furthermore, by doing indirect bonding, the orthodontist obtains the efficiency in delivering the brackets at the initial appointment and this results in a more comfortable situation for the patient.

Before bonding the brackets at the dental cast, we have to analyze the case. We have to look at the smile, at the height of the gingiva, attrition of incisal edges, restoration plans that we have etc. These things will play an important role on where we want to put the brackets: right, left, up, down, more gingivally, incisally etc. For example when we want to close a small diastema, after using elastic chain we might have some tilting. As a result, we might bond the brackets accordingly, with some overcorrection in order to counter the side-effect of tipping (Fig. 4.25).



Figure 4.25 : Photo to evaluate the smile before bonding

Always, we should look at the clinical photos and panoramic and we have to check the angulation of the teeth.

4.4.2.9.5.1 Materials for indirect bonding

- Plaster model
- Isolation material (to isolate the brackets from the plaster model)
- Tweezer
- Explorer
- Light cure
- Gauge
- Bonding paste
- Pencil
- Bracket set

4.4.2.9.6 Cad/Cam lingual system

The cad/cam system is the most popular among patients and orthodontists and the most marketed system. There are many companies offering this treatment option (Win, Incognito, Harmony and others).

The concept behind cad/cam lingual is to design a bracket which is individualized for every patient and every tooth. The general idea is “Each bracket for each tooth and each bracket set for each patient”. After designing brackets that are individualized for each tooth, then we bend wires that are designed for these brackets and for this patient and this is done by robots, with an amazing precision that exceeds up to nanometers.

4.4.2.9.7 Lingual orthodontics with completely customized appliances

The use of customized appliances gave the clinicians the chance to include the lingual technique in their everyday clinical life (Fig. 4.26). Not only did it become an easier tool for the orthodontist to use, compared with other lingual techniques, but it was more comfortable for the patient. As a consequence, it became the most used lingual appliance since it was introduced in 2004.

Being an aesthetic alternative to correct the malocclusions, is one of the main advantages of the lingual technique. Moreover, there are advantages of the customized lingual systems compared with other lingual systems, which are :

1. Reduced risk of decalcification

It is proven that in 13 to 75% of patients undergoing orthodontic treatment, decalcification occurs. Since we cannot be sure at all about remineralization, each orthodontist should pay particular attention to this problem, trying to reduce any possible danger that might cause decalcification.

When customized lingual system are used, at the area around the bracket, it is five times less possible that decalcification will eventually take place. Even when it happens, there are not aesthetic concerns, because of its lingual location.

This is a truly important issue that needs to be discussed during the initial appointment , between each patient and the orthodontist and not only with patients that belong to the high-risk group of decalcification.

2. Defining the treatment plan precisely and individually

The target setup provides us with the opportunity to define a treatment goal when lingual customized systems are used. The orthodontist can then have an idea of the potential outcome which can be put into practice (Thalheim and Schwetska-Polly). Having the intercanine distance as reference, a small deviation of 0.5mm between the setup and our outcome shows that the treatment objective was finally achieved very precisely.

3. Improved third-order control

Third-order control can be achieved by the insertion of rectangular archwires in high precision slots. The lower anterior area is a region that requires high torque control at most of the treatments. Wiechman *et al.*, showed that the setup prescription could be achieved at a case which combined Herbst appliance with the Incognito system.

Proclination of the lower anterior teeth could be avoided and in half cases there was even uprighting effect, as planned by the setup. All in all, three dimensional control, esthetic advantages, low risk of decalcification, precise treatment plan and achievement of it, are the main differences among customized lingual appliances and other lingual systems.



Figure 4.26 : Customized lingual appliances

A customized lingual appliance: Incognito. Insertion of thin superelastic NiTi archwires. The bracket bases are extended over the occlusal surface of the second molars. In the lower anterior area, the archwire is placed in the self-ligating slots.

4.4.2.9.8 Main differences between lingual and labial techniques

- Anatomic differences of the lingual surfaces :

It is impossible to design and predict the treatment outcome based on the mean values, like we do for labial treatment. The reason for this is the differences in the morphology of the lingual surfaces of the teeth (Fig. 4.27). For example, the labial

surface of the upper central incisor is most of the time similar from tooth to tooth. Whereas, the lingual surface of the central incisor shows morphologic variations from tooth to tooth.

A difference in the position of a buccal bracket results in a small impact on the torque, almost 2 degrees. The malposition will not be noticed by the patient, only by the orthodontist. However, even a small difference in the position of the lingual bracket, results in a change to the third-order prescription, with a major difference of 22 degrees. The malposition will be significant in the vertical plane. The greater the distance between the surface of the tooth and the archwire, the greater the malposition of the tooth.

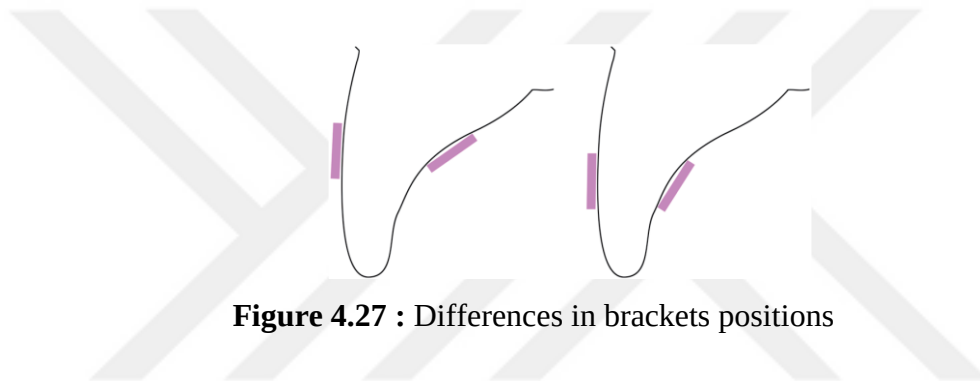


Figure 4.27 : Differences in brackets positions

As a result, when we want to achieve a good treatment outcome with proper torque values in lingual orthodontics, it is of paramount importance that we proceed with indirect bonding of the lingual customized appliances. This will guarantee the achievement of the desired torque values. Moreover, the slot has to be engaged fully by the archwire in order the torque to be expressed. Otherwise, if we use smaller archwires, overcorrection has to be added.

- Exposure of bonding area :

When we treat children or adolescents, we deal with the problem of unerupted, partially erupted teeth or teeth with reduced height of clinical crown. This is visible especially at the upper and lower second molars and lower premolars. As a result, it is difficult to bond conventional lingual brackets to these teeth, so labial treatment was the only existing choice for them. This explains why adults were the biggest part of

the patients that received lingual orthodontic treatment, since their teeth had been erupted and crown heights were mostly normal.

After the use of customized lingual appliances, in case of reduced bonding area, bonding pads, that can extend over the occlusal surface, can be used. This opens up a new age group and enables adults and adolescents to receive that kind of treatment.

4.4.2.9.9 Treatment stages in lingual orthodontics

The treatment stages that are followed during a lingual treatment are not different compared to the labial technique (Fig. 4.28). We always follow the protocol:

- Before starting (if we do not proceed with a customized appliance) we should choose the correct arch shape and size, according to the patient's mouth, comparing it with the chart that we have. We normally go for levelling and aligning, rotation control and control of the bite opening. The wires should stay in the mouth as maximum as possible in order to let them “cook” and not be in hurry to change them, thinking that by doing this we accelerate the treatment.
- After we finish with the previous stage, we proceed to torque control. It is needed in more complicated cases where we need a bracket with slot. This should be done with stiff wire and low forces.
- Again on stiff wires, we stabilize the segments and by the help of compensation bendings we deal with space dentition cases or extraction cases.

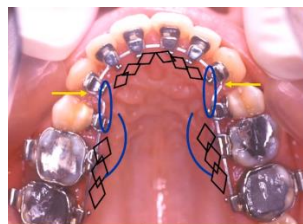


Figure 4.28 : Extraction case- lingual

- Detailing and finishing. We may need the set up by the technician, artistic wire bendings or elastics to achieve better occlusion and maximum optimal intercuspation (Fig. 4.29).



Figure 4.29 : Detailing – finishing

The success of the archwire sequence depends also on the correct planning and well-planned goals, on allowing sufficient time for each archwire to do its work completely and on using steel ligation with all rectangular wires.

4.4.2.9.10 Differences in anchorage value: lingual versus labial orthodontics

The anchorage value of the posterior teeth in the anterior-posterior and vertical directions appear to be higher in lingual orthodontics than in labial orthodontics (Takemoto, unpublished data, 1997).

In a randomized study of 44 adult Class II, division 1 malocclusions or bimaxillary protrusion malocclusions, the anchorage value was significantly higher in lingually treated cases than in those treated with labial techniques. The anchorage value of the lower arch is higher than that of the upper arch because the mandible has a thicker cortical layer and thinner cancellous layer of bone.

4.4.2.9.11 Lingual crown height

Lingual clinical crown heights on the average patient are approximately 30% shorter than the available crown on the labial surfaces. In general, 7mm of lingual crown height is necessary on the maxillary incisors in order to achieve optimum bracket placement.

Particular attention should be given in the following instances:

- Extreme brachyfacial types with short alveolar and crown height dimensions
- Partially erupted teeth in the young adolescent patient
- Crown heights that have been diminished by excessive wear, trauma, or restorative work
- Diminutive teeth, i.e., peg laterals

4.4.2.9.12 Types of ligation

There are different types of ligation, when needed in non-self ligating braces:

- Elastic modules
- Elastic chain
- Metal ligatures
- Figure-8
- Double over-tie (“german”)

4.4.2.9.13 Hygiene considerations

Hygiene as previously mentioned, should be the most important concern during our treatment. The gingival edge of the bracket should be about 1.5-2 mm away from the crest. Particular attention should be paid to the removal of the adhesive and patients

must be well educated in oral hygiene and motivated from the beginning. The oral instructions given should cover the use of floss and floss threaders, dietary constrictions and routine prophylaxis.

4.4.2.9.14 General advantages – disadvantages of lingual orthodontic treatment

As every treatment modality, lingual technique has some great advantages and some drawbacks as well.

Advantages :

- The labial surfaces are well preserved, as they are not damaged throughout treatment. This is of high importance, since anterior teeth play an esthetic role as well.
- The gingiva is not affected so much as there is an easy access to hygiene procedures
- Susceptibility to decalcification is much less in the lingual technique
- We can see the position of the teeth much more precisely, since they are not obstructed by wires and brackets

Disadvantages :

- Tongue and speech discomfort, reported almost by all patients especially in the early stages of the treatment
- Bigger appointments, since it is more time consuming
- Requires expertise and biomechanical knowledge
- More expensive

4.4.2.9.15 Lingual technique and other concerns

Throughout the years, the lingual technique has been improved dramatically and the system has proved to be reliable and it has been shown to be satisfactory, regarding the results that it produces.

The main concerns for the development of the lingual appliance was esthetic and they still remain until today. Without any doubt, appearance is the most important factor because of which patients seek orthodontic treatment. Not only dental appearance but facial appearance as well.

Breece *et al.*, has shown that physically attractive people are more successful in many domains of life than unattractive people. The reason for this, is that these people receive more positive attention and positive comments by teachers, peers etc, than unattractive people. This has a positive effect on the development of their personality and their self-image. Furthermore, orthodontic treatment has been proven to improve someone's physical appearance. As a result, it can affect the life of the individual and his/her social interaction. Whereas, deterioration of someone's appearance can affect his/her self-esteem. This is very common during adulthood.

If take as granted that the treatment outcomes and the quality of treatment are the same, most of the patients would choose invisible treatment if they were given the choice.

This service gives the orthodontist an important advantage over other colleagues that do not offer the treatment option of lingual appliances.

4.5 Index of Treatment Need (IOTN)

IOTN is an index used to determine the cases that mostly need orthodontic treatment, to distinguish the mild cases from the cases where patients are in greatest need of treatment. Since 2006 it is used by the British government and the national health system of Great Britain (NHS)

There are two components of the Index:

1. The dental health component (DHC)
2. The aesthetic component (AC), which is used only when the patient belongs to DHC group 3 or more. The “group 3” then is splitted into 10 subcategories.

When a patient is assessed on the IOTN scale, he/she is graded as 1,2,3,4 or 5 on the dental health component. Grade 1 means that the patient does not need treatment, whereas grade 5 is in absolute need of treatment.

Grade 1 : Does not need treatment (Fig. 4.30)



Figure 4.30: IOTN 1

Grade 2 : Little need for treatment (Fig. 4.31)



Figure 4.31: IOTN 2

Grade 3 : Needs treatment (Fig. 4.32)



Figure 4.32: IOTN 3

Grade 4 : Needs treatment (Fig. 4.33)



Figure 4.33: IOTN 4

Grade 5 : Cleft lip and palate, severe malocclusion and missing teeth

The dental health component (DHC) uses an acronym called MOCDO. This represents:

- M : missing teeth
- O : overjet
- C : crossbites
- D : displacement of contact points
- O : overbites

In detail, the characteristics that each grade includes are:

Grade 1 : Minor malocclusion

Grade 2 : Overjet 3,5 - 6 mm, crossbite ≤ 1 mm, openbite 1-2 mm, overbite ≥ 3.5 mm

Grade 3 : Overjet 3,5 - 6 mm, crossbites 1-2 mm, openbite 2-4 mm,

Grade 4 : Overjet 6 - 9 mm, crossbites > 2 mm, openbite > 4 mm, supernumerary teeth, ectopic teeth, impacted teeth

Grade 5 : Overjet > 9 mm, extensive crowding, impactions, cleft lip and palate, other pathological causes.

4.6 Oral Health Related Quality Of Life

The HRQoL is a concept regarding the QoL, but is related to oral health. QoL is an abstract term that reflects an individual's satisfaction in life. The term OHRQoL reflects an individual's judgement regarding some factors that may affect his/her well-being. These factors are:

- i. pain/discomfort
- ii. psychology (self-esteem)
- iii. social function (interactions with other people)
- iv. physical function

As soon as these factors place emphasis on orofacial concerns, then the “oral health related quality of life” is determined.

The term “health-related quality of life” (HRQoL) was initially introduced to describe the evaluation of an individual's well-being, but on many domains. The domains that were evaluated were, as mentioned, : pain or discomfort, psychological function, physical function, social function. (Hasan *et al.*, 2010). Therefore, the enriched “oral-health-related quality of life” (HRQoL) is a concept which can shed light on the demand of orthodontic treatment without looking only at the clinical parameters, helping us understand what the effect of malocclusion is , in people's lives. (Hasan *et al.*, 2010)

According to Johansson OHRQoL is a “subjective concept, which is based on the assumption that aspects of oral health affect the individual's or dental patients” (Johansson G., 2015). According to Locker and Allen, OHRQoL is “the impact of oral disease and disorders on aspects of everyday life that a patient or person values, that are of sufficient magnitude, in terms of frequency, severity or duration to affect the experience and perception of their life overall” (Locker D and Allen F, 2007).

Gift *et al.*, claimed that OHRQoL is an integral part of an individual's general health, on the grounds that it has an overall impact on the well-being and health status of the individual. (Gift *et al.*, 1997)

The health condition of the oral tissues defines the oral health of the patient. The oral health plays an important role at the patient's mental, social and physical well-

being by giving the opportunity to them to eat, socialize and communicate without feeling embarrassed or without having discomfort. The OHRQoL gives an idea of how a person perceives the relationship between his/her oral health and his quality of life and well-being. The large impact of the oral health on the first sight, comfort, social life, breath, sleep is unmistakable.

There is rapid growth of interest in the concept of quality of life. Every year there are more than 1000 articles that are indexed. Decade by decade, year by year, the methodology that enables us to measure OHQoL is improving. In this way, we can identify the needs, monitor the progress of the patients and select therapies. Until today, many OHQoL measures have been introduced and evaluated. At the international meeting in 1996 at the University North Carolina, eleven OHQoL measures were examined and it was claimed that the questionnaires of “Oral Health Impact Profile” (OHIP) and the “UK Oral Health Related Quality of Life” (OHQoL-UK) received the biggest attention. (Slade GD *et al.*, 1997, McGrath C and Bedi R., 2001) (These two are based on different models of orofacial health.)

Among these, the most used one and probably the most comprehensive is the “Oral health impact profile” (OHIP), which has been used in many languages (e.g. French, Finnish, Japanese, Chinese, German, Turkish, Swedish and others) and has been proven to be valid. (Montero *et al.*, 2009)

4.6.1 OHIP-14

The concept behind the OHRQoL is that the patient describes what the effect of the orofacial conditions and the dental interventions are, according to his experience. This concept is influenced by the patient’s physical health, the social relationship, his psychological state, the environment and other factors. In order to have an objective evaluation, OHIP-14 was developed and introduced by Slade GD. This tool used for assessment, covers seven domains of specific interest and it is used by clinicians to evaluate the current oral situation of a patient, but also in order help the researchers

supervise possible changes that might have occurred in the oral health-related quality of life of patients. For these reasons, it has been widely used by researchers and clinicians.

The OHIP was developed in Australia and uses a model of orofacial health that utilizes the “World Health Organization” (WHO) classification of disabilities, handicaps and impairments.

Originally it consisted of 49 questions, but Slade shortened it to 14 items, allowing it to be used as a validated index of oral health’s impact. (Slade *et al.*,1997).

The Ohip-14 due to its practicability, is preferred from researchers and clinicians to the Ohip-49.. It consists of seven sub-categories: physical pain, physical disability, psychological disability, physiological discomfort, functional limitation, social disability, handicap. (Slade and Spencer, 1994). These are the impacts that can affect the daily life of a patient and give them the motivation they need to ask for orthodontic treatment.

It is a tool which is sensitive and can help the clinicians to assess the oral state of a patient, but also it can help the researchers control the changes in QoL and that is the reason why it caught so much attention by doctors from different fields who wanted to evaluate the effect of some treatment methods on the QoL of their patients.

The OHQoL-UK was developed some years ago in the United Kingdom and uses the WHO model of “structure-ability-participation-ability”, incorporating both the negative and the positive influences on oral health.

Among the many methods that are developed and focus on different age groups and different conditions, the “Child-oral Impact on Daily Performance” (C-OIDP), is one questionnaire that examines the ability of a child in performing 8 activities: speaking, sleeping, smiling, study, eating, speaking, emotion, cleaning teeth. These constitute the psychosocial and functional domains.

The research that is being done on the psychological, physical and social impact of malocclusion on the OHRQoL can help us understand what the effects of malocclusion are on individuals’ lives. Thus, we have a better understanding of the necessity for orthodontic treatment, without taking only the clinical parameters into consideration. Since psychological and social effects are often the main reasons to seek

for orthodontic treatment, OHRQoL can be considered as the way to measure the need and outcome of the orthodontic treatment. (Masood *et al.*, 2014).

The dentofacial deformities and the malocclusion are quite prevalent and they can influence psychological physical and social functioning, thus having an important role regarding the interactions and social acceptance of the patient. (Rusanen *et al.*, 2010, Sylvola *et al.*, 2012).

The emphasis on health services that are evidence-based is increasing and makes it necessary that outcome measures are used, in order to evaluate how effective the orthodontic treatment can be. As a result, if we study the OHRQoL in orthodontic patients, this will provide us with information that will be of assistance to clinicians and public health researchers to improve the orthodontic care being offered.

4.6.2 Why do patients seek for orthodontic treatment?

The most important reasons that the patients seek orthodontic treatment for, are to improve their psychology, their quality of life, their oral function and regarding adults, they are mostly concerned about improving their appearance. (Tang *et al.*, 2015)

Nowadays, there is an increase in the number of the adults that are in need of oral rehabilitation and seek for orthodontic treatment as well. The explanation for this, is that esthetics are of paramount importance in the facial appearance and in the individual's life and reverberate in professional and social relationships. The treatment of an adult most of the times demands an approach which will be multidisciplinary. For example, in periodontal patients tooth and bone loss cause migration of teeth and this results in malocclusion. In such cases, periodontology can prevent the damage of the tissue and orthodontics can improve the position of the teeth, the bone insertion and promote the hygiene levels. It is obvious then, that interdisciplinary treatments play an important role in the quality of life of the patients, especially when additional oral rehabilitation is needed.

The positive aspect of a malocclusion is that it is indeed considered to be a deviation from what is considered to be esthetic norm, but it is not considered to be a

disease. Therefore, an orthodontist does not deal with sick patients. The demand for orthodontic care is increased day by day and year by year. One of the most important reasons –if not the most important- to seek for orthodontic treatment, is occlusal irregularities. However, things do not seem to be that simple, since some patients worry about problems that are considered to be minor esthetic, whereas other patients where severe malocclusion problems are present, do not seem to pay attention to them. However, it is claimed that the main reason that people seek for orthodontic treatment is esthetics and not the anatomic irregularities.

Sometimes the concerns of the patients about orthodontic treatment are not aligned with the evaluations of the professional. According to that, it can be assumed that the existing relationship between the OHRQoL that is reported by the patient and the malocclusion, is also affected by other factors. Some studies in the field of general medicine have pointed out that psychological factors, like self-esteem (SE) affect the quality of life of the patient and the general health conditions. It is indeed acceptable that the perception of malocclusion and dental esthetics tends to differ among patients, parents and orthodontists.

Until today, there has been more emphasis on clinical outcome measures than on subjective measures that are patient-based. (de Oliveira and Sheiham, 2003) These patient-based measures provide important information about the impact of oral problems, since patients are the best judges of their own OHRQoL. (Cunningham and Hunt, 2001).

4.6.3 OHRQoL in other fields

In recent years, OHRQoL measures have been used quite a lot, in the medical field and in researches. Many researchers, in many healthcare systems across the world, in order to determine to what extend the treatment affects QoL, used OHRQoL as an outcome measure.

For example, a longitudinal study by reported that endodontic treatment improves OHRQoL (Pei Liu *et al.*, 2014). In addition, Viola *et al.*, claimed that complete dentures affect the QoL in a positive way (Viola *et al.*, 2013).

The orthodontic treatment aims to correct variations that diverge from the norm. By using and studying the OHRQoL index, this would help us apprehend not only the clinical-based outcomes, but the patient-based outcomes as well. We should always take into consideration that brackets themselves can cause problems like unesthetic appearance, discomfort to the patients, functional limitations, pain and other. Understanding all these problems related to the daily wear of orthodontic appliances may help the orthodontists choose the right treatment plan and help them understand what the real expectations of an orthodontic treatment are. Furthermore, it would also help the patients become more adherent to their treatment.

4.7 Self Esteem

The word self-esteem describes what the person believes about his/her personal value or self-worth. A lot of beliefs can be involved, with the assessment of one's emotions, appearance and behaviors, being some of them.

Self-esteem is defined by Rosenberg as “a positive or negative attitude towards a particular object, namely the self”, while Coopersmith outlines self-concept as “personal judgement of worthiness that is expressed in the attitudes the individual holds”.

Children that have normal dental appearance seem to be judged as more intelligent, better looking, less likely to behave aggressively (Shaw, 1981) and more desirable as friends. Moreover, their teacher have better expectations from them. Therapists, teachers, parents focused on strengthening self-esteem, providing that the higher the self-esteem, the better the benefits and outcomes. Endeavors to boost pupils' self-esteem didn't show to improve their self-esteem. On the other hand, they might be counterproductive sometimes. In adults, sometimes job performance is associated with self-esteem, even though there might be a wide variation of the correlations. People

with high self-esteem is claimed to be more attractive, to be able to make better impressions on others and have better relationships, than people with low self-esteem. In addition, people with low self-esteem are more liable to have depression in some occasions.

