International Journal of Innovation and Research in Educational Sciences
Volume 5, Issue 3, ISSN (Online) : 2349–5219

Braces- Another Way of Treatment of Dentofacial and Maxillofacial Deformities

Ani Atanasova Atanasova[1*] and Mihaela Atanasova Varneva[2]
*Corresponding author email id: a.ani@mail.bg

Date of publication (dd/mm/yyyy): 15/05/2018

***Abstract* – Orthodontic treatment is an investment both in our teeth's and in our body's health. Over-crowding of teeth and abnormal bite lead to dental bone loss, gum withdrawal, dental cavities, tooth abrasion, teeth loss, discomfort and jaw joint pain. The potential of orthodontic practices in children, adolescents and adults treatment is constantly expanding regarding the correction of dentofacial and maxillofacial deformities through using differently fixed orthodontic appliances on the oral carriage. It's never too late for a brackets treatment. However, treatment at younger age (up to 18) goes more easily. As for adults, since their bones don't grow any longer, it might take a longer period of time. According to which dental surface the braces are fixed to, they can be divided into internal lingual braces and vestibular external braces. According to the material they are made from, braces can be metal, aesthetic and semi-aesthetic braces. Among them, there is no difference in the quality of treatment and in the final results. Braces do not cause teeth and gum diseases. Problems appear when food is stuck around them and it isn't being cleaned well.**

***Keywords* – Age, Clinical Features, Contradictions, Oral Hygiene, Orthodontic Treatment, Types of Braces.**

One of the most ancient scientific fields is medicine. It arises at the very dawn of mankind and follows the evolution of human society, science and technical progress. In the shadow of general medicine, the significance of dental medicine remained modest for a long period. Dental science acquired its state later, in other historical times, as its separate disciplines have developed asynchronously, according to practical needs and applied science [17], [8], [7].

Ever since ancient times, the social character of human existence has enforced the search of ways and means of restoration, substitution and arrangement of front teeth upon aesthetic basis [16], [17].

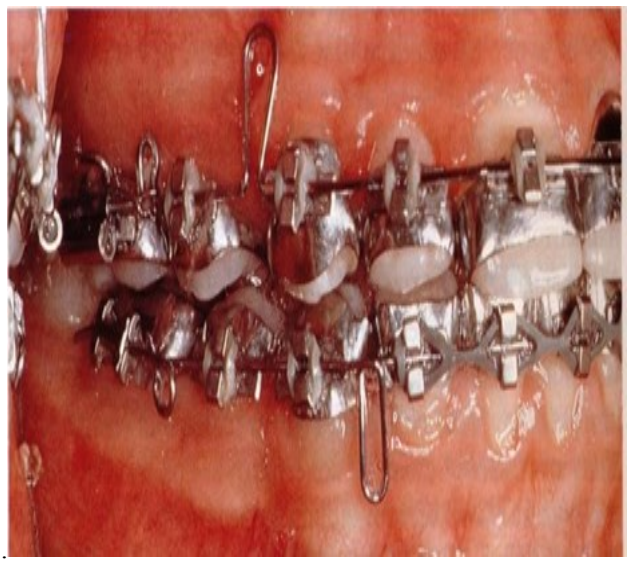
Either today and in the past, a special attention has been paid to appearance and mainly to the beautiful smile. Our smile is our visit card and one of the factors defining our self-confidence and the freedom to communicate with the outer world. Orthodontic treatment gives us more than just a pretty smile- it is an investment in the health of our teeth and body. Over-crowded teeth and abnormal bite lead to dental bone loss, gum withdrawal, dental cavities, tooth abrasion, teeth loss, discomfort and jaw joint pain. Abnormal bite obstructs chewing of food and digestive disorders occur [11], [19].

With the development of material knowledge and new technologies, the potential of orthodontic practices is being expanded with regard to children, adolescents and adults treatment for correction of dentofacial and maxillofacial deformities through using non-removable vestibular Edgewise technique and lingual technique, as well as other orthodontic appliances [6]. With the help of fixed appliances the occlusion on the three plates (sagittal, transverse and horizontal) can be corrected and age is not a contraindication to withhold orthodontic treatment [21]. Brackets treatment can be conducted after the permanent teeth eruption till the age when there are still existent teeth and the jawbone structure is preserved [11], [19].

In orthodontic treatment a basic principle is the force impact upon the structures which continues until the changes in the value of the parameters of the structures reach morphological rate [18].

Precise treatment, putting together the proper personal plan for treatment, and its accurate execution from the whole team, lead to expectedly high results [21]. Two types of orthodontic appliances are used for teeth alignment and for improving teeth proportions- removable and fixed (non-removable). Teeth alignment and improved teeth proportions can be achieved at any age [11], [19].

Contemporary multi- ligature-tied appliances originate from Angle's universal appliance [5], [9], [13], [26]. Between 1925 and 1928, Edward Angle (called the "father of orthodontics"), created the Edgewise technique [12], [26]. He introduced bends to the rectangular arch wire and rings on each tooth, instead of an arch with a round section and bearing molar bands [4]. This technique allows three planes control over each tooth, tooth segmentation or over the whole dental arch [5], [9]. The term "Edgewise" means "attached in the direction of the edge" and consists of an arch wire with a rectangular cut, which goes into a horizontal slot in brackets (literally translated as locks) with its narrow side. When the size of the arch wire is close to the slot size, on the condition of a proper bending, the arch wire allows tooth movement in all 3 planes of space [12].



Picture 1. Brackets Edgewise technique [1]

Picture 2. Initial stage of treatment by the method of Begg, requiring multiple bending of the arch wire [1]

Half of a century later, Andrews invents the Straight-wire technique, which sets the beginning of a new revolutionary foundation in the development of fixed appliances. The information about the three-dimensional position of each tooth is encoded in the bracket itself. The wire arches are straight, with a lack of additional bends which facilitates the practice and leads to an even progressive movement of the teeth in the desired direction [1], [5], [9].

The materials used for the manufacturing of the brackets must fulfill certain conditions. Being hygienic, non toxic, rot-resistant, aesthetical, non-water absorbent are basic requirement for brackets. It is very important that they do not change their colour under the influence of the oral fluids and have a minimal friction between the brackets and the wire arch. And at last but not the least, of course, these materials must be resistant to the forces which wire arches exert upon them [20].

Brackets are small "locks" which are passive and glued to each tooth surface by photopolymer adhesive. In each "lock" there is a slot through which goes an elastic ligature - a source of power. The ligature has initial starting position it tries constantly to restore and by doing this, changes the position of the tooth to which it is bonded- it can push, pull or turn the tooth. The width and the cross-sections are various - thin, less wide, wider, round, rectangular, square, changeable at the different stages of the treatment, defined by the desired movement [19]. The bracket passes through the force impact of the ligament to the tooth [2].

According to which dental surface the braces are fixed to, they can be divided into internal lingual braces and vestibular external braces. According to the material they are made from, braces can be metal, aesthetic and semi-aesthetic braces. Among them there is no difference in the quality of treatment and in the final results (patients' choice).

Metal braces are one of the most popular types and are exceptionally strong. They are made from different base alloys, but they can also be golden or silver.

17-4 stainless steel is used as a material for manufacturing of braces because its physical characteristics exceed all other previously used types of steel. In the fixation of the braces, it is important that the force of friction with the tooth surface is strong/hard enough so as to guarantee the whole period of treatment and weak enough so as not to cause any damage to the tooth enamel while being removed [2].

Aesthetic braces are made from composite material. They are less noticeable, because they are clear and blend with the tooth colour. They can be ceramic, sapphire and fiberglass [19].

Pictures 3 and 4. Vestibular metal and aesthetic braces [19], [27].