It is overall recognized that the physical, social and psychological well-being are affected by oral health. In the field of general medicine, in order to do the treatment plan and assess the need of treatment, we should take the patient's assessments into consideration. Therefore, in oral medicine we can also use patient-centered outcome measures. In spite of not being fatal, oral diseases can result in serious consequences that affect the patients' QoL.

What is already obvious, has been confirmed by a number of relevant studies: it is highly possible that severe malocclusion could be a social handicap. We should bear in mind what the caricature of someone who is not too smart, includes; protruded upper incisors, is the answer (Fig. 4.34). Another example is: we all know the "bad witch" from the cartoons, not only does she ride a broom, but she appears with a very prominent lower jaw with a Class III skeletal problem (Fig. 4.35).



Figure 4.34: Bad witch illustration



Figure 4.35 : Goofy teeth illustration of Class II of Class III

Studies in the field of medicine pointed out the importance of psychological features such as self-esteem, in foretelling what the effect of health conditions to the patients' quality of life will be (Katz *et al.*, 1995).

Marques *et al.*, in their study of Brazilian schoolchildren, showed that the children with low self-esteem, were more sensitive regarding the esthetic effects of malocclusion. (Marques *et al.*, 2005)

Nowadays, it is widely accepted that malocclusion negatively affects the individual's social, physical and psychosocial well-being. (Feu *et al.*, 2010). Traditionally, orthodontists have considered function and oral health as the main goals of the treatment. (O'Brien *et al.*, 1998; Hunt *et al.*, 2001). However, esthetics and the psychosocial impact of it, are addressed as a very important benefit of the treatment. (Cunningham and Hunt, 2001)

It is of paramount importance to understand the bidirectional interaction between OHRQoL and SE, on the grounds that it is complex to evaluate self-esteem when at the same time it is affected by many other factors. As a result, the relationship between malocclusion, OHRQoL and self-esteem should be examined thoroughly if we want to interpret the results of clinical examinations using OHRQoL measures.

Moving the teeth to their correct position is one aspect of the treatment offered to the patients. Every patient is unique and different and has his/her own pattern. His/her responses to the treatment are influenced by his/her personal experience, cultural differences and family history. Kivak *et al.*, showed that if we correct the malocclusion, this improves the body image of facial and dental features (Kivak *et al.*, 2002).

The relationship between esthetic improvement and psychological profile has been shown to be positive. Studies being performed on orthognathic patients, suggested that after facial surgery which resulted in better facial esthetics, an improvement in self-esteem and body image was also obvious (Hunt *et al.*, 2001). This psychological benefit is expected because of the fact that orthognathic surgery is planned with a view to improve the facial profile of the patient and his appearance. However, there has been very little research in order to examine the changes in self-esteem and over QoL, in patients receiving orthodontic treatment without skeletal discrepancies.

4.8 Oral Health Impact Factors

During the recent years, there is a growing interest in both realizing the symptoms that the patients experience during their treatment (for example pain, discomfort etc)

and in the oral impacts of their treatment, such as the influence of their orthodontic treatment in the quality of life.

In dental research there has been more emphasis on clinician-driven outcome measures, rather than on measures based on patients, such as social and psychological well-being (de Oliveira and Sheiham, 2003). The assessment being done by the clinician is relevant, but the assessment by the patient provides more accurate information regarding the oral impacts, on the grounds that patients are the best judges of their own OHRQoL.

In patients with malocclusion problems, we see quite often problems associated with periodontal disease, chewing and speaking. Compared with the general population, patients where severe malocclusion was present, reported higher levels of oral impact factors.

Some of the reasons that patients seek orthodontic treatment for, are to improve their psychological well-being, oral function and quality of life. The main reason though, is to improve their appearance. However, brackets can cause unaesthetic appearance, discomfort, pain and functional limitations during treatment. In recent decades, esthetic dentistry plays an important role in the life of the dentist-orthodontist and the patient. The demand for esthetic orthodontics has also been increased, that is why ceramic brackets, clear-aligners and lingual brackets have been invented to improve esthetics. During the first stage of fixed orthodontic treatment, we face teeth alignment which depends on the response of the fixed appliances to the levelling archwire. The effective alignment is characterized by a balance between the speed of teeth movement and the as much as possible less damage to the teeth and periodontal structures, achieving like this the minimum discomfort levels for the patient.

Scheurer *et al.*, showed that during orthodontic treatment, discomfort is a potential side effect (Scheurer *et al.*, 1996) and this can affect in a negative way the motivation to seek for orthodontic treatment (Oliver and Knapman, 1985). The discomfort related to the treatment can be influenced by many factors, including gender (Bergius *et al.*, 2000), previous experiences of pain (Okeson, 1995) and age (Scheurer *et al.*, 1996). One of the most important variables is the force applied to the teeth by the wire, especially during the early stages of treatment. The histological studies that we are based on, indicate that the lighter the forces, the more biological and the less traumatic

the teeth movement. That is the reason why when we use more increased forces, we should expect increased discomfort. In addition, the greater the initial crowding, the bigger the discomfort, because more teeth will need to be engaged with the archwire.

4.8.1 Pain in orthodontics

Pain itself is a sequelae of fixed orthodontic treatment and it is experienced by most of the patients (Keim, 2004). Furthermore, it is a crucial fear and dislike of the patients regarding orthodontic treatment.

4.8.1.1 Etiology and evolution of pain

Despite the fact that pain during orthodontic treatment is not until now fully understood, there have been various concepts discussed:

- Bernick and Furstman claimed that periodontal pain could be caused by the pressure in periodontium. At first comes ischaemia, then inflammation and then the subsequent oedema.
- Burstone identified two pain responses, one immediate and one delayed. The immediate pain response is related to the compression of the periodontal ligament (PDL) after the wire is placed and the delayed pain response was due to the release of prostaglandins causing hyperalgesia.
- Kvam *et al.*, supported that perception of pain was due to the changes in the blood flow in the PDL and are associated with the presence of substance P and prostaglandins. (Kvam *et al.*, 1987)

Ngan *et al.*, suggested the use of non-steroid anti-inflammatory, like ibuprofen and aspirin to relieve the pain. It is difficult to measure the subjective perception of pain. Burstone pointed out a variety of different responses to similar forces that were applied

to the teeth. One of them mentioned that pain starts some hours after the force application and lasts about 5 days (Jones and Chan, 1992).

Ertan Erdiñç and Diñçer, showed that level of pain peaks at around 24 hours after the initial placement of the wire, and it reduces during the subsequent week. (Ertan Erdiñç and Diñçer, 2004).

The pain owing to fixed labial orthodontic appliances has been reported by Bondemark even in the beginning at the placement of separators, continuing to the placement of the wire (Bondemark *et al.*, 2004)(Firestone *et al.*, 1999; Polat and Karaman, 2005). However, we can see a paucity of information that compares the pain experience between patients treated with labial and patients treated with lingual fixed appliances. (Caniklioglu and Öztürk, 2005). Miller suggested that Invisalign can cause less pain during orthodontic treatment than the labial orthodontic appliances.

4.8.2 Aesthetic considerations

Apart from comfort, cost, pain, length of treatment, patients appear to have also aesthetic considerations. The main orthodontic appliance to be used is the traditional buccal fixed appliance. However, after the introduction of the lingual appliance, patients had an important aesthetic advantage, but a prolonged adaptation period reduced its use up until the last two decades.

The Invisalign, which is more aesthetic compared to the labial appliances, was introduced in 1997. It is easily removable for eating and easily cleaned (Wong BH, 2002). However, there are the disadvantages of higher cost and of technical limitations.

According to researches, in Invisalign technique, the mean accuracy of tooth movement is 41%. Lingual constriction is considered to be the most accurate movement (47.1%) and the least accurate is extrusion of teeth (29.6%).

Women under the age of 40 prefer lingual over labial for professional and buccal reasons (Kravitz *et al.*, 2009), because lingual appliances have many esthetic advantages over the labial ones (Fujita, 1978) and bear a smaller risk of caries. (Van

der Veen *et al.*, 2010). Even the color-matched labial brackets are not an alternative compared to the lingual technique.

Generally adults react negatively towards the buccal appliances and do not want their braces to be shown. Despite the fact that plastic and porcelain brackets have appeared to satisfy this desire, lingual orthodontic appliances might be considered as impractical due to the discomfort, speech problems, tongue irritation, hygiene problems and other problems that they cause.

The reason is that the lingual brackets are positioned lingually to the teeth surface and cause a change in these surfaces' morphology, leading to articulation problems, chewing difficulty, irritation of tongue. Khattab *et al.*, reported that the severe speech deteriorations were mostly related to lingual appliances rather than labial appliances. (Khattab *et al.*, 2012). However, until today there has not been evidence-based studies assessing this belief. Thus, a systematic review evaluating this evidence is necessary.

Even though oral function is for sure affected by malocclusion, it adapts itself surprisingly well. Malocclusion affects function in a way that it makes oral function more difficult but not impossible, so that a lot of effort is needed to compensate this anatomic deformity. For example, difficulty in swallowing is not affected in the end, because tongue and lips adapt to the teeth position. Furthermore, distorted speech most of the times cannot be noticed at patients, even if they have to make a big effort to have a normal speech, because almost everyone is capable of moving the jaws so that proper lip-jaws relationships exist.

If we understand the discomfort that is related to wearing orthodontic appliances, then orthodontists might have more realistic expectations about the treatment and will be able to choose the most suitable treatment method.

4.9 Bullying

Bullying is the aggressive behavior against an individual, which is characterized by power imbalance (Gini and Pozzoli., 2013). An individual is repeatedly exposed to non-positive actions by others –at least one or more other persons. These non-positive

actions can be direct actions, such as kicking, threats, hitting, insults or indirect actions, such as gossiping, social exclusion, spreading of rumors and are likely to cause damage to the victim.

Bullying's implications include low self-esteem, both physical and mental problems, depression, involvement in crime, poor performance at academic environment. This academic performance should be also addressed by the educational institutions that must motivate their students' socialization and emphasize on strengthening the students' respect and assertiveness.

Bullying has raised the interest of many scientists all around the world. However, its relationship with teeth appearance is not clear. In the past fifteen years, many health professionals and researchers have devoted a lot of effort to this issue in order to understand the nature and the prevalence of bullying. A good evidence of this increased attention to this issue, is the big number of published articles over the past fifteen years. If we type the keywords "bully or bullying at schools" at the American Psychological Association database (PsycINFO), we will see more than 1700 articles published from 1980 to 2010. Quite surprisingly, most of these articles were published after 2000. In accordance with that, in Turkey also we can find approximately 80 studies after 2000 and most of them, almost 88% (70 studies) were published after 2006, which indicated also an increased attention in Turkey as well.

Despite the fact that there is a quite significant number of studies about bullying. There is little attention paid to its precise assessment. This is of paramount importance, because the precise assessment of bullying is crucial to gain a better understanding of it and develop effective strategies about its intervention and prevention. Only a few studies have evaluated concerns about bullying's assessment and discuss measurements. (Sheras, & Cole 2006, Tanigawa, & Greif-Green 2010, Griffin & Gross, 2004). Therefore, a precise interpretation of bullying is related to how accurately it is assessed.

In fact, we have some options to assess bullying (peer-reports, teacher-reports etc), but the most usual procedure is by using self-reported instruments. This is a more practical way to collect data (Furlong *et al.*, 2015) and today most of the research findings have been based on these self-reports.

The school bullying is an important concern that influences students' social functioning and their well-being. It is a worldwide problem that can affect negatively the school climate and the students' right to be educated at a safe environment. School bullying can also lead to permanent life consequences, both for the victims and for the students that bully others.

In addition, school bullying is endemic and ranges between 5-58% worldwide (Fleming and Jacobsen, 2010). The prevalence of school bullying in children 11-12 years old in the United Kingdom is 15% (Boulton and Underwood, 1992). In the school environment, the most common place that bullying might occur is the playground (Glew *et al.*, 2005).

The victims often find it hard to tell their problems to the others and this is a reason why the prevalence of bullying is often underestimated. Bullying seems to increase during the elementary years, peak during the middle school years and the decrease during high school years. Males experience mostly direct bullying, such as verbal and physical abuse. On the other hand, females experience mostly indirect bullying such as gossiping and rumors (Baldry and Farrington, 1999).

Regarding the facial appearance, it is generally accepted that deviations from what is considered to be normal dentofacial esthetics, could possibly affect the individual's psychology and result in social handicap. (Shaw *et al.*, 1980).

Individuals with malocclusion are considered to be less desirable as friends, less intelligent, more aggressive compared with individuals that have normal incisors' alignment. (Kerosuo *et al.*, 1995).

Furthermore, good dentofacial appearance is crucial for making friends and career progress. (Linn, 1966). Sehra *et al.*, showed that adolescents that experienced bullying due to their malocclusion, experienced also bigger oral symptoms and functional limitations. (Seehra *et al.*, 2011).

4.9.1 Dental characteristics and bullying

Maxillary crowding, excessive overjet, excessive overbite have been identified as some of the dental characteristics that increase the risk of bullying. (Helm *et al.*, 1985). Al Bitar *et al.*, showed that teeth ranked the third position among the general characteristics being targeted for bullying. The first two were strength and weight. (Al Bitar *et al.*, 2013). The most common dental features that composed a target by bullies, were spacing, missing teeth, color/shape of the teeth, prominent maxillary incisors.

4.9.2 Other problems and bullying

As far as their personality is concerned, the victims are anxious and with low self-esteem and depressive tendency. (Olweus *et al.*, 1993) Victims is also found to be less attractive than those that are not subjected to bullying. Olweus also showed that one possible consequence is underachievement at school and decreased social interaction. A problem regarding the facial and dental anomalies is that in everyday life and in our everyday interaction, normally the eyes attend the face, so it is difficult to hide this anomalies. The bigger the dental deviation is, the worse the bullying that the child might be subjected to. (Shaw *et al.*, 1980).

4.9.3 Other concerns

Every orthodontist will face the “goofy child” or the child with “metal mouth”, that is being bullied at school. Most of the times, parents are enthusiastic about their children’s treatment because they feel that this will be the key to their child’s problem. However, will correction of malocclusion improve the self-esteem of the child and help in the cessation of bullying? That is a question that needs to be answered.

Orthodontic treatment is considered to be necessary in children that experience bullying because of their teeth and malocclusion. It remains to be seen and proven whether orthodontics improve, worsen or do not make any difference in these episodes of bullying and what the psychosocial gain is.



5. MATERIALS AND METHODS

5.1 Ethical approval

The Ethical Committee of the Institute of Health Sciences, Marmara University, approved of this questionnaire - based study. These patients had already been selected to be treated at the Department of Orthodontics, School of Dentistry at Marmara University and were about to start orthodontic treatment with either buccal fixed orthodontic appliances or 2D lingual fixed orthodontic appliances.

5.2 Patient Selection

A total number of 34 patients were selected. Our sample consisted of two groups. The first group consisted of 17 patients undergoing treatment with buccal fixed orthodontic appliances and the second group consisted of 17 patients undergoing treatment with 2D lingual fixed orthodontic appliances. The mean age of the patients in the sample size was 15.38 years (Table 5.1). The mean treatment time was 7 ± 1 months. All the questionnaires were given to the patients every single time that they were coming to their appointments at the clinic of Orthodontic department, Marmara University (approximately every 4-5 weeks). Our questionnaire-based study is conducted focusing on the initial treatment period at each patient. Mainly, each patient was at the levelling and alignment period.

Table 5.1: Chronological Ages, Gender Distribution and Final Sample Size.

Gender	Male	Female	Total
Initial sample size	17	17	34
Final sample size	17	17	34
Mean Age (years)	15	15.76	15.38

As part of the routine protocol in the Department of Orthodontics of Marmara University informed consent forms had been signed by all patients or their parents.

5.2.1 Selection Criteria

The following inclusion and exclusion criteria were followed to include or discard patients who were not in line with the purpose of this study:

Inclusion criteria:

- Age between 12 to 30
- Class I /mild Class II malocclusions with IOTN: 1 or 2 grade
- No treatment history
- Overbite 0-2 mm
- Non-extraction treatment

Exclusion criteria:

- Extractions or missing teeth.
- Craniofacial syndromes, systemic diseases and anomalies, including cleft lip and palate, or a history of trauma to the jaw.
- Excessive crowding, IOTN above 3

5.3 Bonding Procedure

Direct bonding technique was used for the bonding of the brackets at the patients that were treated with buccal fixed orthodontic appliances. Regular bonding procedures were followed for each patient.

All teeth were polished before bonding, to remove the dental plaque from their surfaces and to be able to achieve better long-term bonding results (Fig. 5.1).



Figure 5.1 : Polishing

Mouth retractor was used to retract the lips and cheek and obtain good and dry bonding field (Fig. 5.2).



Figure 5.2 : Mouth retractor

Dental etching took place by using phosphoric acid 37% directly on the buccal surface of the teeth, followed by dental adhesive material of 3M company (Fig. 5.3, Fig. 5.4).



Figure 5.3 : Adhesive



Figure 5.4 : Phosphoric acid

After the placement of the braces, archwire was inserted according to the severity of dental crowding and anomalies of each patient.

Indirect bonding technique was used for the bonding of the brackets at the patients that were treated with 2D lingual fixed orthodontic appliances. The bonding tray was prepared by the doctor himself/herself with the help of a soft essix-plaque (2 mm thickness) (Fig. 5.5) and “Biostar” thermal forming machine (Fig. 5.6). After the transfer tray was completed, sandblasting was performed on to the bracket bases and it was kept in a dry and dark place until the day of the bonding.



Figure 5.5 : Soft plaque- transfer tray



Figure 5.6 : Thermal machine

Like in the buccal braces, all teeth were polished before bonding, to remove the dental plaque from their surfaces and to be able to achieve better long-term bonding results. Normal bonding procedures were followed for each patient as well.

Special mouth retractor, which is called “Nola Retractor” (Fig. 5.7) was used to retract the lips and cheek and obtain good and dry bonding field.



Figure 5.7 : Nola retractor

Again like in the buccal braces, dental etching took place by using phosphoric acid 37% directly on the lingual teeth surface, followed by dental adhesive material of 3M company. After the placement of the braces, wire was inserted according to the severity of dental crowding and anomalies of each patient. The wires that are used for lingual bonding usually have the so-called “mushroom shape” (Fig. 5.8). According to the size of the patient’s mouth, different size was used. Shapes can range from 1 to 5.



Figure 5.8 : Mushroom-shaped lingual archwires

5.4 Treatment Protocol

The diagnosis, planning and the treatment was provided under supervision at the Department of Orthodontics, School of Dentistry at Marmara University.

As far as the treatment with buccal braces is concerned, 0.018” Roth prescription bracket system was used in all patients. This would help to improve the reliability of our results. The bracket set that is used in the Orthodontic clinic of Marmara University is produced by 3M company (Gemini Metal Brackets, 3M Unitek, USA) (Fig. 5.9).

Straight wire mechanics were used, and initial alignment was initiated by round Nickel-Titanium wires followed by rectangular wires either stainless steel or Nickel-Titanium. The brackets were ligated with metal ligature wires, which consider to reduce friction and produce more stable results. These are standard treatment mechanics that are used in orthodontic treatments.



Figure 5.9 : 3M bracket set

As far as the treatment with lingual braces is concerned, a 2D-lingual bracket system was used. In our thesis, we are dealing with the lingual bracket set that is produced by Forestadent Company, Pforzheim, Germany.

Straight wire mechanics was used, and initial alignment was initiated by round Nickel-Titanium wires (mushroom shaped) , followed by rectangular wires either stainless steel or Nickel-Titanium.

Brackets did not need to be ligated with the wire, since the brackets of this bracket system have two hooks that can be opened and closed after the wire is placed. It is mainly a “wire holder”. Special orthodontic plier can be used for this purpose in order to place the wire and open and close the hooks faster and safer.

5.5 Collection of data

All of the data were collected by the use of the four questionnaires. First questionnaire to be used was OHIP-14, second questionnaire to be used was Rosenberg self-esteem scale, third one was Visual Analog Scale (VAS) and the fourth one was a self-administered questionnaire being used for measuring the bullying.

Data were collected from 34 patients (aged 12 to 30) who had undergone orthodontic treatment.

Participants were classified into two groups:

- 1) Patients undergoing treatment with buccal braces (n = 17)
- 2) Patients undergoing treatment with lingual braces (n = 17)

OHRQoL was assessed using the Oral Health Impact Profile (OHIP-14).

All subjects were examined and interviewed at levelling and alignment period ,during the first 6 months. We defined four time intervals:

- (T1) was defined as the first appointment of the patient, which was 1.5 months after the bonding.
- (T2) was defined as the second appointment of the patient, which was 3 months after the bonding.
- (T3) was defined as the third appointment of the patient, which was 4.5 months after the bonding.
- (T4) was defined as the fourth appointment of the patient, which was 6 months after the bonding.

All four questionnaires were delivered to the patients at each time interval.

5.5.1 Questionnaires

The following four questionnaires have been used in order to assess and compare the oral health related quality of life, self-esteem and bullying among patients receiving orthodontic treatment with buccal and 2D lingual fixed orthodontic appliances.

5.5.1.1 OHIP-14

The Ohip-14 was examined and found to be valid among Turkish population. (Mumcu *et al.*, 2006). A version of this questionnaire was used and the questions were adjusted to orthodontic treatment-related questions (Table 5.2).

Table 5.2 : OHIP-14 Questionnaire

İmza:

Tarih:

TC No:

Oral health related quality of life (OHIP-14) anketi :

No	Sorular	0	1	2	3	4
1	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile herhangi bir kelimeyi telaffuz etmekte sorununuz oldu mu?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
2	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile tat alma hissinizin bozulduğunu hissediyor musunuz?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
3	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile ağzınızda ağrılı bir durum yaşadınız mı?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
4	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile yemek yemeyi rahatsız edici buldunuz mu?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
5	Daha önceden, dişleriniz, ağzınız veya braketlerinizle ilgili bilinç ve bilgiye sahip miydiniz?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
6	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile gerginlik hissettiniz mi?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman

Table 5.2 : OHIP-14 Questionnaire (continued)

7	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile diyetinizin tatmin edici olmadığı oldu mu?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
8	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile yemeğinizi yarıda bırakmak zorunda kaldınız mı?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
9	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile gevşemede zorlandığınız oldu mu?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
10	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile utandığınız bir durum oldu mu?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
11	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile diğer insanlara az da olsa asabi davrandığınız oldu mu?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
12	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile her zaman yaptığınız işinizi yapmada herhangi bir zorluk yaşadınız mı?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
13	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile genelde hayatın daha az tatmin edici olduğu hissine kapıldınız mı?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman

Table 5.2 : OHIP-14 Questionnaire (continued)

14	Dişleriniz, ağzınız veya braketleriniz ile ilgili problemler nedeni ile fonksiyonlarınızı tümüyle yapamayacak duruma geldiniz mi?	Hiç	Nadiren	Bazen	Sıklıkla	Her zaman
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This questionnaire consists of 14 questions carefully selected to guide the patient. The questions cover seven specific domains:

1. Psychological discomfort
2. Psychological disability
3. Physical disability
4. Physical pain
5. Functional limitation
6. Social disability
7. Handicaps

There are five possible answers, which are: i) never, ii) hardly ever, iii) occasionally, iv) fairly often, v) very often/every day. Each of the answers is scored on a scale from 0 to 4 , which is:

- “Never” equals to 0 points.
- “Hardly ever” equals to 1 point
- “Occasionally” equals to 2 points
- “Fairly often” equals to 3 points
- “Very often/every day” equals to 4 points

According to the patient’s answers a score is conducted. The Ohip-14 score can range from 0 to 56 points. When the score is between 0-10, it is considered to be a domain score, whereas when the score is high, this represents poor OHRQoL.

5.5.1.2 Rosenberg Self-esteem Scale

Table 5.3 : Rosenberg Self-Esteem Questionnaire

İmza:

Tarih :

TC No:

1. <u>Genel olarak, kendimden memnumum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
2. <u>Bazen, hiç iyi olmadığımı düşünüyorum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
3. <u>İyi özelliklere sahip olduğumu hissediyorum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
4. <u>Çoğu insanın yapabildiği şeyleri benim de yapabildiğimi düşünüyorum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
5. <u>Gurur duyulacak çok fazla şeyim olmadığımı hissediyorum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
6. <u>Bazen tamamen faydasız olduğumu düşünüyorum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
7. <u>Değerli bir insan olduğumu, en azından diğer insanlar kadar değerim olduğumu düşünüyorum</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
8. <u>Keşke kendime daha çok saygı duysaydım</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
9. <u>Kendimi değerlendirdiğim zaman, başarısız biri gibi hissetmeye meyilliyim</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	
10. <u>Kendime karşı olumlu bir tavır takınırım</u>				
Tamamen katılıyorum	Katılıyorum	Katılmıyorum	Hiç katılmıyorum	

This questionnaire consists of 10 questions used to evaluate individual self-esteem. 5 negative and 5 positive items are presented in a randomized sequence. There are four possible answers to the questions, which are: i) “strongly agree” , ii) “agree” , iii) “disagree” , iv) “strongly disagree”

- The questions 1-2-4-6-7 are scored following this system:

“strongly agree” : 3 points
“agree” : 2 points
“disagree” : 1 point
“strongly disagree” : 0 points

- The questions 3-5-8-9-10 are scored following this system:

“strongly agree” : 0 points
“agree” : 1 point
“disagree” : 2 points
“strongly disagree” : 3 points

According to the patient’s answers a score is conducted. The final score can range from 0-30. Scores from 0-15 represent low self-esteem, scores from 15-25 represent normal self-esteem, whereas scores from 25-30 represent high self-esteem.

5.5.1.3 Visual Analog Scale (VAS)

Table 5.4 : Visual Analog Scale

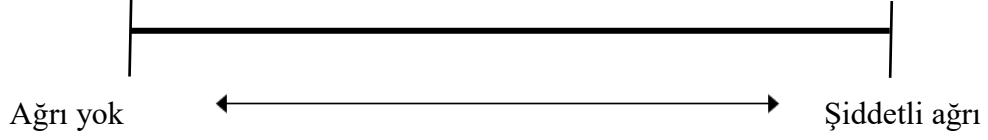
İmza:

Tarih :

TC No :

Görsel Analog Skalası (Visual Analog Scale-VAS)

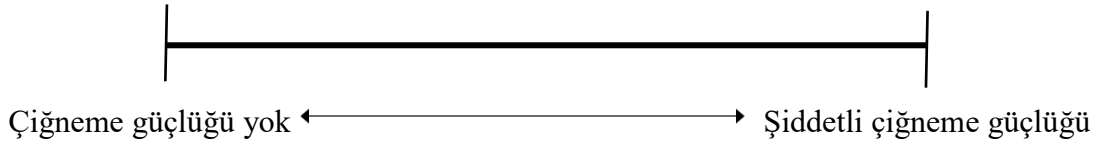
1. Ağrı (Pain)



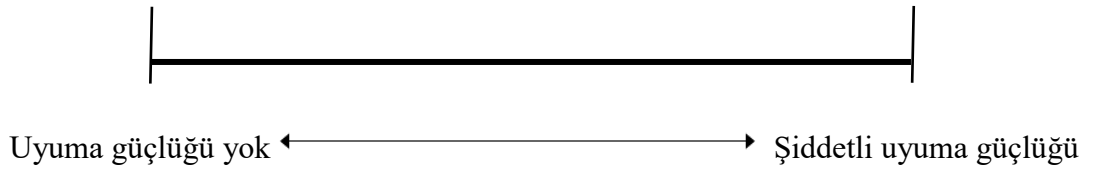
2. Konuşma (Speech)



3. Çiğneme (Chewing)



4. Uyuma (Sleeping)



5. Ağızda yara oluşması (Wounds)

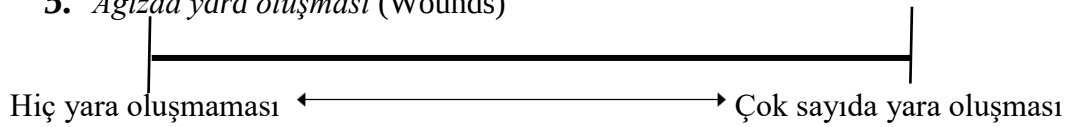
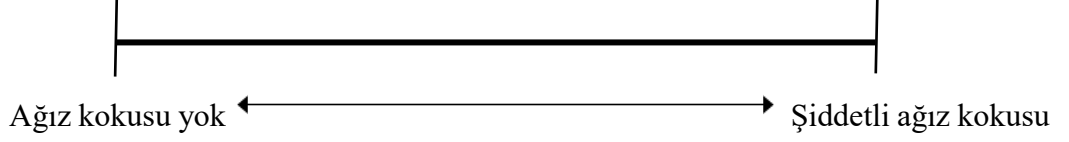
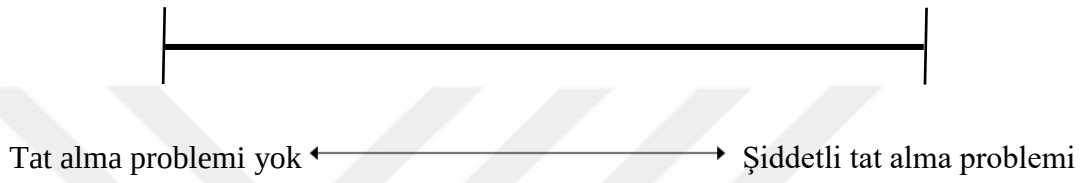


Table 5.4 : Visual Analog Scale (continued)

6. Ağız kokusu (Smell)



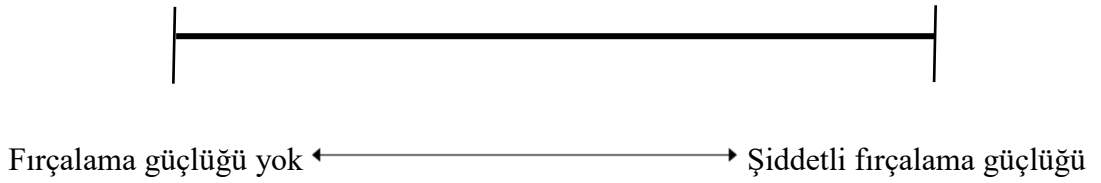
7. Tat alma (Taste)



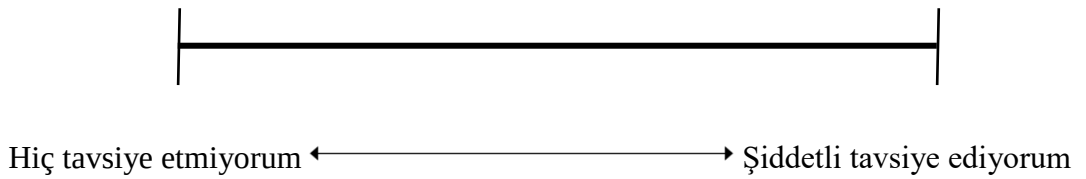
8. Diş ipi kullanımı (Use of dental floss)



9. Diş fırçalama (Teeth brushing)



10. Tedavi önerisi (recommendation of treatment)



All the above measure some key oral impacts such as:

- oral discomfort
- pain
- speech
- disturbances etc.

The patients, after they were taught how this scale-system works, rate their oral impacts experienced on a 100-mm long visual analog scale (VAS) after the brackets placement. All they do is to draw a vertical line on our thick black line. According to the position of the line that they place, their experience on that specific impact factor can be assessed from appointment to appointment. On the left side, at 0 mm we start from “no problem at all” and while going to the right side, the problem deteriorates and the patient’s experience becomes worse, until we reach the 100 mm which means “absolute problem”.

5.5.1.4 Bullying Questionnaire

Table 5.5 : Bullying Questionnaire

İmza:

Tarih :

TC No:

Section I - Sociodemographic characteristics

- Eğitim Düzeyi : Orta okul Lise Üniversite
Devlet (public) Özel (private)
- Cinsiyet (Gender) : Bay (Male) Bayan (Female)
- Yaş (age) :
- Sınıflama (Class) :
- Etnik (ethnicity) :

Table 5.5 : Bullying Questionnaire (continued)

- Ebeveynlerin meslekleri (profession of parents) :

- IOTN grade (bunu doldurmayın) :

Section II - Braketler verleştirilmeden önce (before bracket placement)

1. Herhangi biri tarafından sizinle dalga geçildi mi?

(Have you been bullied by anyone?)

Evet

☐

Hayır

☐

	Evet (Yes)	Hayır (No)
Boyunuz ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your height?)		
Kilonuz ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your weight?)		
Gözünüz ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your eyes?)		
Burnunuz ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your nose?)		
Kulaklarınız ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your ears?)		
Dudaklarınız ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your lips?)		
Çeneniz ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your chin?)		
Saçınız ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your hair?)		
Gözlük takmanız ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your glasses?)		

Table 5.5 : Bullying Questionnaire (continued)

Dişleriniz ile ilgili sizinle dalga geçildi mi? (Have you ever been bullied about your teeth?)		
--	--	--

- Eğer dişleriniz, veya çeneniz hakkındaki cevaplarından herhangi birine **evet** dediyseniz, lütfen aşağıdaki listede hangileri hakkında dalga geçildiğini seçiniz (birden fazla cevap seçebilirsiniz)

If you answered yes to being bullied about your teeth or lips, please which items from the following list, you have been bullied about (you may select more than one answers)

	Evet (Yes)	Hayır (No)
Üst ön dişlerin önde konumlanması (Upper front teeth are sticking out)		
Alt ön dişlerin önde konumlanması (Lower front teeth are sticking out)		
Çenenin önde konumlanması (Chin sticking out)		
Çene geriliği (Chin too far back)		
Çarpık dişler (Crooked teeth)		
Diş rengi (Shape or colour of the teeth)		
Dişler arasında aralık (Gap between the teeth)		
Eksik diş (Missing teeth)		
Başka nedenler (Other reason)		

Table 5.5 : Bullying Questionnaire (continued)

2. Ortodontik tedavinin yukarıda sayılan problemleri gidereceğini düşünüyor musunuz?

Evet (Yes)

☐

Hayır (No)

☐

Section III – Braketler yerleştirildikten 1.5 ay sonra (1.5 months after bracket placement)

	Evet (Yes)	Hayır (No)
Son 1.5 ay boyunca, herhangi biri sizinle dalga geçti mi? (Did anyone try to bully/make fun of you, during the last 1.5 months?)		
Ortodontik tedavinin sizinle dalga geçilmemesine yardımcı olacağını düşünüyor musunuz? (Do you feel that orthodontic treatment will contribute to the reduction of bullying after placement of the braces?)		
Ortodontik tedaviniz bittikten sonra sizinle herhangi bir şekilde dalga geçileceğini düşünüyor musunuz? (Do you feel that after your orthodontic treatment finishes, you will receive any kind of bullying?)		

Table 5.5 : Bullying Questionnaire (continued)

Section III - Braketler yerleştirildikten 3 ay sonra (3 months after bracket placement)

	Evet (Yes)	Hayır (No)
Son 3 ay boyunca herhangi biri sizinle dalga geçti mi? (Did anyone try to bully/make fun of you, during the last 3 months?)		
Ortodontik tedavinin sizinle dalga geçilmemesine yardımcı olduğunu düşünüyor musunuz? (Do you feel that orthodontic treatment contributed to the reduction of bullying after placement of the braces?)		
Ortodontik tedaviniz bittikten sonra sizinle herhangi bir şekilde dalga geçileceğini düşünüyor musunuz? (Do you feel that after your orthodontic treatment finishes, you will receive any kind of bullying?)		

Section IV - Braketler yerleştirildikten 4.5 ay sonra (4.5 months after bracket placement)

	Evet(Yes)	Hayır(No)
Son 4.5 ay boyunca herhangi biri sizinle dalga geçti mi? (Did anyone try to bully/make fun of you, during the last 4.5 months?)		

Table 5.5 : Bullying Questionnaire (continued)

Ortodontik tedavinin sizinle dalga geçilmemesine yardımcı olduğunu düşünüyor musunuz? (Do you feel that orthodontic treatment contributed to the reduction of bullying after placement of the braces?)		
Ortodontik tedaviniz bittikten sonra sizinle herhangi bir şekilde dalga gecileceğini düşünüyor musunuz? (Do you feel that after your orthodontic treatment finishes, you will receive any kind of bullying?)		

Section VI – Seviyelemenin bitirilmesi (finishing of alignment)

	Evet (Yes)	Hayır(No)
Son 6 ay boyunca herhangi biri sizinle dalga geçti mi? (Did anyone bully/make fun of you, during the last 6 months ?)		
Ortodontik tedavinin sizinle dalga geçilmemesine yardımcı olduğunu düşünüyor musunuz? (Do you feel that orthodontic treatment contributed to the reduction of bullying after placement of the braces?)		
Ortodontik tedaviniz bittikten sonra sizinle herhangi bir şekilde dalga gecileceğini düşünüyor musunuz? Do you feel that after your orthodontic treatment finishes, you will receive any kind of bullying?		

- Initially, the patients fill some personal details about themselves. These will provide us with helpful information regarding the sociodemographic characteristics of our study (age, gender etc).
- During the first appointment (before the placement of the brackets) the patient is carefully guided in order to provide accurate information about whether

he/she had experienced bullying in his/her life. If he/she had not experienced any bullying before, then this questionnaire cannot be delivered any more to him/her, because he/she does not belong to our “bullied patients” category any more.

- If, on the other hand, bullying was present during his/her life, he/she is kindly requested to specify the form of bullying and if it was related to teeth or lips. Again, if it was not related to these two factors (teeth , lips) this questionnaire will not be delivered any more in the future, since our study includes patients that had experienced bullying in their lives, but that bullying was related to their teeth or lips, which means that orthodontic treatment could possibly affect it.
- Coming to our objective, if the patient had experienced bullying and it was also related to teeth / lips, then this patient is included in our study and this questionnaire is delivered to him/her in our time intervals (T1, T2, T3, T4).

At every single appointment, the patient is asked three questions. More specifically he/she is asked about:

1. the bullying he/she experienced after placement of the braces and until our appointment
2. the bullying until our time interval.
3. The bullying he/she believes that will occur after finishing of the orthodontic treatment.

In general, these questions aim to monitor the relationship between the pre-existing bullying about teeth and lips and its progress throughout the orthodontic treatment (after bonding-at our time intervals-after finishing), both at buccal fixed orthodontic appliances and at 2D-lingual fixed orthodontic appliances. Finally, it needs to be mentioned that this is an anonymous study, and all information will remain with us.

6. STATISTICAL ANALYSIS

6.1 Power Analysis

The sample size was determined on the basis of the study of Johal A. *et al*, 2015 by using the G*power program. A sample size of 34 would give 80% power to detect a significant difference at the 0.05 level.

6.2 Statistical Method

Statistical analysis was performed using SPSS software version 25. Descriptive analyses was presented using means, standard deviations, median, minimum and maximum values for continuous data and frequencies and percentages for categorical data. The variables investigated using Kolmogorov Smirnov test to determine whether or not they are normally distributed. Since the variables are not normally distributed, Mann-Whitney U test was used to compare the groups. Fisher's exact test was used to compare the proportions of the groups. The effect of time change in measurements were investigated by Friedman test. The Wilcoxon test was performed to test the significance of pairwise differences using Bonferroni correction to adjust for multiple comparisons. The Cochran's Q test was used to compare the proportions between time periods, while the McNemar-Bowker test was used to evaluate the pairwise differences between time periods. Relationships between the repeated results of the questionnaires was determined using Spearman's Correlation Coefficients. A Cronbach's α coefficient was used to assess the internal consistency of each subgroup. A Cronbach's α coefficient > 0.7 was considered acceptable. A 5% type-I error level was used to infer a statistical significance.

6.3 Demographics

All of our patients were caucasian. Our sample consisted of 17 male (50%) and 17 female patients (50%). The patients that were treated with buccal appliances were 17 (50%), as well as the patients that were treated with lingual orthodontic appliances. Within the buccal patients, the mean age was 15 years, with a maximum age of 21 years and a minimum age of 13 years. Within the lingual patients, the mean age was 15.76 years, with a maximum age of 20 years and a minimum age of 14 years. The total mean age of the patients was 15.38 years (Table 6.1).

Table 6.1 : Age ratio

Age:							P value
group	N	Mean	Std. Deviation	Median	Minimum	Maximum	
Buccal	17	15,00	1,936	15,00	13	21	0,085
Lingual	17	15,76	1,522	15,00	14	20	
Total	34	15,38	1,758	15,00	13	21	

Mann-Whitney u test p value.

There is no statistically significant difference between groups in terms of age $p > 0,05$.

Among the male population, 9 of them were treated with buccal appliances (52.9%) and 8 of them (47.1%) were treated with lingual appliances.

Among the female population, 8 of them were treated with buccal appliances (47.1%) and 8 of them (52.9%) were treated with lingual appliances

Gender: Male = 1 , Female = 2 * group

Table 6.2 : Gender ratio

			group		Total	P value
			Buccal	Lingual		
Gender: Male = 1 , Female = 2	1	Count	9 _a	8 _a	17	1,000
		% within Gender: Male = 1 , Female = 2	52,9%	47,1%	100,0%	
	2	Count	8 _a	9 _a	17	
		% within Gender: Male = 1 , Female = 2	47,1%	52,9%	100,0%	
Total		Count	17	17	34	
		% within Gender: Male = 1 , Female = 2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups in terms of gender $p > 0,05$.

7. RESULTS

7.1 Ohip Questionnaire

At the buccal group, it is seen that the Ohip-14 scores decrease throughout treatment from T1→T4, so QoL of the patients treated with buccal appliances increases while time passes. (Table 7.3).

The QoL of lingual patients decreases during the first 3 months and then gets improved significantly. Also, during T2, T3, T4 the buccal-ohip scores are better compared to lingual so, in these time intervals we can say that $QoL(buccal) > QoL(lingual)$ (Table 7.3).

In buccal group there is statistically significant improvement of Ohip scores and QoL, at T2→T4, T1→T4, T1→T3 (Table 7.4). In lingual group there is statistically significant improvement at T1→T4, T2→T3, T2→T4, T3→T4 (Table 7.5).

At the same dt's (time differences) there are statistical differences at:

T1→T2: Ohip(buccal) ↓ so QoL ↑ also, and Ohip(lingual) ↓ so QoL ↑

T1→T3: Ohip(buccal) gets more improved (Table 7.6).

In terms of domains, functional limitation (domain 1): in buccal group it decreases while treatment goes on. In lingual the functional limitation levels increase the first 3 months, then they decrease again (Table 7.9).

Physical pain (domain 2) and handicap (domain 7): Pain and handicap decrease in both groups throughout treatment (Table 7.10) (Table 7.15).

Psychological discomfort (domain 3), physical disability (domain 4) and psychological disability (domain 5): In buccal group they decrease throughout treatment, in lingual group they increase during the first three months and then they improve (Table 7.11) (Table 7.12) (Table 7.13).

Social disability (domain 6): it increases in both groups during the first three months and later on in both groups it gets improved (Table 7.14).

7.1.1 Descriptive Statistics for Buccal Treatment Group

Table 7.1 : Descriptive Statistics of OHIP-14 Questionnaire Results for Buccal Treatment Group

Report ^a						
	N	Mean	Std. Deviation	Median	Minimum	Maximum
OHIP_T1_1	17	,88	,485	1,00	0	2
OHIP_T1_2	17	,65	,702	1,00	0	2
OHIP_T1_3	17	2,35	,996	2,00	0	4
OHIP_T1_4	17	2,65	,931	3,00	0	4
OHIP_T1_5	17	,82	,529	1,00	0	2
OHIP_T1_6	17	1,00	,791	1,00	0	2
OHIP_T1_7	17	2,24	,970	2,00	0	4
OHIP_T1_8	17	2,53	,943	3,00	0	4
OHIP_T1_9	17	1,18	,529	1,00	0	2
OHIP_T1_10	17	1,18	,636	1,00	0	2
OHIP_T1_11	17	,29	,470	,00	0	1
OHIP_T1_12	17	,59	,507	1,00	0	1
OHIP_T1_13	17	,35	,493	,00	0	1
OHIP_T1_14	17	,29	,470	,00	0	1
OHIP_T1_TOTAL	17	17,00	6,452	16,00	0	30
OHIP_T2_1	17	,882	,6002	1,000	,0	2,0
OHIP_T2_2	17	,412	,7123	,000	,0	2,0
OHIP_T2_3	17	2,235	,9701	2,000	,0	4,0
OHIP_T2_4	17	2,529	,9432	3,000	,0	4,0
OHIP_T2_5	17	,824	,6359	1,000	,0	2,0
OHIP_T2_6	17	,882	,9275	1,000	,0	3,0
OHIP_T2_7	17	1,882	,9275	2,000	,0	4,0
OHIP_T2_8	17	2,471	1,0073	3,000	,0	4,0
OHIP_T2_9	17	1,176	,6359	1,000	,0	2,0
OHIP_T2_10	17	1,118	,9926	1,000	,0	3,0
OHIP_T2_11	17	,353	,6063	,000	,0	2,0
OHIP_T2_12	17	,588	,6183	1,000	,0	2,0
OHIP_T2_13	17	,294	,4697	,000	,0	1,0
OHIP_T2_14	17	,235	,4372	,000	,0	1,0
OHIP_T2_TOTAL	17	15,765	7,7744	14,000	,0	35,0

Table 7.1 : Descriptive Statistics of OHIP-14 Questionnaire Results for Buccal Treatment Group
(continued)

OHIP_T3_1	17	,471	,5145	,000	,0	1,0
OHIP_T3_2	17	,176	,3930	,000	,0	1,0
OHIP_T3_3	17	1,824	,6359	2,000	,0	3,0
OHIP_T3_4	17	1,941	,7475	2,000	,0	3,0
OHIP_T3_5	17	,412	,5073	,000	,0	1,0
OHIP_T3_6	17	,412	,5073	,000	,0	1,0
OHIP_T3_7	17	1,588	,7123	2,000	,0	2,0
OHIP_T3_8	17	1,882	,6966	2,000	,0	3,0
OHIP_T3_9	17	,706	,5879	1,000	,0	2,0
OHIP_T3_10	17	,471	,5145	,000	,0	1,0
OHIP_T3_11	17	,118	,3321	,000	,0	1,0
OHIP_T3_12	17	,353	,4926	,000	,0	1,0
OHIP_T3_13	17	,118	,3321	,000	,0	1,0
OHIP_T3_14	17	,176	,3930	,000	,0	1,0
OHIP_T3_TOTAL	17	10,647	4,3724	10,000	,0	21,0
a. grup = 1						