One of the main mistakes of dental doctors is the usage of ceramic braces as well as metal ones, without recognizing the fact that ceramics is strong but fragile material. There are multiple registered cases of broken braces. In order to avoid this, manufacturers develop titanium arches which apply weaker force compared to the steel arches. Titanium arches are significantly softer to the ceramic braces and can be used during the whole treatment period. Nickel titanium, copper nickel titanium and beta titanium arches (TMA®) are recommended especially for ceramic braces. All ceramic braces are made from aluminum oxide which is the second strongest material after diamond and considerably harder than tooth enamel. Ceramic braces fixed to the mandibular dental arch may cause erosion of the tooth enamel of the maxillary arch. If patients are thoroughly informed about the potential risks, the usually agree with metal braces for their lower jaw. It happens especially in the cases when patients are explained that actually braces won't be visible while they speak.

When sapphire braces Starfire® (monocrystalline aluminium) appeared on the market, dental doctors highly appreciated the aesthetics of the monocrystalline material, but they also often encountered destruction and breakage of braces, due to constructional defects [15].

Picture 5. Sapphire braces fixed on the superior dental arch [27]

Learning their lessons from the past, manufacturers develop Inspire™ braces. They are a kind of evolution in technology and go back to the mid 80ies of the last century. They appear on the market as a result of a 15-year research, along with gaining experience and advancing in their work with ceramics and orthodontic technologies. Synthetic sapphire is produced by extracting monocrystalline solid from ultrapure agglomerated aluminium oxide. Since 1984 we have witnessed several braces constructions made from mono- and polycrystalline aluminium oxide [15].

In Semi-aesthetic braces the upper part is ceramic and hardly noticeable and the lower one is made from metal. This makes them look optically smaller than the other types of braces [19].

In practice, various types of systems are known. Recently, the Damon system has increased in popularity due to its new conception for orthodontic treatment. It consists of passive, self-ligating brackets with small sliding doors and high-technological wire arches. The information is laid down both in the brackets and in the wire arches. No elastic o-rings are required to hold the wires in place. The sliding doors can be opened easily and quickly by a special instrument. Wires freely slide through the slots like in a pipe which keeps friction to a minimum. Low biological forces move the teeth rapidly and tightly enabling facial and tongue muscles to support the treatment process. The best advantage of this system is, with very few exceptions, that it is not necessary to extract healthy teeth or to wear extra oral appliances, trans palatal arches or other additional appliances.

- Damon Q – a metal version, latest generation- small, comfortable, effective.
- Damon Clear – retaining all of the treatment quality characteristics of the Damon Q, combined with an exquisite design and aesthetics- made from polycrystalline alumina [22].

Lingual braces are placed on the inner side of the teeth and are nearly invisible to the other people. They are usually metal [19]. The first information about the lingual technique came to Europe in 1982. The advantage of this system is its invisibility and therefore, the unspoiled aesthetics of one's face and smile. In the beginning of the 70ies of the 20-th century, Craven Kurz, by that time being an associate at UCLA School of Dentistry, concludes that most of his patients are mainly older people, public figures, to whom aesthetics has a leading role. With a lot of help from his colleagues, he developed the first lingual appliance, which consisted of plastic brackets Lee Fisher fixed on the surface of the front teeth, and of metal brackets, fixed on the surface of molars and premolars. It is stated that this new technology has some disadvantages but it raises great interest among dental doctors. Along with his team, Craven Kurz continues improving his creation up until November 15-th 1976, when he patents his product as the Cruz Lingual Appliances [5], [10].

The usage of the lingual technique reduces the risk of tooth decay processes on the vestibular surfaces of the teeth [6]. Some of the trademarks related to this technique are: Incognito®, iBraces® (by 3M), In-Ovation® L (by Dentsply), Harmony® (by American Orthodontics), Orapix [5]. Their aesthetic appearance is very good but cleaning occurs to be rather difficult [19].

Pictures 6 and 7. Usage of the lingual technique- a patient before and after a 6- month course of treatment [5, 24].

The Orapix system is the first system of the type which transforms dental impressions and dental casts into 3-D digital information. With the help of Doctor Didier Fillion, Orapix develops and improves the lingual orthodontics. It makes possible the positioning of braces on a completely individualized virtual set-up and the making of transfer jigs (keys) with the CAD/CAM technology. The system can be used in any orthodontic treatment (patients' age being irrelevant) and in any type of fixed appliance technique (labial or lingual). It allows the application of straight wire arches without any additional bending, thus significantly facilitating orthodontists' work. The system is organized in several directions. Owing to a high-technological scanner, models are scanned in 3-D. The visualization software includes instruments facilitating the measurements and the diagnostics. The possible 3-D visualization of the models further supports the practice of diagnosis and gives patients

the opportunity to see in advance the final result of their treatment [5], [3].

Allergies are a problem that might occur with the braces placement. Some people are allergic to nickel which is used in some of the models. Other patients experience latex allergy and latex may also be used by orthodontists.

When any type of allergy or sensitivity towards any substance is present, the treating orthodontist must be informed indispensably. There is always a possibility alternative product to be used thus avoiding further complications that might arise. The orthodontist must also be informed providing fixed braces have caused aphtha or if symptoms of heavy breathing have appeared, as well as rashes or swelling. In the case of allergic reaction, the patient has to be immediately directed towards the nearest hospital, or if necessary, emergency medical aid must be called. Those kinds of symptoms are a serious problem. Severe allergic reaction can kill a person in a few minutes [14].

It is never too late for an orthodontic braces treatment. However, treatment at younger age (up to18) is characterized with a shorter duration while the jaw bones are still growing. As for adults, their bones don't grow anymore and treatment can take more time. Apart from the age, it lasts between 18 and 24 months, depending on each particular case.

Adult patients who undertake such treatment can be divided into two groups:

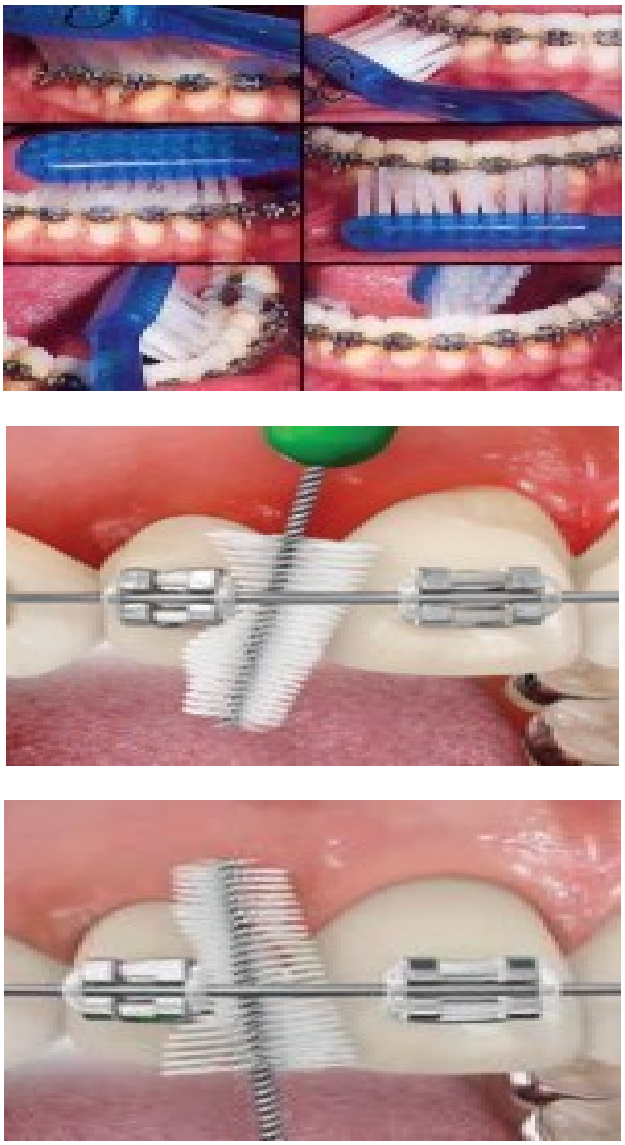
- First group- people between 20 and 35 years old who haven't been treated as children
- Second group - people, often over 40 years old with whom orthodontic treatment is a part of a complex treatment. The main purpose of the orthodontic stage in the whole full mouth rehabilitation process is the correction of the position of crooked and misaligned teeth (including protruded teeth) after a tooth extraction or after bone loss in order to: subsequently place functionally suitable and aesthetic protective constructions (for instance dental crowns, tooth bridges); provide the possibility of implants placement (which require freed space in the dental arch); successfully stabilize teeth by dental splint (in cases of periodontitis disease) [21].