	N	Mean	Std. Deviation	Median	Minimum	Maximum
OHIP_T4_1	17	,41	,507	,00	0	1
OHIP_T4_2	17	,06	,243	,00	0	1
OHIP_T4_3	17	1,35	,606	1,00	0	2
OHIP_T4_4	17	1,59	,712	2,00	0	3
OHIP_T4_5	17	,24	,437	,00	0	1
OHIP_T4_6	17	,29	,470	,00	0	1
OHIP_T4_7	17	1,29	,686	1,00	0	2
OHIP_T4_8	17	1,41	,618	1,00	0	2
OHIP_T4_9	17	,65	,606	1,00	0	2
OHIP_T4_10	17	,41	,507	,00	0	1
OHIP_T4_11	17	,06	,243	,00	0	1
OHIP_T4_12	17	,35	,493	,00	0	1
OHIP_T4_13	17	,06	,243	,00	0	1
OHIP_T4_14	17	,12	,332	,00	0	1
OHIP_T4_TOTAL	17	8,29	3,442	8,00	0	17
a. grup = 1						

7.1.2 Descriptive Statistics for Lingual Treatment Group

Table 7.2 : Descriptive Statistics of OHIP-14 Questionnaire Results for Lingual Treatment Group

Report ^a						
	N	Mean	Std. Deviation	Median	Minimum	Maximum
OHIP_T1_1	17	1,76	,664	2,00	0	3
OHIP_T1_2	17	1,59	,795	2,00	0	3
OHIP_T1_3	17	3,12	,697	3,00	1	4
OHIP_T1_4	17	3,06	,659	3,00	1	4
OHIP_T1_5	17	,53	,717	,00	0	2
OHIP_T1_6	17	,41	,618	,00	0	2
OHIP_T1_7	17	2,71	,849	3,00	1	4
OHIP_T1_8	17	3,00	,612	3,00	1	4
OHIP_T1_9	17	,24	,437	,00	0	1
OHIP_T1_10	17	,47	,514	,00	0	1
OHIP_T1_11	17	,12	,332	,00	0	1
OHIP_T1_12	17	,06	,243	,00	0	1
OHIP_T1_13	17	,24	,437	,00	0	1
OHIP_T1_14	17	,12	,332	,00	0	1
OHIP_T1_TOTAL	17	17,41	6,073	17,00	4	32
OHIP_T2_1	17	2,118	,6966	2,000	,0	3,0
OHIP_T2_2	17	1,941	,8993	2,000	,0	4,0
OHIP_T2_3	17	3,059	,6587	3,000	2,0	4,0
OHIP_T2_4	17	3,059	,6587	3,000	2,0	4,0
OHIP_T2_5	17	,412	,7123	,000	,0	2,0
OHIP_T2_6	17	,588	,7952	,000	,0	2,0
OHIP_T2_7	17	3,059	,7475	3,000	2,0	4,0
OHIP_T2_8	17	3,000	,6124	3,000	1,0	4,0
OHIP_T2_9	17	,647	,7859	,000	,0	2,0
OHIP_T2_10	17	,647	,7019	1,000	,0	2,0
OHIP_T2_11	17	,353	,4926	,000	,0	1,0
OHIP_T2_12	17	,118	,3321	,000	,0	1,0
OHIP_T2_13	17	,235	,4372	,000	,0	1,0
OHIP_T2_14	17	,118	,3321	,000	,0	1,0
OHIP_T2_TOTAL	17	19,353	6,2843	19,000	7,0	35,0
OHIP_T3_1	17	1,588	,6183	2,000	,0	2,0
OHIP_T3_2	17	1,176	,5286	1,000	,0	2,0
OHIP_T3_3	17	2,471	,6243	2,000	2,0	4,0
OHIP_T3_4	17	2,294	,5879	2,000	1,0	3,0

Table 7.2 : Descriptive Statistics of OHIP-14 Questionnaire Results for Lingual Treatment Group
(continued)

OHIP_T3_5	17	,235	,4372	,000	,0	1,0
OHIP_T3_6	17	,294	,4697	,000	,0	1,0
OHIP_T3_7	17	2,294	,6860	2,000	1,0	4,0
OHIP_T3_8	17	2,235	,5623	2,000	1,0	3,0
OHIP_T3_9	17	,412	,6183	,000	,0	2,0
OHIP_T3_10	17	,353	,6063	,000	,0	2,0
OHIP_T3_11	17	,118	,3321	,000	,0	1,0
OHIP_T3_12	17	,059	,2425	,000	,0	1,0
OHIP_T3_13	17	,118	,3321	,000	,0	1,0
OHIP_T3_14	17	,000	,0000	,000	,0	,0
OHIP_T3_TOTAL	17	13,647	3,9677	12,000	5,0	21,0
a. grup = 2						

	N	Mean	Std. Deviation	Median	Minimum	Maximum
OHIP_T4_1	17	1,18	,529	1,00	0	2
OHIP_T4_2	17	,82	,529	1,00	0	2
OHIP_T4_3	17	2,00	,354	2,00	1	3
OHIP_T4_4	17	1,88	,697	2,00	1	3
OHIP_T4_5	17	,18	,393	,00	0	1
OHIP_T4_6	17	,29	,470	,00	0	1
OHIP_T4_7	17	1,94	,243	2,00	1	2
OHIP_T4_8	17	1,59	,618	2,00	0	2
OHIP_T4_9	17	,24	,437	,00	0	1
OHIP_T4_10	17	,24	,437	,00	0	1
OHIP_T4_11	17	,06	,243	,00	0	1
OHIP_T4_12	17	,06	,243	,00	0	1
OHIP_T4_13	17	,12	,332	,00	0	1
OHIP_T4_14	17	,00	,000	,00	0	0
OHIP_T4_TOTAL	17	10,59	3,299	11,00	3	18
a. grup = 2						

7.1.3 Intergroup comparison for OHIP-14 Questionnaire

Table 7.3 : Intergroup comparison of OHIP-14 Questionnaire

group		OHIP_ T1_T OTAL	OHIP_T2_T OTAL	OHIP_T3 _TOTAL	OHIP_T4_TOT AL	P value
Bucc al	N	17	17	17	17	0,000 b*
	Mean	17,00	15,765	10,647	8,29	
	Std. Deviation	6,452	7,7744	4,3724	3,442	
	Median	16,00	14,000	10,000	8,00	
	Minimum	0	,0	,0	0	
	Maximum	30	35,0	21,0	17	
Lingu al	N	17	17	17	17	0,000 b*
	Mean	17,41	19,353	13,647	10,59	
	Std. Deviation	6,073	6,2843	3,9677	3,299	
	Median	17,00	19,000	12,000	11,00	
	Minimum	4	7,0	5,0	3	
	Maximum	32	35,0	21,0	18	
Total	N	34	34	34	34	
	Mean	17,21	17,559	12,147	9,44	
	Std. Deviation	6,173	7,1951	4,3841	3,518	
	Median	16,00	16,500	11,500	9,00	
	Minimum	0	,0	,0	0	
	Maximum	32	35,0	21,0	18	
P value		0,919^a	0,004^{a*}	0,003^{a*}	0,012[*]	

^aMann-Whitney u test p value. ^bFriedman test p value. * p<0,05 statistically significant
There is statistically significant difference between the median values of the groups
p<0,05.

Buccal Group:

Table 7.4 : Intragroup comparison of OHIP-14 Questionnaire for each time intervals for buccal group.

*p<0.05 statistically significant

Sample 1 - Sample 2	mean	Std. Error	Std. Test Statistic	Sig.	p value
OHIP_T4_TOTAL-OHIP_T3_TOTAL	0,765	0,443	1,727	,084	0,505
OHIP_T4_TOTAL-OHIP_T2_TOTAL	2	0,443	4,517	0	0
OHIP_T4_TOTAL-OHIP_T1_TOTAL	2,529	0,443	5,712	0	0
OHIP_T3_TOTAL-OHIP_T2_TOTAL	1,235	0,443	2,790	0,005	0,032
OHIP_T3_TOTAL-OHIP_T1_TOTAL	1,765	0,443	3,985	0	0
OHIP_T2_TOTAL-OHIP_T1_TOTAL	0,529	0,443	1,196	0,232	1

Mann-Whitney u test with Bonferroni adjusted p values. Yellow colored p values are statistically significant between the groups.

Lingual Group :

Table 7.5 : Intragroup comparison of OHIP-14 Questionnaire for each time intervals for lingual group.

Sample 1 - Sample 2	mean	Std. Error	Std. Test Statistic	Sig.	p value
OHIP_T4_TOTAL-OHIP_T3_TOTAL	1,206	0,443	2,723	0,006	0,039
OHIP_T4_TOTAL-OHIP_T1_TOTAL	1,882	0,443	4,251	0	0
OHIP_T4_TOTAL-OHIP_T2_TOTAL	2,794	0,443	6,310	0	0
OHIP_T3_TOTAL-OHIP_T1_TOTAL	,676	0,443	1,528	0,127	0,760
OHIP_T3_TOTAL-OHIP_T2_TOTAL	1,588	0,443	3,587	0	0,002
OHIP_T1_TOTAL-OHIP_T2_TOTAL	-0,912	0,443	-2,59	0,039	0,237

*p<0.05 statistically significant

Mann-Whitney u test with Bonferroni adjusted p values. Yellow colored p values are statistically significant between the groups.

7.1.4 Intergroup comparison of OHIP-14 Questionnaire for time intervals

Table 7.6 : Intergroup comparison of OHIP-14 Questionnaire for time intervals

Group		T1-T2	T1-T3	T1-T4	T2-T3	T2-T4	T3-T4
Buccal	N	17	17	17	17	17	17
	Mean	1,2353	6,3529	8,7059	5,1176	7,4706	2,3529
	Std. Deviation	2,53795	2,71434	3,65316	3,63803	4,92592	1,96663
	Median	2,0000	6,0000	8,0000	4,0000	6,0000	2,0000
	Minimum	-5,00	,00	,00	,00	,00	,00
	Maximum	5,00	11,00	17,00	14,00	20,00	6,00
Lingual	N	17	17	17	17	17	17
	Mean	-1,9412	3,7647	6,8235	5,7059	8,7647	3,0588
	Std. Deviation	1,78433	3,76712	3,52199	3,82042	3,89759	1,59963
	Median	-2,0000	3,0000	6,0000	5,0000	8,0000	3,0000
	Minimum	-4,00	-1,00	1,00	,00	4,00	,00
	Maximum	3,00	11,00	14,00	14,00	18,00	6,00
Total	N	34	34	34	34	34	34
	Mean	-,3529	5,0588	7,7647	5,4118	8,1176	2,7059
	Std. Deviation	2,69548	3,48974	3,66026	3,68550	4,42284	1,80117
	Median	-,5000	5,0000	8,0000	5,0000	7,0000	3,0000
	Minimum	-5,00	-1,00	,00	,00	,00	,00
	Maximum	5,00	11,00	17,00	14,00	20,00	6,00
P value		0,000*	0,018*	0,062	0,274	0,150	0,231
Group		T1-T2	T1-T3	T1-T4	T2-T3	T2-T4	T3-T4
Buccal	N	17	17	17	17	17	17
	Mean	1,2353	6,3529	8,7059	5,1176	7,4706	2,3529
	Std. Deviation	2,53795	2,71434	3,65316	3,63803	4,92592	1,96663
	Median	2,0000	6,0000	8,0000	4,0000	6,0000	2,0000
	Minimum	-5,00	,00	,00	,00	,00	,00
	Maximum	5,00	11,00	17,00	14,00	20,00	6,00

Table 7.6 : Intergroup comparison of OHIP-14 Questionnaire for time intervals (continued)

Lingual	N	17	17	17	17	17	17
	Mean	-1,9412	3,7647	6,8235	5,7059	8,7647	3,0588
	Std. Deviation	1,78433	3,76712	3,52199	3,82042	3,89759	1,59963
	Median	-2,0000	3,0000	6,0000	5,0000	8,0000	3,0000
	Minimum	-4,00	-1,00	1,00	,00	4,00	,00
	Maximum	3,00	11,00	14,00	14,00	18,00	6,00
Total	N	34	34	34	34	34	34
	Mean	-,3529	5,0588	7,7647	5,4118	8,1176	2,7059
	Std. Deviation	2,69548	3,48974	3,66026	3,68550	4,42284	1,80117
	Median	-,5000	5,0000	8,0000	5,0000	7,0000	3,0000
	Minimum	-5,00	-1,00	,00	,00	,00	,00
	Maximum	5,00	11,00	17,00	14,00	20,00	6,00
	P value	0,000*	0,018*	0,062	0,274	0,150	0,231

^aMann-Whitney u test p value..* p<0,05 statistically significant.

There is statistically significant difference between the median values of the groups p<0,05, except the difference OHIP2 and OHIP3.

7.1.5 Relationships of the result in time for OHIP-14 Questionnaire

Table 7.7 : Relationships of the results in time

Correlations					
			Correlation Coefficient	Sig. (2-tailed)	N
Spearman's rho	OHIP_T1_TOTAL	OHIP_T1_TOTAL	1,000	.	34
		OHIP_T2_TOTAL	,677**	,000	34
		OHIP_T3_TOTAL	,571**	,000	34
		OHIP_T4_TOTAL	,618**	,000	34
	OHIP_T2_TOTAL	OHIP_T1_TOTAL	,677**	,000	34
		OHIP_T2_TOTAL	1,000	.	34
		OHIP_T3_TOTAL	,946**	,000	34
		OHIP_T4_TOTAL	,782**	,000	34

Table 7.7 : Relationships of the results in time (continued)

OHIP_T3_TOTAL	OHIP_T1_TOTAL	,571**	,000	34
	OHIP_T2_TOTAL	,946**	,000	34
	OHIP_T3_TOTAL	1,000	.	34
	OHIP_T4_TOTAL	,816**	,000	34
OHIP_T4_TOTAL	OHIP_T1_TOTAL	,618**	,000	34
	OHIP_T2_TOTAL	,782**	,000	34
	OHIP_T3_TOTAL	,816**	,000	34
	OHIP_T4_TOTAL	1,000	.	34

There is statistically significant relationships between the OHIP Totals $p < 0,05$.

7.1.6 Internal consistency: Cronbach's alpha

Tables 7.8 : Internal consistency

T1:

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,878	,882	14

T2:

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,890	,898	14

Tables 7.8 : Internal consistency (continued)

T3:

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,813	,827	14

T4:

Reliability Statistics	
Cronbach's Alpha	N of Items
,763	14

In all time periods internal consistency of the questionnaires are reliable.

7.1.7 Comparing time periods in terms of domains for OHIP-14 Questionnaire:

The Ohip-14 questionnaire has 7 domains and each domain consists of 2 questions.

Domain 1 : Functional limitation

- Question A: “ Did you have any problems pronouncing any words because of problems with your teeth, mouth or braces?”
- Question B : “Did you feel that your sense of taste has worsened because of problems with your teeth, mouth or braces?”

Domain 2: Physical pain

- Question A : “Did you have painful aching in your mouth?”
- Question B : “Did you find it uncomfortable to eat any food because of problems with your teeth, mouth or braces?”

Domain 3 : Psychological discomfort

- Question A : “Have you been self-conscious because of your teeth, mouth or braces?”
- Question B : “Have you felt tense because of problems with your teeth, mouth or braces?”

Domain 4 : Physical disability

- Question A : “ Has your diet been unsatisfactory because of problems with your teeth, mouth or braces?”
- Question B : “Did you have to interrupt meals because of problems with your teeth, mouth or braces?”

Domain 5 : Psychological disability

- Question A : “Did you find it difficult to relax because of problems with your teeth, mouth or braces?”
- Question B : “Have you been a bit embarrassed because of problems with your teeth, mouth or braces?”

Domain 6 : Social disability

- Question A : “Have you been a bit irritable with other people because of problems with your teeth, mouth or braces?”
- Question B : “Did you have difficulty doing your usual jobs because of problems with your teeth, mouth or braces?”

Domain 7 : Handicap

- Question A : “Did you feel that life in general was less satisfying because of problems with your teeth, mouth or braces?”
- Question B : “Have you been totally unable to function because of problems with your teeth, mouth or braces?”

7.1.7.1 Comparing time periods in terms of domain 1 (functional limitation)

Table 7.9 : Relationship of time periods for OHIP-14 Questionnaire - Domain 1

Group		OHIP_T1 _Domain 1	OHIP_T2 _Domain1	OHIP_T3 _Domain1	OHIP_T4 _Domain1	P value
Buccal	N	17	17	17	17	0,000*
	Mean	1,5294	1,2941	,6471	,4706	
	Std. Deviation	,94324	1,21268	,78591	,62426	
	Minimum	,00	,00	,00	,00	
	Maximum	4,00	4,00	2,00	2,00	
Lingual	N	17	17	17	17	0,000*
	Mean	3,3529	4,0588	2,7647	2,0000	
	Std. Deviation	1,32009	1,43486	,97014	,79057	
	Minimum	,00	,00	,00	,00	
	Maximum	6,00	7,00	4,00	3,00	
	Maximum	6,00	7,00	4,00	3,00	

Friedman test p value.* $p < 0,05$ statistically significant.

There is statistically significant difference between the median values of the time periods $p < 0,05$.

7.1.7.2 Comparing time periods in terms of domain 2 (physical pain)

Table 7.10 : Relationship of time periods for OHIP-14 Questionnaire - Domain 2

Group		OHIP_T1 _Domain 2	OHIP_T2 _Domain2	OHIP_T3 _Domain2	OHIP_T4 _Domain2	P values
Buccal	N	17	17	17	17	0,000*
	Mean	5,0000	4,7647	3,7647	2,9412	
	Std. Deviation	1,73205	1,78639	1,20049	1,02899	
	Minimum	,00	,00	,00	,00	
	Maximum	8,00	8,00	6,00	4,00	
Lingual	N	17	17	17	17	0,000*
	Mean	6,1765	6,1176	4,7647	3,8824	

Table 7.10 : Relationship of time periods for OHIP-14 Questionnaire - Domain 2 (continued)

Std. Deviation	1,28624	1,11144	,97014	,92752
Minimum	2,00	4,00	3,00	2,00
Maximum	8,00	8,00	7,00	6,00

Friedman test p value.* $p < 0,05$ statistically significant

There is statistically significant difference between the median values of the time periods $p < 0,05$.

7.1.7.3 Comparing time periods in terms of domain 3 (psychological discomfort)

Table 7.11 : Relationship of time periods for OHIP-14 Questionnaire - Domain 3

Group		OHIP_T1_ Domain3	OHIP_T2_D omain3	OHIP_T3_D omain3	OHIP_T4_D omain3	P values
Buccal	N	17	17	17	17	0,000*
	Mean	1,8235	1,7059	,8235	,5294	
	Std. Deviation	1,13111	1,35852	,72761	,71743	
	Minimum	,00	,00	,00	,00	
	Maximum	4,00	5,00	2,00	2,00	
Lingual	N	17	17	17	17	0,009*
	Mean	,9412	1,0000	,5294	,4706	
	Std. Deviation	1,08804	1,32288	,62426	,62426	
	Minimum	,00	,00	,00	,00	
	Maximum	4,00	4,00	2,00	2,00	

Friedman test p value.* $p < 0,05$ statistically significant

There is statistically significant difference between the median values of the time periods $p < 0,05$.

7.1.7.4 Comparing time periods in terms of domain 4 (physical disability)

Table 7.12 : Relationship of time periods for OHIP-14 Questionnaire - Domain 4

Group		OHIP_T1_D omain4	OHIP_T2_D omain4	OHIP_T3_D omain4	OHIP_T4_D omain4	P value
Buccal	N	17	17	17	17	0,000*
	Mean	4,7647	4,3529	3,4706	2,7059	
	Std. Deviation	1,78639	1,80074	1,23073	1,04670	
	Minimum	,00	,00	,00	,00	
	Maximum	8,00	8,00	5,00	4,00	
Lingual	N	17	17	17	17	0,000*
	Mean	5,7059	6,0588	4,5294	3,5294	
	Std. Deviation	1,35852	1,19742	1,00733	,79982	
	Minimum	2,00	3,00	2,00	1,00	
	Maximum	8,00	8,00	7,00	4,00	

Friedman test p value.* p<0,05 statistically significant

There is statistically significant difference between the median values of the time periods p<0,05.

7.1.7.5 Comparing time periods in terms of domain 5 (psychological disability)

Table 7.13 : Relationship of time periods for OHIP-14 Questionnaire - Domain 5

Group		OHIP_T1_ Domain5	OHIP_T2_ _Domain5	OHIP_T3_ _Domain5	OHIP_T4_ _Domain5	P value
Buccal	N	17	17	17	17	0,000*
	Mean	2,3529	2,2941	1,1765	1,0588	
	Std. Deviation	1,05719	1,49016	,88284	,89935	
	Minimum	,00	,00	,00	,00	
	Maximum	4,00	5,00	3,00	3,00	
Lingual	N	17	17	17	17	0,000*
	Mean	,7059	1,2941	,7647	,4706	
	Std. Deviation	,68599	1,21268	1,03256	,71743	
	Minimum	,00	,00	,00	,00	
	Maximum	2,00	4,00	3,00	2,00	

Friedman test p value.* p<0,05 statistically significant.

There is statistically significant difference between the median values of the time periods p<0,05.

7.1.7.6 Comparing time periods in terms of domain 6 (social disability)

Table 7.14 : Relationship of time periods for OHIP-14 Questionnaire - Domain 6

Group		OHIP_T1_ Domain6	OHIP_T2 _Domain6	OHIP_T3 _Domain6	OHIP_T4 _Domain6	P value
Buccal	N	17	17	17	17	0,004*
	Mean	,8824	,9412	,4706	,4118	
	Std. Deviation	,78121	1,08804	,71743	,61835	
	Minimum	,00	,00	,00	,00	
	Maximum	2,00	4,00	2,00	2,00	
Lingual	N	17	17	17	17	0,008*
	Mean	,1765	,4706	,1765	,1176	
	Std. Deviation	,52859	,71743	,52859	,48507	
	Minimum	,00	,00	,00	,00	
	Maximum	2,00	2,00	2,00	2,00	

Friedman test p value.* p<0,05 statistically significant.

There is statistically significant difference between the median values of the time periods p<0,05.

7.1.7.7 Comparing time periods in terms of domain 7 (handicap)

Table 7.15 : Relationship of time periods for OHIP-14 Questionnaire - Domain 7

Group		OHIP_T1 _Domain7	OHIP_T2 _Domain7	OHIP_T3 _Domain7	OHIP_T4 _Domain7	P value
Buccal	N	17	17	17	17	0,001*
	Mean	,6471	,5294	,2941	,1765	

Table 7.15 : Relationship of time periods for OHIP-14 Questionnaire - Domain 7

Std. Deviation	,78591	,71743	,68599	,52859
Minimum	,00	,00	,00	,00
Maximum	2,00	2,00	2,00	2,00
N	17	17	17	17
Mean	,3529	,3529	,1176	,1176
Std. Deviation	,70189	,70189	,33211	,33211
Minimum	,00	,00	,00	,00
Maximum	2,00	2,00	1,00	1,00

Friedman test p value.* $p < 0,05$ statistically significant

There is statistically significant difference between the median values of the time periods $p < 0,05$.

7.2 Self-Esteem- Rosenberg Scale

In both groups, self esteem scores increase, so Self-esteem of patients improves throughout treatment. (Table 7.16). However, we cannot claim that at specific time intervals, one of the two treatment methods works better in terms of self-esteem ($p > 0.05$) (Table 7.16)

In the buccal treatment group, the improvement of self-esteem is noticed as statistically significant at T1→T3, T1→T4, T2→T4 intervals (Table 7.17).

In the lingual treatment group, this improvement is noticed at T1→T3, T1→T4, T2→T4 intervals (Table 7.18).

The comparison between the two groups in specific dt's reveals no difference between the groups. As a result, buccal and lingual braces have comparable results in term of self-esteem (Table 7.19).

7.2.1 Intergroup comparison and time effect

Table 7.16 : Intergroup comparison of Rosenberg scale

Group		Rosenberg_T1	Rosenberg_T2	Rosenberg_T3	Rosenberg_T4	P value
Buccal	N	17	17	17	17	0,000^{b*}
	Mean	18,65	20,88	23,65	25,71	
	Std. Deviation	7,566	6,927	5,722	4,120	
	Median	20,00	23,00	25,00	27,00	
	Minimum	7	10	13	17	
	Maximum	30	30	30	30	
Lingual	N	17	17	17	17	0,000^{b*}
	Mean	18,76	22,06	24,88	27,12	
	Std. Deviation	4,931	3,230	2,315	2,667	
	Median	18,00	22,00	25,00	28,00	
	Minimum	10	16	20	21	
	Maximum	30	30	30	30	
Total	N	34	34	34	34	
	Mean	18,71	21,47	24,26	26,41	
	Std. Deviation	6,289	5,355	4,344	3,491	
	Median	18,50	22,00	25,00	27,50	
	Minimum	7	10	13	17	
	Maximum	30	30	30	30	
P value		0,708^a	0,973^a	0,865^a	0,454^a	

^aMann-Whitney u test p value. ^bFriedman test p value. * p<0,05 statistically significant
There is no statistically significant difference between the groups p>0,05. There is statistically significant change in time within the groups p<0,05.

Buccal:

Table 7.17 : Intragroup comparison of Rosenberg scale for buccal group

Sample 1 - Sample 2	mean	Std. Error	Std. Test Statistic	Sig.	p value
Rosenberg_T1-Rosenberg_T2	-0,824	0,443	-1,86	0,63	0,377
Rosenberg_T1-Rosenberg_T3	-1,706	0,443	-3,852	0	0,001
Rosenberg_T1-Rosenberg_T4	-2,412	0,443	-5,447	0	0
Rosenberg_T2-Rosenberg_T3	-0,882	0,443	-1,993	0,046	0,278
Rosenberg_T2-Rosenberg_T4	-1,588	0,443	-3,587	0	0,002
Rosenberg_T3-Rosenberg_T4	-0,706	0,443	-1,594	0,111	0,665

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant changes in pairwise time in Buccal group.

Lingual

Table 7.18 : Intragroup comparison of Rosenberg scale for lingual group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Rosenberg_T1-Rosenberg_T2	-0,794	0,443	-1.793	0.73	0.437
Rosenberg_T1-Rosenberg_T3	-1.735	0,443	-3.919	0	0,001
Rosenberg_T1-Rosenberg_T4	-2.647	0,443	-5.978	0	0
Rosenberg_T2-Rosenberg_T3	-0.941	0,443	-2.125	0.034	0.201
Rosenberg_T2-Rosenberg_T4	-1.853	0,443	-4.185	0	0
Rosenberg_T3-Rosenberg_T4	-0.912	0,443	-2.059	0.039	0.237

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant changes in pairwise time in Lingual group.

7.2.1.1 Intergroup comparison and pairwise differences

Table 7.18 : Intragroup comparison of Rosenberg scale for lingual group

group		R_dif_T1 T2	R_dif_T1 T3	R_dif_T1 T4	R_dif_T2 T3	R_dif_T2 T4	R_dif_T3 T4
Buccal	N	17	17	17	17	17	17
	Mean	-2,2353	-5,0000	-7,0588	-2,7647	-4,8235	-2,0588
	Std. Deviation	1,60193	2,97909	4,24957	1,82104	3,35848	1,85306
	Median	-3,0000	-5,0000	-7,0000	-3,0000	-4,0000	-2,0000
	Minimum	-5,00	-9,00	-14,00	-6,00	-10,00	-5,00
	Maximum	,00	,00	,00	,00	,00	,00
Lingual	N	17	17	17	17	17	17
	Mean	-3,2941	-6,1176	-8,3529	-2,8235	-5,0588	-2,2353
	Std. Deviation	2,20127	3,12014	3,82330	1,23669	1,88648	1,43742
	Median	-4,0000	-7,0000	-9,0000	-3,0000	-6,0000	-3,0000
	Minimum	-7,00	-11,00	-14,00	-4,00	-7,00	-5,00
	Maximum	2,00	2,00	,00	,00	,00	,00
Total	N	34	34	34	34	34	34
	Mean	-2,7647	-5,5588	-7,7059	-2,7941	-4,9412	-2,1471
	Std. Deviation	1,97037	3,05695	4,03417	1,53306	2,68488	1,63545
	Median	-3,0000	-6,0000	-8,5000	-3,0000	-5,0000	-2,0000
	Minimum	-7,00	-11,00	-14,00	-6,00	-10,00	-5,00
	Maximum	2,00	2,00	,00	,00	,00	,00
P value		0,079	0,218	0,322	0,892	0,973	0,760

Mann-Whitney u test p value.

There is no statistically significant differences between the groups $p > 0,05$.

7.2.1.2 Correlations of Rosenberg scale within time periods

Table 7.20 : Correlation of Rosenberg scale within time periods

Correlations					
			Correlation Coefficient	P value	N
Spearman's rho	Rosenberg_T1	Rosenberg_T1	1,000	.	34
		Rosenberg_T2	,937**	,000	34
		Rosenberg_T3	,916**	,000	34
		Rosenberg_T4	,750**	,000	34
	Rosenberg_T2	Rosenberg_T1	,937**	,000	34
		Rosenberg_T2	1,000	.	34
		Rosenberg_T3	,951**	,000	34
		Rosenberg_T4	,870**	,000	34
	Rosenberg_T3	Rosenberg_T1	,916**	,000	34
		Rosenberg_T2	,951**	,000	34
		Rosenberg_T3	1,000	.	34
		Rosenberg_T4	,868**	,000	34
	Rosenberg_T4	Rosenberg_T1	,750**	,000	34
		Rosenberg_T2	,870**	,000	34
		Rosenberg_T3	,868**	,000	34
		Rosenberg_T4	1,000	.	34
**. Correlation is significant at the 0.01 level (2-tailed).					

There are statistically significant relationships between Rosenberg scales $p < 0,05$.

7.3 Visual Analog Scale (VAS)

At T1 the lingual group appears to have bigger impacts in pain, speech, chew, wounds, smell, taste. The other factors are comparable among the groups (Table 7.21).

At T2 the lingual group appears to have bigger impacts in pain, speech, chew, smell, taste. The other factors are comparable among the groups (Table 7.21).

At T3 the lingual group appears to have bigger impacts in speech and taste. The other factors are comparable among the groups (Table 7.21).

At T4 the lingual group appears to have bigger impacts only in speech. The other factors are comparable among the groups (Table 7.21).

Pain (Table 7.22), speech (Table 7.25), chewing (Table 7.28), sleeping (Table 7.31), wounds (Table 7.34), smell (Table 7.37, taste (Table 7.40), brushing (Table 7.45) and recommendation of treatment (Table 7.48) improve during treatment in both groups.

7.3.1 Intergroup comparison of VAS scores at each time intervals

Table 7.21 : Intergroup comparison of VAS scores at each time intervals

	group	N	Mean	Std. Deviation	Median	Minimum	Maximum	P value
Pain_T1	Buccal	17	5,253	1,5828	5,200	,0	7,2	0,004*
	Lingual	17	6,306	1,5139	6,300	1,1	8,2	
	Total	34	5,779	1,6160	6,150	,0	8,2	
Speech_T1	Buccal	17	2,300	,9347	2,300	,2	3,8	0,000*
	Lingual	17	4,824	1,7046	4,900	1,5	8,5	
	Total	34	3,562	1,8635	3,250	,2	8,5	
Chewing_T1	Buccal	17	5,312	1,0594	5,400	3,5	7,5	0,000*
	Lingual	17	7,224	1,3031	7,200	3,5	9,5	
	Total	34	6,268	1,5195	6,200	3,5	9,5	
Sleeping_T1	Buccal	17	,735	,4107	,800	,0	1,2	0,413
	Lingual	17	,888	,9720	,500	,0	3,2	
	Total	34	,812	,7389	,700	,0	3,2	
Wounds_T1	Buccal	17	4,300	,9321	4,200	1,8	6,1	0,009*
	Lingual	17	5,047	,9703	5,200	2,5	7,0	
	Total	34	4,674	1,0106	4,600	1,8	7,0	
Smell_T1	Buccal	17	1,165	1,0155	1,100	,0	3,5	0,001*
	Lingual	17	2,276	1,0906	1,900	,9	4,8	
	Total	34	1,721	1,1811	1,500	,0	4,8	
Taste_T1	Buccal	17	1,765	,9604	1,500	,6	3,8	0,003*
	Lingual	17	3,312	1,8851	2,800	1,3	7,1	
	Total	34	2,538	1,6693	1,900	,6	7,1	
Floss_T1	Buccal	17	2,729	2,7193	3,300	,0	6,2	0,683
	Lingual	17	2,594	3,5268	,800	,0	9,0	
	Total	34	2,662	3,1017	,850	,0	9,0	
Brushing_T1	Buccal	17	4,235	1,1858	4,500	1,1	6,2	0,245
	Lingual	17	4,665	,8329	4,600	2,5	5,9	
	Total	34	4,450	1,0323	4,600	1,1	6,2	
Recommendation_T1	Buccal	17	4,906	1,4801	4,500	3,5	10,0	0,518
	Lingual	17	5,324	1,8397	5,500	2,9	10,0	
	Total	34	5,115	1,6577	4,550	2,9	10,0	

Table 7.21 : Intergroup comparison of VAS scores at each time intervals

Pain_T2	Buccal	17	3,729	1,2185	3,800	,0	5,2
	Lingual	17	5,359	1,5520	5,500	1,0	7,4
	Total	34	4,544	1,6036	4,600	,0	7,4
Speech_T2	Buccal	17	1,753	,6644	1,900	,0	2,5
	Lingual	17	4,412	1,5083	4,500	1,9	7,3
	Total	34	3,082	1,7714	2,500	,0	7,3
Chewing_T2	Buccal	17	4,247	,9612	4,300	2,1	5,6
	Lingual	17	5,653	1,4292	6,000	2,1	7,2
	Total	34	4,950	1,3955	5,050	2,1	7,2
Sleeping_T2	Buccal	17	,518	,3358	,600	,0	1,1
	Lingual	17	,841	,6883	,600	,0	2,3
	Total	34	,679	,5580	,600	,0	2,3
Wounds_T2	Buccal	17	3,576	1,0431	3,500	1,9	5,3
	Lingual	17	4,212	1,1050	4,200	2,2	6,3
	Total	34	3,894	1,1062	3,900	1,9	6,3
Smell_T2	Buccal	17	,859	,7203	1,000	,0	2,0
	Lingual	17	1,818	,9416	1,600	,8	4,8
	Total	34	1,338	,9582	1,250	,0	4,8
Taste_T2	Buccal	17	1,247	,7484	1,200	,0	2,5
	Lingual	17	2,688	1,5588	2,100	1,0	6,2
	Total	34	1,968	1,4088	1,550	,0	6,2
Floss_T2	Buccal	17	2,318	2,2944	3,500	,0	5,3
	Lingual	17	2,488	3,3924	,600	,0	8,5
	Total	34	2,403	2,8530	,800	,0	8,5
Brushing_T2	Buccal	17	3,459	1,2385	3,800	,0	5,3
	Lingual	17	4,176	1,0359	4,200	2,4	6,3
	Total	34	3,818	1,1818	3,900	,0	6,3
Recommendation_T2	Buccal	17	6,100	1,1281	5,800	4,9	10,0
	Lingual	17	6,053	1,5067	5,600	3,6	10,0
	Total	34	6,076	1,3108	5,800	3,6	10,0
Pain_T3	Buccal	17	3,212	1,0994	3,500	,0	4,3
	Lingual	17	3,388	,9532	3,700	1,2	4,6
	Total	34	3,300	1,0171	3,500	,0	4,6
Speech_T3	Buccal	17	,553	,4732	,500	,0	1,5
	Lingual	17	3,265	1,2005	3,000	1,2	5,2
	Total	34	1,909	1,6436	1,350	,0	5,2
Chewing_T3	Buccal	17	3,571	,7439	3,700	1,8	4,9
	Lingual	17	3,694	1,1882	3,600	1,2	5,9
	Total	34	3,632	,9782	3,650	1,2	5,9
Sleeping_T3	Buccal	17	,324	,4085	,000	,0	1,1
	Lingual	17	,312	,4622	,000	,0	1,2
	Total	34	,318	,4296	,000	,0	1,2
Wounds_T3	Buccal	17	2,412	,7865	2,200	1,3	4,1
	Lingual	17	3,000	1,0542	2,800	1,5	5,3
	Total	34	2,706	,9632	2,550	1,3	5,3
Smell_T3	Buccal	17	,400	,5208	,000	,0	1,5
	Lingual	17	,735	,6294	,600	,0	1,6
	Total	34	,568	,5938	,500	,0	1,6

Table 7.21 : Intergroup comparison of VAS scores at each time intervals

Taste_T3	Buccal	17	,818	,7393	,800	,0	2,1
	Lingual	17	1,365	,5061	1,400	,4	2,4
	Total	34	1,091	,6828	1,300	,0	2,4
Floss_T3	Buccal	17	1,365	1,3811	1,800	,0	3,6
	Lingual	17	1,782	2,3373	,700	,0	5,6
	Total	34	1,574	1,9022	,750	,0	5,6
Brushing_T3	Buccal	17	1,688	,8358	1,500	,0	4,1
	Lingual	17	2,024	,5995	2,100	1,1	3,1
	Total	34	1,856	,7362	1,850	,0	4,1
Recommendation_T3	Buccal	17	7,765	,7566	7,600	6,3	10,0
	Lingual	17	7,494	,8591	7,500	6,5	10,0
	Total	34	7,629	,8089	7,600	6,3	10,0
Pain_T4	Buccal	17	2,329	,9655	2,500	,0	4,0
	Lingual	17	2,524	,6057	2,400	1,5	3,5
	Total	34	2,426	,7997	2,450	,0	4,0
Speech_T4	Buccal	17	,235	,4716	,000	,0	1,5
	Lingual	17	2,741	,7714	2,600	1,5	4,1
	Total	34	1,488	1,4191	1,500	,0	4,1
Chewing_T4	Buccal	17	2,359	,6285	2,600	1,1	3,3
	Lingual	17	2,506	,6647	2,500	1,4	3,4
	Total	34	2,432	,6414	2,550	1,1	3,4
Sleeping_T4	Buccal	17	,106	,2106	,000	,0	,6
	Lingual	17	,112	,2595	,000	,0	1,0
	Total	34	,109	,2327	,000	,0	1,0
Wounds_T4	Buccal	17	,953	,6355	1,100	,0	2,1
	Lingual	17	1,871	2,3213	1,500	,0	10,0
	Total	34	1,412	1,7393	1,100	,0	10,0
Smell_T4	Buccal	17	,388	,5159	,000	,0	1,2
	Lingual	17	,435	,5159	,300	,0	1,5
	Total	34	,412	,5086	,000	,0	1,5
Taste_T4	Buccal	17	,359	,4273	,000	,0	1,2
	Lingual	17	,547	,6166	,200	,0	1,6
	Total	34	,453	,5310	,200	,0	1,6
Floss_T4	Buccal	17	1,065	1,0458	1,600	,0	2,3
	Lingual	17	1,688	2,2544	,000	,0	6,5
	Total	34	1,376	1,7591	,650	,0	6,5
Brushing_T4	Buccal	17	,871	,5850	1,000	,0	2,0
	Lingual	17	1,188	,8852	1,300	,0	3,1
	Total	34	1,029	,7562	1,100	,0	3,1
Recommendation_T4	Buccal	17	8,906	,6349	8,900	7,6	10,0
	Lingual	17	8,494	,8050	8,500	7,1	10,0
	Total	34	8,700	,7439	8,700	7,1	10,0

Mann-Whitney u test p value. *p<0,05 statistically significant.

7.3.2 Intragroup comparison of VAS scores for each determinant

Table 7.22 : Intragroup comparison of pain scores at each time intervals

Group		Mean	Std. Deviation	N	p value
Buccal	Pain_T1	5,253	1,5828	17	0,000*
	Pain_T2	3,729	1,2185	17	
	Pain_T3	3,212	1,0994	17	
	Pain_T4	2,329	,9655	17	
Lingual	Pain_T1	6,306	1,5139	17	0,000*
	Pain_T2	5,359	1,5520	17	
	Pain_T3	3,388	,9532	17	
	Pain_T4	2,524	,6057	17	

Friedman test p value.*p<0,05

There is statistically significant difference between two groups in time p<0,05 in terms of pain.

Buccal Group:

Table 7.23 : Pairwise comparison of pain scores in buccal group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Pain_T4-Pain_T3	0.971	0,443	2.192	0.028	0.170
Pain_T4-Pain_T2	1.647	0,443	3.720	0	0.01
Pain_T4-Pain_T1	2.676	0,443	6.044	0	0
Pain_T3-Pain_T2	0,676	0,443	1,528	0,127	0,760
Pain_T3-Pain_T1	1,706	0,443	3,852	0	0,001
Pain_T2-Pain_T1	1,029	0,443	2,325	0,020	0,121

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Lingual Group:

Table 7.24 : Pairwise comparison of pain scores in lingual group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Pain_T4-Pain_T3	,529	0,443	1,196	,232	1,000
Pain_T4-Pain_T2	1.647	0,443	3,720	0	0,001
Pain_T4-Pain_T1	2,412	0,443	5,447	0	0
Pain_T3-Pain_T2	1,118	0,443	2,524	,012	,070
Pain_T3-Pain_T1	1,882	0,443	4,251	0	0
Pain_T2-Pain_T1	,765	0,443	1,727	,084	,505

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.25 : Intragroup comparison of speech scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Speech_T1	2,300	,9347	17	0,000*
	Speech_T2	1,753	,6644	17	
	Speech_T3	,553	,4732	17	
	Speech_T4	,235	,4716	17	
Lingual	Speech_T1	4,824	1,7046	17	0,000*
	Speech_T2	4,412	1,5083	17	
	Speech_T3	3,265	1,2005	17	
	Speech_T4	2,741	,7714	17	

Friedman test p value.*p<0,05

There is statistically significant difference in time p<0,05.

Buccal Group:

Table 7.26 : Pairwise comparison of speech scores in buccal group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Speech_T4- Speech_T3	,353	0,443	,797	,425	1,000
Speech_T4- Speech_T2	1,765	0,443	3,985	,000	,000
Speech_T4- Speech_T1	2,235	0,443	5,048	,000	,000
Speech_T3- Speech_T2	1,412	0,443	3,188	,001	,009
Speech_T3- Speech_T1	1,882	0,443	4,251	,000	,000
Speech_T2- Speech_T1	,471	,443	1,063	,288	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Lingual Group:

Table 7.27 : Pairwise comparison of speech scores in lingual group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Speech_T4- Speech_T3	,441	,443	,996	,319	1,000
Speech_T4- Speech_T2	1,647	,443	3,720	,000	,001
Speech_T4- Speech_T1	2,147	,443	4,849	,000	,000
Speech_T3- Speech_T2	1,206	,443	2,723	,006	,039
Speech_T3- Speech_T1	1,706	,443	3,852	,000	,001
Speech_T2- Speech_T1	,500	,443	1,129	,259	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.28 : Intragroup comparison of chewing scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Chewing_T1	5,312	1,0594	17	0,000*
	Chewing_T2	4,247	,9612	17	
	Chewing_T3	3,571	,7439	17	
	Chewing_T4	2,359	,6285	17	
Lingual	Chewing_T1	7,224	1,3031	17	0,000*
	Chewing_T2	5,653	1,4292	17	
	Chewing_T3	3,694	1,1882	17	
	Chewing_T4	2,506	,6647	17	

Friedman test p value.*p<0,05

There is statistically significant difference in time p<0,05.

Buccal Group :

Table 7.29 : Pairwise comparison of chewing scores in buccal group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Chewing_T4- Chewing_T3	,882	,443	1,993	,046	,278
Chewing_T4- Chewing_T2	1,824	,443	4,118	,000	,000
Chewing_T4- Chewing_T1	2,824	,443	6,376	,000	,000
Chewing_T3- Chewing_T2	,941	,443	2,125	,034	,201
Chewing_T3- Chewing_T1	1,941	,443	4,384	,000	,000
Chewing_T2- Chewing_T1	1,000	,443	2,258	,024	,144

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.30 : Pairwise comparison of chewing scores in lingual group

Lingual Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Chewing_T4- Chewing_T3	,529	,443	1,196	,232	1,000
Chewing_T4- Chewing_T2	1,765	,443	3,985	,000	,000
Chewing_T4- Chewing_T1	2,765	,443	6,244	,000	,000
Chewing_T3- Chewing_T2	1,235	,443	2,790	,005	,032
Chewing_T3- Chewing_T1	2,235	,443	5,048	,000	,000
Chewing_T2- Chewing_T1	1,000	,443	2,258	,024	,144

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.31 : Intragroup comparison of sleeping scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Sleeping_T1	,735	,4107	17	0,000*
	Sleeping_T2	,518	,3358	17	
	Sleeping_T3	,324	,4085	17	
	Sleeping_T4	,106	,2106	17	
Lingual	Sleeping_T1	,888	,9720	17	0,000*
	Sleeping_T2	,841	,6883	17	
	Sleeping_T3	,312	,4622	17	
	Sleeping_T4	,112	,2595	17	

Friedman test p value.*p<0,05

There is statistically significant difference in time p<0,05.

Table 7.32 : Pairwise comparison of sleeping scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Sleeping _T4- Sleeping _T3	,500	,443	1,129	,259	1,000
Sleeping _T4- Sleeping _T2	,971	,443	2,192	,028	,170
Sleeping _T4- Sleeping _T1	1,941	,443	4,384	,000	,000
Sleeping _T3- Sleeping _T2	,471	,443	1,063	,288	1,000
Sleeping _T3- Sleeping _T1	1,441	,443	3,255	,001	0,007
Sleeping _T2- Sleeping _T1	,971	,443	2,192	,028	,170

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.33 : Pairwise comparison of sleeping scores in lingual group

Lingual Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Sleeping _T4- Sleeping _T3	,235	,443	,531	,595	1,000
Sleeping _T4- Sleeping _T1	1,706	,443	3,852	,000	,001
Sleeping _T4- Sleeping _T2	1,824	,443	4,118	,000	,000
Sleeping _T3- Sleeping _T1	1,471	,443	3,321	,001	,005
Sleeping _T3- Sleeping _T2	1,588	,443	3,587	,000	,002
Sleeping _T1- Sleeping _T2	-,118	,443	-,266	,79	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.34 : Intragroup comparison of wounds scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Wounds_T1	4,300	,9321	17	0,000*
	Wounds_T2	3,576	1,0431	17	
	Wounds_T3	2,412	,7865	17	
	Wounds_T4	,953	,6355	17	
Lingual	Wounds_T1	5,047	,9703	17	0,000*
	Wounds_T2	4,212	1,1050	17	
	Wounds_T3	3,000	1,0542	17	
	Wounds_T4	1,871	2,3213	17	

Friedman test p value.*p<0,05

There is statistically significant difference in time p<0,05.