Contraindication for treatment is the presence of periodontitis and bleeding gums. Before the braces are attached, good periodontal health must be achieved. Braces themselves cause discomfort. However it is surmountable. At the beginning patients should get used to the new lay out of their teeth. If braces are attached on the frontal tooth surface, they irritate the lips and if they are placed on the inner surfaces they provoke the tongue.

Patients treated with braces have to know the following things:

- All hard food should be cut into pieces before consuming it- apples, carrots, toasts, chocolate;
- Cherries, olives, peaches, apricots should be consumed after removing the stones;
- No chewing gums are allowed;
- It is recommended that patients avoid consuming big nuts almond and hazelnut), as well as seeds and popcorn.

Braces themselves are not the reason patients to develop dental and gum diseases. Problems appear when food gets lodged in and around them and it isn't cleaned out properly. When patients don't remove the lodged food, the potential risk of tooth decay raises multiple times. It is recommended that after each meal the mouth is rinsed with water in order to get rid of the bigger parts of the food which has remained between the teeth and around the braces. In general, teeth should be thoroughly cleaned twice a day (in the morning and in the evening) with fluoride toothpaste. A soft toothbrush should be used; it should be held at a 45°angle towards the surface of the teeth. Brushing starts from the space between the gums and the wire arch. Interdental cleaner (floss) and antiseptic mouth rinse are strongly recommended for usage. Once in every six months a professional cleaning is executed by the treating orthodontist.



Pictures 8-10. Cleaning of teeth and achieving the perfect oral hygiene [25]

If patients maintain perfect oral hygiene no inflammation or cavity processes will be registered [19].

Important conditions for a successful orthodontic treatment are:

- Regular visits to the orthodontist's.
- Information for patients about the duration of the treatment even before its beginning,
- Encouraging patients' motivation during the whole period.
- Cooperation from the patient's side which is a very important factor.

Braces are removed after achieving the desired treatment outcome.

Picture 11. Special plastic debonding *pliers* in the *removalofceramic brackets* [15]

Hard ceramic braces, compared to metal ones, offer a challenge to dental doctors with the hard task to remove them after the end of the treatment. Metal brackets contain stronger components and allow an easy, fast and non-traumatic removal. General practice gradually rejects older technologies of ceramic braces which require chemical bonding between the base and the tooth surface and may lead to damages on the tooth enamel and to braces breakage while being removed. 'Inspire' is a debonding technique in the removal of braces which emphasizes on the special surface of the base and on the usage of special plastic pliers, designed to assemble and distribute the forces, stirring in the removal process while the surfaces bracket/material are being separated [15].

Once treatment is completed, it is necessary that some dental retainers be created in order to retain the achieved position (to prevent the risk of relapse). Such dental retainers are lingual plates, silicone splints, etc. [19].

The great diversity of orthodontic cases with regard to the etiology and the pathogenesis of the development of deformities demands an individual approach in the choice of a therapy [16].

Nowadays, braces are getting smaller and more aesthetic-orientated. They are an alternative way of treating dentofacial and maxillofacial deformities. The development of techniques and systems follow the evolution of science and technologies thus improving the aesthetic qualities and gives more and more patients the opportunity to receive treatment and even to those of them who don't want orthodontic appliances to disrupt their social contacts.

The choice of a proper orthodontic treatment is determined by several factors. It should be made along with the patients and their parents/ partners and it is necessary that it is compliant with the patient's age, profession, social activity and the extent of the dentofacial deformity. Increasingly number of patients at older age realizes and admits the need of some kind of orthodontic treatment, which they have not undertaken earlier, whereas braces appear to be the only way of treatment for them.

In order to define the advantages and disadvantages of the types of braces described in this article, we are planning to conduct elaborate researches amongst dental doctors and patients with the purpose to determine: the portion of patients who