Table 7.35 : Pairwise comparison of wounds scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Wounds_T4- Wounds_T3	1,000	,443	2,258	,024	,144
Wounds_T4- Wounds_T2	2,294	,443	5,181	,000	,000
Wounds_T4- Wounds_T1	2,706	,443	6,111	,000	,000
Wounds_T3- Wounds_T2	1,294	,443	2,923	,003	,021
Wounds_T3- Wounds_T1	1,706	,443	3,852	,000	,001
Wounds_T2- Wounds_T1	,412	,443	,930	,352	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.36 : Pairwise comparison of wounds scores in lingual group

Lingual Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Wounds_T4- Wounds_T3	,882	,443	1,993	,046	,278
Wounds_T4- Wounds_T2	1,853	,443	4,185	,000	,000
Wounds_T4- Wounds_T1	2,559	,443	5,779	,000	,000
Wounds_T3- Wounds_T2	,971	,443	2,192	,028	,170
Wounds_T3- Wounds_T1	1,676	,443	3,786	,000	,001
Wounds_T2- Wounds_T1	,706	,443	1,594	,111	,665

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.37 : Intragroup comparison of smelling scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Smell_T1	1,165	1,0155	17	0,000*
	Smell_T2	,859	,7203	17	
	Smell_T3	,400	,5208	17	
	Smell_T4	,388	,5159	17	
Lingual	Smell_T1	2,276	1,0906	17	0,000*
	Smell_T2	1,818	,9416	17	
	Smell_T3	,735	,6294	17	
	Smell_T4	,435	,5159	17	

Friedman test p value.*p<0,05

There is statistically significant difference in time p<0,05.

Table 7.38 : Pairwise comparison of smelling scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Smell_T3- Smell_T4	-,235	,443	-,531	,595	1,000
Smell_T3- Smell_T2	1,059	,443	2,391	,017	,101
Smell_T3- Smell_T1	1,529	,443	3,454	,001	,003
Smell_T4- Smell_T2	,824	,443	1,860	,063	,377
Smell_T4- Smell_T1	1,294	,443	2,923	,003	,021
Smell_T2- Smell_T1	,471	,443	1,063	,288	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Lingual Group:

Table 7.39: Pairwise comparison of smelling scores in lingual group

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Smell_T4- Smell_T3	,353	,443	,797	,425	1,000
Smell_T4- Smell_T2	1,912	,443	4,317	,000	,000
Smell_T4- Smell_T1	2,206	,443	4,982	,000	,000
Smell_T3- Smell_T2	1,559	,443	3,520	,000	,003
Smell_T3- Smell_T1	1,853	,443	4,185	,000	,000
Smell_T2- Smell_T1	,294	,443	,664	,507	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.40 : Intragroup comparison of taste scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Taste_T1	1,765	,9604	17	0,000*
	Taste_T2	1,247	,7484	17	
	Taste_T3	,818	,7393	17	
	Taste_T4	,359	,4273	17	
Lingual	Taste_T1	3,312	1,8851	17	0,000*
	Taste_T2	2,688	1,5588	17	
	Taste_T3	1,365	,5061	17	
	Taste_T4	,547	,6166	17	

Friedman test p value.*p<0,05. There is statistically significant difference in time p<0,05.

Table 7.41 : Pairwise comparison of taste scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Taste_T4- Taste_T3	,618	,443	1,395	,163	,978
Taste_T4- Taste_T2	1,324	,443	2,989	,003	,017
Taste_T4- Taste_T1	2,412	,443	5,447	,000	,000
Taste_T3- Taste_T2	,706	,443	1,594	,111	,665
Taste_T3- Taste_T1	1,794	,443	4,052	,000	,000
Taste_T2- Taste_T1	1,088	,443	2,458	,014	,084

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.42: Pairwise comparison of taste scores in lingual group

Lingual Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Taste_T4- Taste_T3	,794	,443	1,793	,073	,437
Taste_T4- Taste_T2	1,647	,443	3,720	,000	,001
Taste_T4- Taste_T1	2,500	,443	5,646	,000	,000
Taste_T3- Taste_T2	,853	,443	1,926	,054	,324
Taste_T3- Taste_T1	1,706	,443	3,852	,000	,001
Taste_T2- Taste_T1	,853	,443	1,926	,054	,324

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.43 : Intragroup comparison of flossing scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Floss_T1	2,729	2,7193	17	0,000*
	Floss_T2	2,318	2,2944	17	
	Floss_T3	1,365	1,3811	17	
	Floss_T4	1,065	1,0458	17	
Lingual	Floss_T1	2,594	3,5268	17	0,355
	Floss_T2	2,488	3,3924	17	
	Floss_T3	1,782	2,3373	17	
	Floss_T4	1,688	2,2544	17	

Friedman test p value.*p<0,05

There is statistically significant difference in time only for Buccal group p<0,05.

Table 7.44 : Pairwise comparison of flossing scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Floss_T4- Floss T3	,353	,443	,797	,425	1,000
Floss _T4- Floss _T2	1,088	,443	2,458	,014	,084
Floss _T4- Floss _T1	1,382	,443	3,122	,002	,011
Floss _T3- Floss _T2	,735	,443	1,661	,097	,581
Floss _T3- Floss _T1	1,029	,443	2,325	,020	,121
Floss T2- Floss _T1	,294	,443	,664	,507	1,000

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.45 : Intragroup comparison of brushing scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Brushing_T1	4,235	1,1858	17	0,000*
	Brushing_T2	3,459	1,2385	17	
	Brushing_T3	1,688	,8358	17	
	Brushing_T4	,871	,5850	17	
Lingual	Brushing_T1	4,665	,8329	17	0,000*
	Brushing_T2	4,176	1,0359	17	
	Brushing_T3	2,024	,5995	17	
	Brushing_T4	1,188	,8852	17	

Friedman test p value.*p<0,05. There is statistically significant difference in time p<0,05.

Table 7.46 : Pairwise comparison of brushing scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Brushing_T4- Brushing T3	,824	,443	1,860	,063	,377
Brushing _T4- Brushing _T2	1,912	,443	4,317	,000	,000
Brushing _T4- Brushing _T1	2,794	,443	6,310	,000	,000
Brushing _T3- Brushing _T2	1,088	,443	2,458	,014	,084
Brushing _T3- Brushing _T1	1,971	,443	4,450	,000	,000
Brushing T2- Brushing _T1	,882	,443	1,993	,046	,278

Wilcoxon test with Bonferroni adjusted p values.

Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.47: Pairwise comparison of brushing scores in lingual group

Lingual Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Brushing _T4- Brushing T3	,529	,443	1,196	,232	1,000
Brushing _T4- Brushing _T2	2,059	,443	4,649	,000	,000
Brushing _T4- Brushing _T1	2,471	,443	5,579	,000	,000
Brushing _T3- Brushing _T2	1,529	,443	3,454	,001	,003
Brushing _T3- Brushing _T1	1,941	,443	4,384	,000	,000
Brushing T2- Brushing _T1	,412	,443	,930	,352	1,000

Wilcoxon test with Bonferroni adjusted p values.

Yellow colored p values are statistically significant change in pairwise time in Lingual group.

Table 7.48 : Intragroup comparison of recommendation scores at each time intervals

Group		Mean	Std. Deviation	N	P value
Buccal	Recommendation_T1	4,906	1,4801	17	0,000*
	Recommendation_T2	6,100	1,1281	17	
	Recommendation_T3	7,765	,7566	17	
	Recommendation_T4	8,906	,6349	17	
Lingual	Recommendation_T1	5,324	1,8397	17	0,000*
	Recommendation_T2	6,053	1,5067	17	
	Recommendation_T3	7,494	,8591	17	
	Recommendation_T4	8,494	,8050	17	

Friedman test p value.*p<0,05There is statistically significant difference in time p<0,05.

Table 7.49 : Pairwise comparison of recommendation scores in buccal group

Buccal Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Recommendation _T1- Recommendation T2	-,941	,443	-2,125	,034	,201
Recommendation _T1- Recommendation _T3	-1,882	,443	-4,251	,000	,000
Recommendation _T1- Recommendation _T4	-2,824	,443	-6,376	,000	,000
Recommendation _T2- Recommendation _T3	-,941	,443	-2,125	,034	,201
Recommendation _T2- Recommendation _T4	-1,882	,443	-4,251	,000	,000
Recommendation T3- Recommendation _T4	-,941	,443	-2,125	,034	,201

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Buccal group.

Table 7.50: Pairwise comparison of recommendation scores in lingual group

Lingual Group:

Sample 1 - Sample 2	Mean	Std. Error	Std. Test Statistic	Sig.	p value
Recommendation _T1- Recommendation T2	-,971	,443	-2,192	,028	,170
Recommendation _T1- Recommendation _T3	-1,853	,443	-4,185	,000	,000
Recommendation _T1- Recommendation _T4	-2,706	,443	-6,111	,000	,000
Recommendation _T2- Recommendation _T3	-,882	,443	-1,993	,046	,278
Recommendation _T2- Recommendation _T4	-1,735	,443	-3,919	,000	,001
Recommendation T3- Recommendation _T4	-,853	,443	-1,926	,054	,324

Wilcoxon test with Bonferroni adjusted p values. Yellow colored p values are statistically significant change in pairwise time in Lingual group.

7.3.3 Pairwise intergroup comparison of VAS scores for each determinants at every time points

Regarding pain, smell, taste and chewing, it can be seen that for the same time differences (dt's) that provide us with significant results (T1→T3, T1→T4, T2→T3, T2→T4), the improvement is always more significant in the lingual patients (Table 7.51). As for sleeping, the improvement is bigger in the buccal treatment group at

T1→T2, whereas it is bigger in lingual group at T2→T3 (Table 7.51). Furthermore, regarding the recommendation of treatment, there is an important difference at T1→T2, when the patients of the buccal treatment group report more negative experiences.

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points

		group			
		Buccal	Lingual	Total	P value
pain_dif_t1t2	N	17	17	34	0,231
	Mean	1,5235	,9471	1,2353	
	Std. Deviation	1,18719	1,11362	1,17057	
	Median	1,6000	,7000	1,1000	
	Minimum	-,20	-,90	-,90	
	Maximum	3,90	3,00	3,90	
pain_dif_t1t3	N	17	17	34	0,031*
	Mean	2,0412	2,9176	2,4794	
	Std. Deviation	1,26790	1,33615	1,35753	
	Median	1,7000	3,1000	2,4000	
	Minimum	,00	-,10	-,10	
	Maximum	5,10	5,80	5,80	
pain_dif_t1t4	N	17	17	34	0,038*
	Mean	2,9235	3,7824	3,3529	
	Std. Deviation	1,47289	1,33755	1,45232	
	Median	2,7000	4,0000	3,7500	
	Minimum	,00	-,40	-,40	
	Maximum	5,80	5,70	5,80	
pain_dif_t2t3	N	17	17	34	0,000*
	Mean	,5176	1,9706	1,2441	
	Std. Deviation	,69032	1,12515	1,17839	
	Median	,4000	2,1000	1,1000	
	Minimum	-,40	-,20	-,40	
	Maximum	2,10	3,60	3,60	
pain_dif_t2t4	N	17	17	34	0,001*
	Mean	1,4000	2,8353	2,1176	
	Std. Deviation	,98489	1,33975	1,36792	
	Median	1,7000	3,3000	1,9500	
	Minimum	,00	-,50	-,50	
	Maximum	3,30	4,60	4,60	

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points (continued)

pain_dif_t3t4	N	17	17	34
	Mean	,8824	,8647	,8735
	Std. Deviation	,65787	,86382	,75611
	Median	,8000	1,0000	,9000
	Minimum	-,30	-,60	-,60
	Maximum	2,20	2,40	2,40
speech_dif_t1t2	N	17	17	34
	Mean	,5471	,4118	,4794
	Std. Deviation	,75673	,85431	,79764
	Median	,4000	,6000	,5000
	Minimum	-,80	-1,20	-1,20
	Maximum	1,90	1,70	1,90
Speech_dif_t1t3	N	17	17	34
	Mean	1,7471	1,5588	1,6529
	Std. Deviation	,94016	1,20575	1,06891
	Median	1,8000	1,5000	1,6500
	Minimum	,10	-,60	-,60
	Maximum	3,30	3,70	3,70
Speech_dif_t1t4	N	17	17	34
	Mean	2,0647	2,0824	2,0735
	Std. Deviation	1,13299	1,37124	1,23860
	Median	2,2000	2,0000	2,1500
	Minimum	-,40	-,70	-,70
	Maximum	3,80	5,30	5,30
Speech_dif_t2t3	N	17	17	34
	Mean	1,2000	1,1471	1,1735
	Std. Deviation	,66802	1,00940	,84327
	Median	1,1000	1,0000	1,0500
	Minimum	,00	-,80	-,80
	Maximum	2,40	3,00	3,00
Speech_dif_t2t4	N	17	17	34
	Mean	1,5176	1,6706	1,5941
	Std. Deviation	,78441	1,19623	,99907
	Median	1,5000	1,9000	1,6000
	Minimum	-,30	-,30	-,30
	Maximum	2,50	3,90	3,90

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points (continued)

Speech_dif_t3t4	N	17	17	34
	Mean	,3176	,5235	,4206
	Std. Deviation	,42314	,98459	,75349
	Median	,4000	,8000	,5000
	Minimum	-,50	-1,80	-1,80
	Maximum	1,20	2,00	2,00
Chewing_dif_t1t2	N	17	17	34
	Mean	1,0647	1,5706	1,3176
	Std. Deviation	,72019	,94853	,86811
	Median	1,1000	1,4000	1,2500
	Minimum	-,50	,20	-,50
	Maximum	2,40	3,00	3,00
Chewing_dif_t1t3	N	17	17	34
	Mean	1,7412	3,5294	2,6353
	Std. Deviation	,70184	1,13950	1,30079
	Median	1,7000	3,6000	2,3000
	Minimum	,20	1,70	,20
	Maximum	3,00	5,50	5,50
Chewing_dif_t1t4	N	17	17	34
	Mean	2,9529	4,7176	3,8353
	Std. Deviation	1,16572	1,37533	1,54211
	Median	3,1000	5,0000	3,8500
	Minimum	,90	2,00	,90
	Maximum	4,90	7,40	7,40
Chewing_dif_t2t3	N	17	17	34
	Mean	,6765	1,9588	1,3176
	Std. Deviation	,49438	1,00129	1,01398
	Median	,6000	1,9000	1,2000
	Minimum	,00	,10	,00
	Maximum	1,60	3,70	3,70
Chewing_dif_t2t4	N	17	17	34
	Mean	1,8882	3,1471	2,5176
	Std. Deviation	,93667	1,43227	1,35210
	Median	2,0000	3,1000	2,4000
	Minimum	-,40	,60	-,40
	Maximum	3,40	5,40	5,40

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points
(continued)

Chewing_dif_t3t4	N	17	17	34
	Mean	1,2118	1,1882	1,2000
	Std. Deviation	,80303	1,12132	,96043
	Median	1,3000	1,3000	1,3000
	Minimum	-,70	-,50	-,70
	Maximum	2,70	3,50	3,50
Sleeping_dif_t1t2	N	17	17	34
	Mean	,2176	,0471	,1324
	Std. Deviation	,22146	,44317	,35566
	Median	,2000	,0000	,1000
	Minimum	,00	-,60	-,60
	Maximum	,60	1,40	1,40
Sleeping_dif_t1t3	N	17	17	34
	Mean	,4118	,5765	,4941
	Std. Deviation	,33332	,59111	,47986
	Median	,4000	,4000	,4000
	Minimum	,00	,00	,00
	Maximum	,90	2,20	2,20
Sleeping_dif_t1t4	N	17	17	34
	Mean	,6294	,7765	,7029
	Std. Deviation	,41347	,92906	,71201
	Median	,7000	,5000	,5500
	Minimum	-,20	-,40	-,40
	Maximum	1,20	3,20	3,20
Sleeping_dif_t2t3	N	17	17	34
	Mean	,1941	,5294	,3618
	Std. Deviation	,42789	,31378	,40677
	Median	,3000	,6000	,5000
	Minimum	-,50	,00	-,50
	Maximum	,80	1,20	1,20
Sleeping_dif_t2t4	N	17	17	34
	Mean	,4118	,7294	,5706
	Std. Deviation	,40138	,62925	,54413
	Median	,5000	,6000	,6000
	Minimum	-,20	,00	-,20
	Maximum	1,10	2,00	2,00

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points (continued)

Sleeping_dif_t3t4	N	17	17	34
	Mean	,2176	,2000	,2088
	Std. Deviation	,37456	,45826	,41221
	Median	,0000	,0000	,0000
	Minimum	-,50	-,40	-,50
	Maximum	,90	1,20	1,20
Wounds_dif_t1t2	N	17	17	34
	Mean	,7235	,8353	,7794
	Std. Deviation	,85479	1,01239	,92434
	Median	,7000	1,0000	,9500
	Minimum	-,60	-1,10	-1,10
	Maximum	2,50	2,40	2,50
Wounds_dif_t1t3	N	17	17	34
	Mean	1,8882	2,0471	1,9676
	Std. Deviation	,90959	1,31154	1,11429
	Median	1,7000	2,0000	1,7500
	Minimum	,50	-,10	-,10
	Maximum	4,00	5,20	5,20
Wounds_dif_t1t4	N	17	17	34
	Mean	3,3471	3,1765	3,2618
	Std. Deviation	,85886	2,49713	1,84079
	Median	3,4000	4,0000	3,5000
	Minimum	,90	-4,70	-4,70
	Maximum	4,70	6,40	6,40
Wounds_dif_t2t3	N	17	17	34
	Mean	1,1647	1,2118	1,1882
	Std. Deviation	,64802	,90821	,77724
	Median	1,2000	1,0000	1,1500
	Minimum	,10	-,20	-,20
	Maximum	2,70	3,30	3,30
Wounds_dif_t2t4	N	17	17	34
	Mean	2,6235	2,3412	2,4824
	Std. Deviation	,91072	2,69538	1,98624
	Median	2,7000	2,9000	2,7500
	Minimum	,80	-7,10	-7,10
	Maximum	4,10	4,70	4,70

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points
(continued)

Wounds_dif_t3t4	N	17	17	34
	Mean	1,4588	1,1294	1,2941
	Std. Deviation	,65580	2,60882	1,88051
	Median	1,6000	1,7000	1,6500
	Minimum	,20	-8,40	-8,40
	Maximum	2,70	3,10	3,10
Smell_dif_t1t2	N	17	17	34
	Mean	,3059	,4588	,3824
	Std. Deviation	,56731	,80316	,68908
	Median	,1000	,3000	,2000
	Minimum	-,50	-1,00	-1,00
	Maximum	1,60	2,10	2,10
Smell_dif_t1t3	N	17	17	34
	Mean	,7647	1,5412	1,1529
	Std. Deviation	,91511	,94542	,99734
	Median	,5000	1,3000	,9000
	Minimum	,00	,00	,00
	Maximum	3,50	3,30	3,50
Smell_dif_t1t4	N	17	17	34
	Mean	,7765	1,8412	1,3088
	Std. Deviation	1,06977	1,30865	1,29506
	Median	,8000	1,5000	1,1500
	Minimum	-,80	-,10	-,80
	Maximum	3,50	4,50	4,50
Smell_dif_t2t3	N	17	17	34
	Mean	,4588	1,0824	,7706
	Std. Deviation	,58316	,78121	,74895
	Median	,2000	1,0000	,6500
	Minimum	,00	,10	,00
	Maximum	1,90	3,30	3,30
Smell_dif_t2t4	N	17	17	34
	Mean	,4706	1,3824	,9265
	Std. Deviation	,80914	1,06785	1,04136
	Median	,3000	1,2000	,8500
	Minimum	-1,00	,00	-1,00
	Maximum	1,90	4,50	4,50

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points (continued)

Smell_dif_t3t4	N	17	17	34
	Mean	,0118	,3000	,1559
	Std. Deviation	,46888	,62450	,56310
	Median	,0000	,2000	,0000
	Minimum	-1,00	-1,00	-1,00
	Maximum	,90	1,20	1,20
Taste_dif_t1t2	N	17	17	34
	Mean	,5176	,6235	,5706
	Std. Deviation	,47068	1,00842	,77676
	Median	,5000	,6000	,5000
	Minimum	-,20	-2,10	-2,10
	Maximum	1,70	2,90	2,90
Taste_dif_t1t3	N	17	17	34
	Mean	,9471	1,9471	1,4471
	Std. Deviation	,76167	1,66700	1,37339
	Median	1,2000	1,5000	1,2500
	Minimum	-,70	-,10	-,70
	Maximum	2,20	5,50	5,50
Taste_dif_t1t4	N	17	17	34
	Mean	1,4059	2,7647	2,0853
	Std. Deviation	,99842	2,13364	1,77937
	Median	1,4000	2,1000	1,6000
	Minimum	-,30	-,20	-,30
	Maximum	3,80	7,10	7,10
Taste_dif_t2t3	N	17	17	34
	Mean	,4294	1,3235	,8765
	Std. Deviation	,67617	1,20754	1,06517
	Median	,3000	1,0000	,8000
	Minimum	-1,30	-,50	-1,30
	Maximum	1,30	3,80	3,80
Taste_dif_t2t4	N	17	17	34
	Mean	,8882	2,1412	1,5147
	Std. Deviation	,80613	1,67035	1,43951
	Median	1,1000	1,9000	1,2000
	Minimum	-,90	-,40	-,90
	Maximum	2,50	6,20	6,20

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points
(continued)

Taste_dif_t3t4	N	17	17	34
	Mean	,4588	,8176	,6382
	Std. Deviation	,52922	,75931	,66970
	Median	,4000	1,0000	,6000
	Minimum	,00	-,90	-,90
	Maximum	1,60	2,40	2,40
Floss_dif_t1t2	N	17	17	34
	Mean	,4118	,1059	,2588
	Std. Deviation	,59988	,35964	,51116
	Median	,0000	,0000	,0000
	Minimum	-,20	-,40	-,40
	Maximum	1,50	1,30	1,50
Floss_dif_t1t3	N	17	17	34
	Mean	1,3647	,8118	1,0882
	Std. Deviation	1,38832	1,36055	1,38230
	Median	1,2000	,0000	,1000
	Minimum	,00	-,70	-,70
	Maximum	3,00	3,70	3,70
Floss_dif_t1t4	N	17	17	34
	Mean	1,6647	,9059	1,2853
	Std. Deviation	1,73239	2,07890	1,92324
	Median	1,2000	,0000	,0000
	Minimum	,00	-2,10	-2,10
	Maximum	4,20	6,50	6,50
Floss_dif_t2t3	N	17	17	34
	Mean	,9529	,7059	,8294
	Std. Deviation	,95402	1,26564	1,11070
	Median	1,4000	,0000	,1000
	Minimum	,00	-,70	-,70
	Maximum	2,50	3,60	3,60
Floss_dif_t2t4	N	17	17	34
	Mean	1,2529	,8000	1,0265
	Std. Deviation	1,30677	2,03316	1,69854
	Median	1,4000	,0000	,0000
	Minimum	,00	-2,00	-2,00
	Maximum	3,20	6,00	6,00

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points
(continued)

Floss_dif_t3t4	N	17	17	34
	Mean	,3000	,0941	,1971
	Std. Deviation	,50000	1,00838	,79066
	Median	,0000	,0000	,0000
	Minimum	-,30	-1,90	-1,90
	Maximum	1,30	2,80	2,80
Brushing_dif_t1t2	N	17	17	34
	Mean	,7765	,4882	,6324
	Std. Deviation	,54833	,85578	,72267
	Median	,7000	,5000	,7000
	Minimum	-,20	-1,00	-1,00
	Maximum	1,70	2,00	2,00
Brushing_dif_t1t3	N	17	17	34
	Mean	2,5471	2,6412	2,5941
	Std. Deviation	,78431	,92199	,84421
	Median	2,5000	2,5000	2,5000
	Minimum	1,10	1,30	1,10
	Maximum	3,80	4,40	4,40
Brushing_dif_t1t4	N	17	17	34
	Mean	3,3647	3,4765	3,4206
	Std. Deviation	,86670	1,35487	1,12136
	Median	3,5000	3,7000	3,5500
	Minimum	1,10	,50	,50
	Maximum	4,40	5,90	5,90
Brushing_dif_t2t3	N	17	17	34
	Mean	1,7706	2,1529	1,9618
	Std. Deviation	,86224	,87330	,87629
	Median	1,8000	2,0000	1,9000
	Minimum	,00	,70	,00
	Maximum	3,10	3,80	3,80
Brushing_dif_t2t4	N	17	17	34
	Mean	2,5882	2,9882	2,7882
	Std. Deviation	,95648	1,50120	1,25596
	Median	2,7000	2,9000	2,8000
	Minimum	,00	,40	,00
	Maximum	4,20	5,30	5,30

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points (continued)

Brushing_dif_t3t4	N	17	17	34
	Mean	,8176	,8353	,8265
	Std. Deviation	,59607	1,04160	,83568
	Median	,9000	,9000	,9000
	Minimum	-,50	-,90	-,90
	Maximum	2,10	3,10	3,10
Recommendation_dif_t1t2	N	17	17	34
	Mean	-1,1941	-,7294	-,9618
	Std. Deviation	,56841	,68169	,66150
	Median	-1,3000	-,6000	-,9000
	Minimum	-2,10	-2,20	-2,20
	Maximum	,00	,00	,00
Recommendation_dif_t1t3	N	17	17	34
	Mean	-2,8588	-2,1706	-2,5147
	Std. Deviation	,97792	1,45592	1,27020
	Median	-3,0000	-2,6000	-2,9000
	Minimum	-4,40	-4,60	-4,60
	Maximum	,00	,00	,00
Recommendation_dif_t1t4	N	17	17	34
	Mean	-4,0000	-3,1706	-3,5853
	Std. Deviation	1,28889	1,70065	1,54432
	Median	-4,2000	-3,4000	-3,9500
	Minimum	-5,90	-6,10	-6,10
	Maximum	,00	,00	,00
Recommendation_dif_t2t3	N	17	17	34
	Mean	-1,6647	-1,4412	-1,5529
	Std. Deviation	,54076	1,17530	,90796
	Median	-1,7000	-1,3000	-1,6000
	Minimum	-2,30	-3,90	-3,90
	Maximum	,00	,20	,20
Recommendation_dif_t2t4	N	17	17	34
	Mean	-2,8059	-2,4412	-2,6235
	Std. Deviation	,93238	1,36201	1,16413
	Median	-3,1000	-2,1000	-2,7500
	Minimum	-4,00	-5,00	-5,00
	Maximum	,00	,00	,00

Table 7.51 : Pairwise intergroup comparison of VAS scores for each determinants at every time points (continued)

Recommendation_d if_t3t4	N	17	17	34
	Mean	-1,1412	-1,0000	-1,0706
	Std. Deviation	,52447	,88034	,71712
	Median	-1,3000	-,7000	-,9500
	Minimum	-1,80	-2,90	-2,90
	Maximum	,00	,10	,10

Mann-Whitney u test p value. * $p < 0,05$ statistically significant.

7.4 Bullying

In our study 23 out of 37 patients had bullying before ($p > 0.05$) (Table 7.52), 20 out of these 23 had teeth/chin bullying ($p > 0.05$) (Table 7.53) and 14 out of these 23 were bullied also for another reason ($p > 0.05$) (Table 7.54).

Protruded upper incisors, crowding and spaces were the most frequently reported problems ($p > 0.05$) (Table 7.55, Table 7.59, Table 7.61).

While treatment continues, fewer patients report bullying episodes ($p < 0.05$) (Table 7.77).

During the treatment, more and more patients believe that orthodontic treatment contributes to the reduction of bullying ($p < 0.05$) (Table 7.78).

While treatment goes on, the expectation of patients improves ($p < 0.05$) (Table 7.79).

7.4.1 Pre-existing bullying and problems

Table 7.52 : Pre-existing bullying of the patients for each group

Had Bullying before? Yes=1, No=2, no answer=0 * group

			group		Total	P value
			Buccal	Lingual		
Had Bullying before? Yes=1, No=2, no answer=0	1	Count	11 _a	12 _a	23	1,000
		% within had Bullying before? Yes=1, No=2, no answer=0	47,8%	52,2%	100,0%	
	2	Count	6 _a	5 _a	11	
		% within had Bullying before? Yes=1, No=2, no answer=0	54,5%	45,5%	100,0%	
Total		Count	17	17	34	
		% within had Bullying before? Yes=1, No=2, no answer=0	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

Table 7.53 : Bullying about teeth/chin before treatment**Bullying about teeth-chin: Yes=1, No=2 * group**

			group		Total	P value
			Buccal	Lingual		
Bullying about teeth-chin: Yes=1, No=2	1	Count	9 _a	11 _a	20	0,728
		% within Bullying about teeth-chin: Yes=1, No=2	45,0%	55,0%	100,0%	
	2	Count	8 _a	6 _a	14	
		% within Bullying about teeth-chin: Yes=1, No=2	57,1%	42,9%	100,0%	
Total		Count	17	17	34	
		% within Bullying about teeth-chin: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value. There is no statistically significant difference between groups $p>0,05$.

Table 7.54 : Bullying for other reason before treatment**Bullying for other reason: Yes=1, No=2 * group**

			group		Total	P value
			Buccal	Lingual		
Bullying for other reason: Yes=1, No=2	1	Count	8 _a	6 _a	14	0,728
		% within Bullying for other reason: Yes=1, No=2	57,1%	42,9%	100,0%	
	2	Count	9 _a	11 _a	20	
		% within Bullying for other reason: Yes=1, No=2	45,0%	55,0%	100,0%	
Total		Count	17	17	34	
		% within Bullying for other reason: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value. There is no statistically significant difference between groups $p>0,05$.

Table 7.55 : Problem 1

problem 1: Yes=1, No=2 * group (Upper front teeth are sticking out)

			Group		Total	P value
			Buccal	Lingual		
problem 1: Yes=1, No=2	yes	Count	7 _a	4 _a	11	0,465
		% within problem 1: Yes=1, No=2	63,6%	36,4%	100,0%	
	no	Count	10 _a	13 _a	23	
		% within problem 1: Yes=1, No=2	43,5%	56,5%	100,0%	
Total		Count	17	17	34	
		% within problem 1: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value. There is no statistically significant difference between groups $p > 0,05$.

Table 7.56 : Problem 2

problem 2: Yes=1, No=2 * group (Lower front teeth are sticking out)

			group		Total	P value
			Buccal	Lingual		
problem 2: Yes=1, No=2	no	Count	17 _a	17 _a	34	n.c
		% within problem 2: Yes=1, No=2	50,0%	50,0%	100,0%	
Total		Count	17	17	34	
		% within problem 2: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

n.c. not computed

Table 7.57 : Problem 3

problem 3: Yes=1, No=2 * group (Chin sticking out)

			group		Total	P value
			Buccal	Lingual		
problem 3: Yes=1, No=2	no	Count	17 _a	17 _a	34	n.c
		% within problem 3: Yes=1, No=2	50,0%	50,0%	100,0%	
Total		Count	17	17	34	
		% within problem 3: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

n.c. not computed

Table 7.58 : Problem 4

problem 4: Yes=1, No=2 * group (Chin too far back)

			group		Total	P value
			Buccal	Lingual		
problem 4: Yes=1, No=2	no	Count	17 _a	17 _a	34	n.c.
		% within problem 4: Yes=1, No=2	50,0%	50,0%	100,0%	
Total		Count	17	17	34	
		% within problem 4: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

n.c. not computed

Table 7.59 : Problem 5

problem 5: Yes=1, No=2 * group (Crooked teeth)

			group		Total	P value
			Buccal	Lingual		
problem 5: Yes=1, No=2	yes	Count	6 _a	9 _a	15	0,491
		% within problem 5: Yes=1, No=2	40,0%	60,0%	100,0%	
	no	Count	11 _a	8 _a	19	
		% within problem 5: Yes=1, No=2	57,9%	42,1%	100,0%	
Total		Count	17	17	34	
		% within problem 5: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value. There is no statistically significant difference between groups $p > 0,05$.

Table 7.60 : Problem 6

problem 6: Yes=1, No=2 * group (Shape or colour of the teeth)

			group		Total	P value
			Buccal	Lingual		
problem 6: Yes=1, No=2	yes	Count	2a	2a	4	1,000
		% within problem 6: Yes=1, No=2	50,0%	50,0%	100,0%	
	no	Count	15a	15a	30	
		% within problem 6: Yes=1, No=2	50,0%	50,0%	100,0%	
Total		Count	17	17	34	
		% within problem 6: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

Table 7.61 : Problem 7**problem 7: Yes=1, No=2 * group (Gap between the teeth)**

			group		Total	P value
			Buccal	Lingual		
problem 7: Yes=1, No=2	yes	Count	3 _a	4 _a	7	1,000
		% within problem 7: Yes=1, No=2	42,9%	57,1%	100,0%	
	no	Count	14 _a	13 _a	27	
		% within problem 7: Yes=1, No=2	51,9%	48,1%	100,0%	
Total		Count	17	17	34	
		% within problem 7: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$ **Table 7.62 : Problem 8****problem 8: Yes=1, No=2 * group (Missing teeth)**

			group		Total	P value
			Buccal	Lingual		
problem 8: Yes=1, No=2	no	Count	17 _a	17 _a	34	n.c
		% within problem 8: Yes=1, No=2	50,0%	50,0%	100,0%	
Total		Count	17	17	34	
		% within problem 8: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

n.c. not computed

Table 7.63 : Problem 9

problem 9: Yes=1, No=2 * group (Other reason)

			group		Total	P value
			Buccal	Lingual		
problem 9: Yes=1, No=2	no	Count	17 _a	17 _a	34	n.c
		% within problem 9: Yes=1, No=2	50,0%	50,0%	100,0%	
Total		Count	17	17	34	
		% within problem 9: Yes=1, No=2	50,0%	50,0%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

n.c. not computed

7.4.2 Separate questions

Table 7.64 : Expectation question

question about expectation: Yes=1, No=2 * group

				group		Total	pvalue
				Buccal	Lingual		
question about expectation: Yes=1, No=2	yes	Count	15 _a	16 _a	31	1,000	
		% within question about expectation: Yes=1, No=2	48,4%	51,6%	100,0%		
	no	Count	2 _a	1 _a	3		
		% within question about expectation: Yes=1, No=2	66,7%	33,3%	100,0%		
Total		Count	17	17	34		
		% within question about expectation: Yes=1, No=2	50,0%	50,0%	100,0%		
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.							

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$

T1: question 1 * group

Table 7.65 : T1-Q1

			group		Total	P value
			Buccal	Lingual		
T1: question 1	yes	Count	11 _a	9 _a	20	0,728
		% within T1: question 1	55,0%	45,0%	100,0%	
	no	Count	6 _a	7 _a	13	
		% within T1: question 1	46,2%	53,8%	100,0%	
Total		Count	17	16	33	
		% within T1: question 1	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value. There is no statistically significant difference between groups $p > 0,05$.

T1: question 2 * group

Table 7.66 : T1-Q2

			group		Total	P value
			Buccal	Lingual		
T1: question 2	yes	Count	0 _a	2 _a	2	0,227
		% within T1: question 2	0,0%	100,0%	100,0%	
	no	Count	17 _a	14 _a	31	
		% within T1: question 2	54,8%	45,2%	100,0%	
Total		Count	17	16	33	
		% within T1: question 2	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T1: question 3 * group

Table 7.67 : T1-Q3

			group		Total	P value
			Buccal	Lingual		
T1: question 3	yes	Count	11 _a	9 _a	20	0,728
		% within T1: question 3	55,0%	45,0%	100,0%	
	no	Count	6 _a	7 _a	13	
		% within T1: question 3	46,2%	53,8%	100,0%	
Total		Count	17	16	33	
		% within T1: question 3	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T2: question 1 * group

Table 7.68 : T2-Q1

			group		Total	P value
			Buccal	Lingual		
T2: question 1	yes	Count	10 _a	4 _b	14	0,080
		% within T2: question 1	71,4%	28,6%	100,0%	
	no	Count	7 _a	12 _b	19	
		% within T2: question 1	36,8%	63,2%	100,0%	
Total		Count	17	16	33	
		% within T2: question 1	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T2: question 2 * group

Table 7.69 : T2-Q2

			group		Total	P value
			Buccal	Lingual		
T2: question 2	yes	Count	1 _a	7 _b	8	0,017*
		% within T2: question 2	12,5%	87,5%	100,0%	
	no	Count	16 _a	9 _b	25	
		% within T2: question 2	64,0%	36,0%	100,0%	
Total		Count	17	16	33	
		% within T2: question 2	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is statistically significant difference between groups interms of T2 questions $p < 0,05$. Lingual group t2 question2 yes answer percent is greater than buccal group.

T2: question 3 * group

Table 7.70 : T2-Q3

			group		Total	P value
			Buccal	Lingual		
T2: question 3	yes	Count	10 _a	4 _b	14	0,08
		% within T2: question 3	71,4%	28,6%	100,0%	
	no	Count	7 _a	12 _b	19	
		% within T2: question 3	36,8%	63,2%	100,0%	
Total		Count	17	16	33	
		% within T2: question 3	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value.

There is no statistically significant difference between groups $p > 0,05$.

T3: question 1 * group

Table 7.71 : T3-Q1

			group		Total	P value
			Buccal	Lingual		
T3: question 1	yes	Count	7 _a	3 _a	10	0,259
		% within T3: question 1	70,0%	30,0%	100,0%	
	no	Count	10 _a	13 _a	23	
		% within T3: question 1	43,5%	56,5%	100,0%	
Total		Count	17	16	33	
		% within T3: question 1	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T3: question 2 * group

Table 7.72 : T3-Q2

			group		Total	P value
			Buccal	Lingual		
T3: question 2	yes	Count	5 _a	8 _a	13	0,296
		% within T3: question 2	38,5%	61,5%	100,0%	
	no	Count	12 _a	8 _a	20	
		% within T3: question 2	60,0%	40,0%	100,0%	
Total		Count	17	16	33	
		% within T3: question 2	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T3: question 3 * group

Table 7.73 : T3-Q3

			group		Total	P value
			Buccal	Lingual		
T3: question 3	yes	Count	6 _a	3 _a	9	0,438
		% within T3: question 3	66,7%	33,3%	100,0%	
	no	Count	11 _a	13 _a	24	
		% within T3: question 3	45,8%	54,2%	100,0%	
Total		Count	17	16	33	
		% within T3: question 3	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T4: question 1 * group

Table 7.74 : T4-Q1

			group		Total	P value
			Buccal	Lingual		
T4: question 1	yes	Count	4 _a	3 _a	7	1,000
		% within T4: question 1	57,1%	42,9%	100,0%	
	no	Count	13 _a	13 _a	26	
		% within T4: question 1	50,0%	50,0%	100,0%	
Total		Count	17	16	33	
		% within T4: question 1	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value. There is no statistically significant difference between groups $p > 0,05$.

T4: question 2 * group

Table 7.75 : T4-Q2

			group		Total	P value
			Buccal	Lingual		
T4: question 2	yes	Count	7 _a	8 _a	15	0,732
		% within T4: question 2	46,7%	53,3%	100,0%	
	no	Count	10 _a	8 _a	18	
		% within T4: question 2	55,6%	44,4%	100,0%	
Total		Count	17	16	33	
		% within T4: question 2	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

T4: question 3 * group

Table 7.76 : T4-Q3

			group		Total	P value
			Buccal	Lingual		
T4: question 3	yes	Count	4 _a	3 _a	7	1,000
		% within T4: question 3	57,1%	42,9%	100,0%	
	no	Count	13 _a	13 _a	26	
		% within T4: question 3	50,0%	50,0%	100,0%	
Total		Count	17	16	33	
		% within T4: question 3	51,5%	48,5%	100,0%	
Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the ,05 level.						

Fisher's Exact test p value

There is no statistically significant difference between groups $p > 0,05$.

7.4.3 Intergroup progress of bullying

7.4.3.1 Question 1

Table 7.77 : Intergroup progress of bullying- Q1

Frequencies				
group		Value		<i>P value</i>
		1	2	
Buccal	T1: question 1	11	6	0,002*
	T2: question 1	10	7	
	T3: question 1	7	10	
	T4: question 1	4	13	
Lingual	T1: question 1	9	7	0,001*
	T2: question 1	4	12	
	T3: question 1	3	13	
	T4: question 1	3	13	

Cohran's Q test p value. *p<0,05 statistically significant

There is statistically significant difference in time within each group p<0,05.

7.4.3.2 Question 2

Table 7.78 : Intergroup progress of bullying- Q1

Frequencies				
group		Value		P value
		1	2	
Buccal	T1: question 2	0	17	0,001*
	T2: question 2	1	16	
	T3: question 2	5	12	
	T4: question 2	7	10	
Lingual	T1: question 2	2	14	0,001*
	T2: question 2	7	9	
	T3: question 2	8	8	
	T4: question 2	8	8	

Cohran's Q test p value. * $p < 0,05$ statistically significant. There is statistically significant difference in time within each group $p < 0,05$.

7.4.3.3 Question 3

Table 7.79 : Intergroup progress of bullying- Q3

Frequencies				
group		Value		P value
		1	2	
Buccal	T1: question 3	11	6	0,001*
	T2: question 3	10	7	
	T3: question 3	6	11	
	T4: question 3	4	13	
Lingual	T1: question 3	9	7	0,001*
	T2: question 3	4	12	
	T3: question 3	3	13	
	T4: question 3	3	13	

Cohran's Q test p value. * $p < 0,05$ statistically significant.

There is statistically significant difference in time within each group $p < 0,05$.

8. DISCUSSION

8.1 Discussion of Aims

In the field of dentistry, greater attention has been paid to evaluating the relationship between the malocclusion and the patients' psychosocial impacts, owing to the fact that, dental aesthetics appears to have a substantial influence on the self esteem and quality of life of the individual. Poor dental aesthetics is known to be associated with lower self-esteem. During the recent years, the number of patients and especially the adults patients that seek for orthodontic treatment has arisen. Esthetic reasons are one the main reasons that explain this tendency, on the grounds that they have a significant influence on personal as well as on social relationships.

Conventional labial orthodontic appliances have been considered as unaesthetic by especially adult patients. Due to the aesthetic demands of the patients, lingual orthodontics has been introduced to overcome this drawback and has been used in a widespread manner in recent years. The growing interest for lingual orthodontics is also demonstrated in the literature. Publications related to lingual appliances mainly focused on oral impacts such as discomfort, pain in the tongue, speech difficulty, difficulty in maintaining oral hygiene compared to buccal appliances.

Therefore, in this comprehensive thesis study, our aim was to examine the changes that are associated not only with oral impacts, but also with the oral health related quality of life, self-esteem, and bullying among the patients receiving lingual and labial treatments, with the help of questionnaires.

8.2 Discussion of Material and Methods

The final sample, following power analysis and exclusion criteria, was 34 patients. All of the patients had Class I or very slight Class II with mild crowding. The main goal of orthodontic treatment was leveling and alignment of the dental arches in both groups. Therefore, patients having skeletal discrepancies were not preferred for the study. The sample consisted of 17 male and 17 female patients. The ages ranged from 12-30 years. There were no statistical differences in terms of gender and age in both groups.

The patients were randomly divided into two groups, according to their preferred treatment modality (buccal orthodontic treatment/2D lingual orthodontic treatment). Each time that a patient was coming, four questionnaires were delivered to him/her. These were the OHIP-14, Rosenberg Self-Esteem Scale, VAS questionnaire and a self-administered bullying-questionnaire.

During the initial 7 months of the treatments, the two treatment methods, in terms of the questions that are asked in the questionnaires, were compared. The increasing knowledge about OHRQoL has been a big advantage for dental research. It is shown by many studies that the commonly-occurring disorders have a significant impact on the social, functional and psychological well-being of the patients (Doğramacı and Brennan, 2019). The OHIP-14 is a well accepted, reliable method for measuring OHRQoL and demonstrated adequate cross-cultural consistency. The validated Turkish version of OHIP-14 Questionnaire is used in the current study. Rosenberg Self Esteem scale, which is a worldwide used measurement tool, was used in order to determine the self-esteem of the patients.

It is rather worrying that according to population-level results, subjective oral condition is not better in today's young patients compared to older generations, who experienced more noteworthy levels of oral-disease and when there was less exposure to the so-called preventive dental care.

Therefore, the use of "socio-dental indicators" may provide us with a measure of the benefits of the population, regarding the dental care. In principle, we can quantify the benefits of dental care and oral health by using collective measures of health. The

questionnaires that we used in our study are indeed such measures, however there seems to be some fundamental limitations.

First of all, the population's health is a measure which is characterized as contextual. As a result, it does not include only the aggregated health condition of individuals, as examined in our study.

A possible limitation of our study may be the subjective factor while filling out the questionnaires. The process depends on many other parameters, such as the compliance of the patients, their honesty, their emotional state at that specific moment and their accuracy of answering the questions. However, we took every effort to reduce the bias in our study, including a pilot test prior to the first 1.5 month, to make sure that our questionnaires were fully understood by the patients. Moreover, full explanations were given to our participants.

Furthermore, our participants were recruited from one university hospital and as a result do not reflect the occlusal characteristics of the population. The age range limited the socioeconomic background of our study. Therefore, it cannot be representative of all Turkish young adolescents of this age. This restricted representativeness, may reduce the generalization of our findings. Also, our study lasted 6-7 months which is generally not an adequate amount of time, if one aims to report general results to the broader public. There were very few questions and words, that synonyms were added to make their understanding easier for the patients.

In addition, we can claim that even though we have specific results from our study, the sociocultural context of one specific country (in our study Turkey), does not extend to the rest of the world as well. Therefore, this is another reason that limits our intention to generalize the findings. Another reason that we cannot transfer our findings to the general population and to the rest of the world, is that it was very difficult for us to have a control group with non-treated patients. The reason behind is that almost all of the orthodontic patients, are patients with malocclusion, who are seeking for a treatment to improve their oral condition. So, the shortage of a control group with non-treated patients might have an impact on the interpretation of our results, but this was something that unfortunately could not be avoided.

The treatment type was also taken into account, restricting the protocol to straight wire technique in order to achieve Class I Angle relationship. To have a better

uniformity of our results, all buccal patients had been bonded with the same Roth bracket 0.018” slot using direct protocol of bonding. However, the lingual bonding required an indirect protocol with the same bracket prescription for all the patients, a 2D Forestadent bracket. If a bracket failed or needed to be repositioned, it was replaced by the same kind of brackets as initially bonded. This is another factor that we should take into consideration. Bozelli et al, showed that the total time spent with the direct bonding technique compared to the indirect technique, was shorter, because the indirect technique included the laboratorial time. However, the clinical part took less time in the indirect bonding, which is actually what matters to us. (Bozelli *et al.*, 2013).

After the initial 6-7 month period finished and the patients completed filling the questionnaires, all the data was collected and analyzed statistically in order to obtain the final findings of our study. No other equipment needed during our study, no x-rays or photo/model analyses and no undesirable effects and risks may arise from participating in the research, since it was based absolutely on interpreting the results of our questionnaires.

8.3 Discussion of the Results

8.3.1 Discussion of OHRQoL results

8.3.1.1 General results

The oral health related quality of life is a concept which can be characterized as multidimensional and shows to what extent the oral disease may affect the individual's normal function.

In our study we measured the variation of OHIP-14 scores-and therefore the variation of QoL- in the two groups, throughout treatment. We found out that in the buccal group the OHIP-14 scores gradually decrease from T1 to T4. Consequently the

QoL of the buccal patients improves throughout treatment for the first 6 months of treatment. There is no improvement between the first and second appointment, whereas the better scores are obtained at the third appointment and after.

Regarding the lingual group, the OHIP-14 has upward tendencies during the first two appointments (3 months of treatment). So the quality of life of the lingual patients decreased during the first three months of treatment and then it is considerably improved. A possible explanation for this is that many daily activities, such as speaking eating are affected by the treatment and its impact, resulting in a poorer OHRQoL. Vanessa de Couto Nascimento *et al*, Chen *et al* and Palomares *et al*, in their studies, also concluded that the QoL of their patients was increased after orthodontic treatment. (Vanessa de Couto Nascimento *et al*, 2016)(Chen *et al*, 2012)(Palomares *et al*, 2014)

When we compare the lingual vs buccal at the same specific time intervals, we come to the conclusion that at the times of T2, T3, T4, the QoL of our buccal patients is better compared to the QoL of our lingual patients, which indicates the effectiveness of the buccal appliances at the early stages of treatment in terms of QoL. Interestingly, our results showed that there are no significant differences from from the third month, to the sixth month of treatment between two groups. So, regarding OHRQoL, later stages of leveling phase was not influenced from the treatment modality.

8.3.1.2 Intragroup comparisons - buccal / lingual group

In all single dt's we can see that our results are statistically significant. As a consequence we can claim that in our buccal group we don't have improvement in QoL between T1→T2 and T3→T4, whereas the QoL improves at : T1→T3, T1→T4, T2→T3, T3→T4.

So, we found that, from 1,5 months of orthodontic treatment to 4,5 and 6 months of treatment, QoL improved. Our results are in accordance with the results of De-Hua Zheng *et al*, who showed a significant improvement on QoL of the patients only after alignment and leveling (De-Hua Zheng *et al*, 2018). Our study disagrees with Mu

Chen *et al* and Ama Johal *et al*, who stated that there is a negative impact on the overall HRQoL during the first three months with a gradual return at 6 months, whereas we found that this negative impact exists only in the lingual group and the gradual return occurs directly after the 3 months (Mu Chen *et al.*, 2015)(Ama Johal *et al.*, 2015). Quite different was also the finding of the study of Daniela Feua *et al*, who showed that patients during treatment experienced worsened QoL, whereas we showed that especially after the third month, there is significant improvement of QoL of patients.

Under the same procedure, in our lingual group we have improvement in QoL at the dt's of: $T1 \rightarrow T4$, $T2 \rightarrow T4$, $T2 \rightarrow T3$, $T3 \rightarrow T4$. The patient profile of both groups may be quite different, being more demanding in the lingual group. This could explain why the OHRQoL of the patients in the buccal group was better than the patients in the lingual group at the initial stages. Moreover, the patients seeking lingual treatment generally get used to the braces in 3 months, which supports the results of this study.

8.3.1.3 Results of comparison in terms of OHIP-14 domains

In our study we also compared the two groups in terms of the 7 domains that the OHIP-14 is consisted of.

When it comes to domain 1 (functional limitation: speech and sense of taste), in the buccal group OHIP-14 scores decrease gradually during the first six months. . These results do not agree with the results of Zheng DH *et al*, who showed that functional limitation had no difference among patients in the leveling alignment period (Zheng DH *et al.*, 2018). However, in the lingual group, what we understood is that the functional limitation of our lingual patients got worse during the first three months and then it improved. Lingual appliances are associated with speech disturbances compared with labial appliances in the literature and patients with lingual braces are more likely to report a perception of articulation change (Slater RD.,2013). The results of this study are in accordance with the literature. The reason of the improvement of functional limitation after the third month might be because of the profile of the lingual

bracket, which in this case is a low profile bracket when compared with 3 dimensional lingual brackets in the market.

When it comes to domain 2 (physical pain), physical pain was reported to be at the highest level at T1 (1,5 month of treatment) and reduces gradually over time in both groups. Zheng DH *et al*, showed that physical pain had no difference among patients in the leveling alignment period with buccal treatment (Zheng DH *et al*., 2018). Pain is reported to be experienced more in lingual treatment compared to buccal treatment (Binhuwaishel and Al-Jewair, 2018). The OHIP-14 scores were higher in lingual group in this study, however the difference was small when compared with the buccal one. 2D lingual brackets are low-profile brackets, which interferes with the functional space of the tongue less, resulting in less discomfort. This might be the explanation of this result.

In psychological discomfort (domain 3), physical disability (domain 4) and psychological disability (domain 5), we have different findings among the two groups. In the buccal group, the scores were at the peak level at T1 and decreased during treatment. These results coincide with the results of a study, which showed that patients benefit in psychological discomfort, physical disability and psychological disability at the first stage of buccal orthodontic treatment (Zheng DH *et al*., 2018). As for lingual group, the scores were increased during the first three months and then decreased throughout leveling stage. The highest scores were found for physical disability domain (unsatisfactory diet, interrupting meals). These scores were highest at T1 and T2 and decreased during treatment. According to the literature, patients with lingual braces were significantly more likely to present eating difficulties than the patients with buccal braces (Madurantakam P and Kumar S., 2017). Possible explanations for this are; the restriction of the tongue space leading a discomfort on the tongue and posterior disocclusion created by the bite planes in most of the lingual cases.

Regarding the social disability (domain 6), in both groups the scores are increased during the first two appointments (three months) and then it decreased while treatment goes on.

Finally, handicap (domain 7), is improved in both groups throughout the first six months of treatment.

We can see that the greatest impact of malocclusion on HRQoL is located at the domain 2 (physical pain) and domain 4 (physical disability). However, Mu Chen *et al*, supported the theory that the greatest impact at buccal treatment group could be seen in the domain 3 (psychological discomfort) and domain 5 (psychological disability) (Mu Chen *et al.*, 2015).

8.3.2 Discussion of the Self-esteem Results

8.3.2.1 General results

In order to examine how the psychological health is affected by orthodontic treatment, we must take many intervening factors into account. One of these factors is self-esteem.

After comparing the Rosenberg self-esteem scale between the groups and within the groups, it is shown that in both groups the patients' score increase at each time interval. As a consequence the self-esteem of the patients increases and improves in both groups during our treatment period. There are conflicting studies regarding self-esteem measures following buccal orthodontic treatment in the literature. Pabari *et al* and Nascimento VC, found that self-esteem improved significantly during the first six months of treatment. (Pabari *et al.*, 2011, Nascimento VC., 2016).

On the other hand, Shaw *et al* showed that self-esteem was not affected during orthodontic treatment and supported that the benefits of orthodontic treatment can be realized on the long term and that there are many intervening factors that might also affect self-esteem. Yetkiner E *et al*, and Seehra *et al*, also claim that there was no significant change in self-esteem. In these studies it was mentioned as well that due to the lack of evidence that justifies the relationship between occlusal features and self-esteem and due to the relatively high self-esteem scores it was impossible to detect the difference in self-esteem pre- and post treatment. (Yetkiner E *et al.*, 2017)(Seejra *et al.*, 2011).

According to a study comparing psychological traits between labial and lingual orthodontic patients, patients receiving lingual orthodontic treatment may be more perfectionists than the labial orthodontic patients (Bellot-Arcis C *et al.*, 2019). Although lingual orthodontic patients may have higher expectations, in this study, the improvement of self-esteem of lingual patients throughout treatment was found similar when compared to the buccal orthodontic patients.

When comparing the self-esteem between the two groups at the same specific time, it is illustrated that there is no important difference that will make us claim that on treatment modality is better than the other at a specific time interval.

8.3.2.2 Intragroup comparison – buccal / lingual group

Both in buccal and lingual patients, the self-esteem is affected the same way during the first 6 months of treatment. The patients appear to have an improved self-esteem from T1→T4. During the first three months the patients do not have a so much improved self-esteem. However after they most probably see some first results of their treatment, their self-esteem tends to improve and we finally have improvement at T1→T3, T1→T4, T2→T4. We do not ever see a difference in self esteem between two consecutive time intervals, differences are spotted at the time difference of two appointments and more.

8.3.2.3 Intergroup comparison

We attempted to check the speed of change of self-esteem on buccal and lingual patients at specific time differences (dt's). It was found that the speed of self-esteem change is comparable at buccal and lingual patients. As a result, we cannot support that at a specific time, one treatment or the other, works better when it comes to self-esteem.

8.3.3 Discussion of Oral Health Impact Factors Results

8.3.3.1 General results

Both patients treated with buccal and lingual appliances reported oral disturbances. In general our lingual patients experienced more oral impacts during the first six months of treatment. The literature also supports similar results in many studies (Ata-Ali F. *et al.*, 2016). Wu A *et al* and Caniklioglu and Ozturk, demonstrated in their studies that, patients treated with lingual appliances reported more oral impacts than patients treated with labial appliances (Wu A *et al.*, 2011)(Caniklioglu and Ozturk, 2005). However, it should be mentioned that in the study of Wu A *et al*, the patients were treated with customized lingual appliances, something that may affect the oral impacts, since these are customly made for each tooth and this can affect some factors such as pain, chewing etc (Wu A *et al.*, 2011).

We did not find any oral impact that at any time interval was worse in buccal patients than in lingual patients.

More specifically, at T1 during the first 1,5 month, our lingual patients experienced more pain, chewing problems, speech problems, wounds, smell and taste problems. There were no significant differences in terms of sleeping problems, flossing, brushing and recommendation of treatment among buccal and lingual patients.

At T2 of treatment, which is the time between 1,5 and 3 months of treatment, there was not a big difference compared with T1. Apart from wounds that got improved and were now comparable between the two groups, lingual patients experienced the same worse impact factors as previously (pain, speech, chew, smell, taste). According to the literature, lingual patients are affected by more tongue wounds and irritation compared to the buccal patients, whereas injuries on the cheeks and lips are more evident in the buccal patients (Hu Longa *et al.*, 2013)(Papageorgiou SN *et al.*, 2016). Since the

tongue activity is continual, it is presumed to observe more wounds on the lingual side than the buccal. Until the third month of treatment, the wounds treated by lingual appliances were more, compared to the wounds treated by labial appliances, which agrees with the findings of Khattab TZ et al., who supported the same theory but for all the duration of treatment (Khattab TZ et al., 2013). However, in our study wounds that are caused after 3 months of treatment, are comparable between the two groups. It can be interpreted that, patients got used to lingual appliances at the third month of their treatment. Chewing problems in lingual patients were more severe at the third month, which agrees with the finding of Khattab TZ. *et al*, who pointed out the increased vertical height caused by the customized braces, as the reason for chewing problem. In our study we did not use customized lingual braces to increase the vertical height, but the bite was raised in almost every patient, so the result was the same. Canikioglu and Ozturk, stated that eating problems were solved after one month, but the duration was longer in our study (Caniklioglu and Ozturk, 2005).

While the treatment goes on, we see that oral impacts subside. After 4.5 months all of the oral impacts are at the same level between our buccal and lingual patients, except from speech problems and taste problems which are still worse in the lingual patients. On the other hand, Canikioglu and Ozturk, showed that speech problems disappeared just four weeks later in the labial patients and in the majority of lingual patients, whereas in our study speech problems were present until the sixth month of treatment in the lingual group. It should be kept in mind that, in this study, perception of articulation change of the patients was our finding, we have not performed any articulation tests by speech pathologists, nor sensitive analysis regarding speech, as done in the previous studies (Khattab TZ. *et al*., 2013). This could be the possible explanation of our findings at the sixth month in terms of speech disturbances. Our finding is also in contrast with the finding of Wu A. *et al*, who showed that after three months all the oral impacts were comparable among buccal and lingual patients.

Furthermore, at our last appointment we monitored that the only impact factor that was still worse in lingual patients, was the speaking disorders. This made speech problems the worse oral impact factor in lingual patients compared with the buccal ones, exactly like Wu A. *et al*, and Caniklioglu and Ozturk proved (Wu A *et al*., 2011)(Caniklioglu and Ozturk, 2005).

Good brushing and flossing, were factors that had comparable results between the two groups, so both groups could achieve same level of oral hygiene. Finally, our “recommendation of treatment” levels are getting improved and have relatively high scores during our treatment, reaching 90% of satisfaction. This agrees with the finding of Nascimento VC, who pointed out that all patients would recommend the treatment to other people that had similar problems (Nascimento VC., 2016).

8.3.3.2 Intragroup time effects

Almost all the oral impacts ameliorate during treatment. In particular, pain, speech, chewing, sleeping, wounds, smell, taste, brushing and recommendation of treatment, report significant improvement. Wu A. *et al*, Polat and Karaman, showed also that pain decreased for both labial and lingual appliance wearers (Wu A. *et al* (2011),(Polat and Karaman (2005)). This has more than one explanations, either the patients are adapted to the appliances or the later stages of treatment include less painful procedures.

The only factor that we cannot come to a conclusion about, is the use of dental floss, which gets improved in buccal patients but in lingual patients, most probably owing to the difficulty of using the floss with the brackets being at the inner part of the teeth, there is no significant difference during treatment.

8.3.3.3 Intergroup differences in time periods

When we examine each one of the oral impacts, we can deduce that in most of the time periods, the amount of improvement of each factor in lingual patients is more significant than the amount of improvement of this specific oral factor in buccal

patients. In particular, it is shown that regarding the pain, chewing, smell and taste, whenever there is improvement according to the patients' answers, the improvement is more significant in the lingual patients. This might be explained from the fact that lingual patients experience more oral impacts in the beginning, so there is bigger allowance for improvement. Another explanation is that due to the fast leveling and alignment at lingual patients and due to the invisibility of the treatment, the patients are happy and more satisfied about their treatment (since self-esteem and psychology also improves) and because of this they tend to "forget" their actual treatment problems. Regarding the oral impacts of speech, wounds, floss, brushing, it is seen that we have a uniform improvement in the two groups.

Special attention should be paid to the oral impact of sleeping where the improvement is not uniform. At T1→T2 there is bigger improvement in buccal patients, whereas at T2→T3 there is bigger improvement in lingual patients. This can be explained by the fact that initially until the first appointment (T1), the buccal patients are not still used to their braces and while sleeping they are annoyed by the presence of them and the wounds at their cheeks that are in contact with the pillow. So, the negative scores allow better improvement at that time (T1→T2).

8.3.4 Discussion of Bullying

The mean age of our patients to be examined was 15.38 years and it was found that there is no statistically significant difference between groups in terms of gender ($p>0.05$). As a consequence we can say that our results can be applied to both genders. This age is very close to the age of 14.6 years, which is the age when bullying episodes are most often reported in school (Boulton and Underwood, 1992).

In our study we found that 68% of our patients (23/34) had received bullying in the past. 20 out of these 23 patients (87%) had received bullying about teeth/chin. Among the most reported problems related to teeth/chin was "crooked teeth" with 75% (15/20 patients) and this is highlighted by Kerosuo *et al*, who supported that

individuals with normal alignment are considered to be more preferable as friends and of better social class compared with others with a malocclusion (Kerosuo *et al.*, 1995).

Second most reported problem was “upper front teeth sticking out” with 55% (11/20 patients) and “gap between the teeth” with 35% (7/20 patients). However, these results are not statistically important so they cannot be concluded as official and tested results and they cannot be generalized. On the other hand, important were the results of Al-Bitar ZB *et al.*, who claimed that the three most commonly reported features that were targeted were spacing, shape/color of teeth and overjet (Al-Bitar *et al.*, 2013). With respect to the first question that was asked to the patients each time that they were coming to their appointments, it is shown that at both groups throughout the first six months of treatment, fewer and fewer patients report bullying. As a result, it can be understood that orthodontic treatment might play an important role to the reduction of the pre-existing bullying. The same was also shown in the study of Sehra *et al.*, who argued that 78% of the patients reported less frequency of bullying, during and after orthodontic treatment and as a result came to the conclusion that participants that received orthodontic treatment had an important reduction in bullying. The explanation to this is rather complex and is related to many factors that act synergistically. Probably bullied children see the other results of their treatment that distract the other’s attention away from their problems, but also they feel like “normal” and equal to their peers. Bernabé *et al.*, showed that QoL of patients is improved after orthodontic treatment and Sehra *et al.*, showed that patients that were bullied because of their malocclusion had low self-esteem and low QoL (Bernabé *et al.*, 2008)(Sehra *et al.*, 2011a).

The only statistically significant difference between buccal and lingual patients, was detected to be at T2 (3 months of treatment) at question 2 (“Do you feel that orthodontic treatment contributed to the reduction of bullying after placement of the braces?”) $p < 0,05$. The lingual group T2-question2 “yes” answer percent, is greater than buccal group’s. This indicates that at T2, significantly more lingual than buccal patients replied that after 3 months treatment, the bullying levels decreased. This is indicative of the importance of the invisibility of lingual treatment and of the possibly fast alignment results that lingual treatment might have.

When the patients were asked if they believe that orthodontic treatment will contribute to the reduction of bullying, more and more patients at both groups during treatment were saying that they are optimistic about the effectiveness of orthodontic treatment on the existing bullying that they received.

At last, when patients were asked about their opinion regarding the bullying levels after the completion of their treatment, it could be seen that they have high expectations about the stability of the treatment results relatively to bullying.



9. CONCLUSIONS

- Both patients treated with labial and lingual fixed orthodontic appliances, had improved QoL at the end of the treatment period. The lingual appliances resulted in deterioration of QoL at the first three months, but then improved. Throughout treatment, labial orthodontic appliances proved to be more effective in terms of QoL.
- Both patients treated with labial and lingual fixed orthodontic appliances, had improved self-esteem at the end of our treatment period and none of the two appliances proved more effective than the other, in terms of self-esteem.
- Both patients treated with labial and lingual fixed orthodontic appliances, reported significant levels of oral impacts, however, the lingual patients experienced more, with speech problems being the most persistent symptom.
- At both groups, orthodontic treatment resulted in fewer bullying episodes at patients that were bullied before. Nevertheless, more research and longitudinal studies need to be conducted about this topic.

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11. CURRICULUM VITAE

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Educational Level

	Name of the Institution where he/she was graduated	Graduation year
Undergraduate	Aristotle University of Thessaloniki, Greece	2015
High school	2 nd high school of Drama, Greece	2008

Job Experience

	Duty	Institution	Duration (Year - Year)
1	General Dentist	Private dental clinic, Germany	04/2015 - 08/2015

Foreign Languages	Reading comprehension	Speaking*	Writing*
English	C2	C2	C2
German	C1	C1	C1

Foreign Language Examination Grade[#]								
YDS	ÜDS	IELTS	TOEFL IBT	TOEFL PBT	TOEFL CBT	FCE	CAE	CPE
			103					

Computer Knowledge

Program	Use proficiency
ECDL Core	Excellent



T.C.
MARMARA ÜNİVERSİTESİ
Diş Hekimliği Fakültesi
Klinik Araştırmalar Etik Kurulu

Projenin Adı: Oral health related quality of life, self esteem and bullying among patients receiving orthodontic treatment; comparison between labial and 2D-lingual fixed orthodontic appliances
Proje yürütücüsü: Doç. Dr. Çağla ŞAR
Projedeki Araştırmacılar: Dt. Nicolaos KARPİTSARİS
Onay tarihi ve sayısı: 28.06.2018, 2018-210

Sayın Doç. Dr. Çağla ŞAR

2018-219 Protokol nolu "Oral health related quality of life, self esteem and bullying among patients receiving orthodontic treatment; comparison between labial and 2D-lingual fixed orthodontic appliances " isimli anket çalışmanız Marmara Üniversitesi Klinik Araştırmalar Etik kurulu tarafından incelenmiş ve etik yönden uygunluğuna karar verilmiştir.

M.Ü. Diş Hekimliği Fakültesi
Klinik Araştırmalar Etik Kurulu Başkanı

Prof. Dr. Nimet Gençoglu

Adı Soyadı

Prof. Dr. Nimet Gençoglu

Prof. Dr. İlknur Tanboğa

Prof. Dr. Ali Recai Menteş

Prof. Dr. Yaşar Özkan

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Oral health related quality of life, psychosocial effects and self-esteem among patients receiving orthodontic treatment, comparison between labial and 2D-lingual fixed orthodontic appliances: Case Report

Karpitsaris Nikolaos
Marmara University of Istanbul, Turkey

Statement of the Problem: In recent years, the percentage of adult orthodontic patients has arisen. Adult patients prefer lingual braces more than the labial ones due to esthetic reasons. Lingual appliances can be comparable with labial appliances.

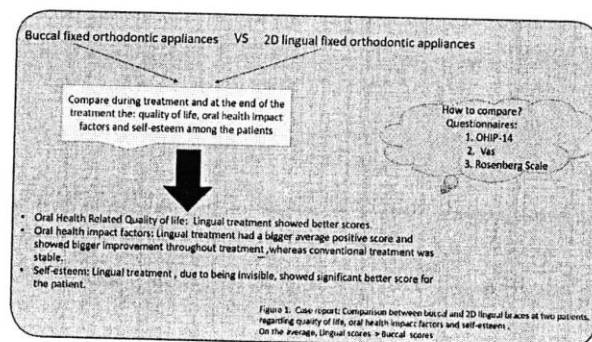
Aim: Among patients receiving lingual and labial orthodontic treatment, we aim to investigate the: changes related to "oral health related quality of life", changes related to "self-esteem" and oral impacts during treatment.

Case: A pair of female adults (twins) were referred to our clinic with same chief complaints of minor crowding and unesthetic smile. They had no medical history. Examination revealed skeletal Class I relationship, normal profile and minor crowding in both arches. One of them underwent orthodontic treatment with buccal fixed orthodontic appliances. The other had orthodontic treatment with 2D lingual fixed orthodontic-appliances.

Materials and Methods: Our case is based on questionnaires being delivered to the patient at every appointment. Three proven and valid questionnaires were delivered: Ohip-14, Rosenberg Self-Esteem Scale, VAS. Their answers were used to quantify the differences between the two different treatment modalities throughout treatment.

Result: Esthetically pleasing and ideal dental and skeletal occlusion was achieved in both cases. The patient with the lingual treatment showed better response regarding his quality of life and psychology.

Conclusion: This case shows a successful orthodontic treatment plan in both methods, with the lingual treatment playing a truly important role in the patient's everyday life and psychology.



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1. Jung MH. An evaluation of self-esteem and quality of life in orthodontic patients: effects of crowding and protrusion. Angle Orthod. 2015; 85:812-819.
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Biography

Karpitsaris Nikolaos is a postgraduate student, currently final year resident at the department of Orthodontics, Marmara University of Istanbul. He graduated from Aristotle university of Thessaloniki and worked in dental clinics in Greece and Germany as a general dentist before choosing the path of Orthodontics. He believes that a perfect smile is the prettiest thing you can wear. His main interests include lingual orthodontics, orthognathic surgeries and modern treatment modalities.

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Notes: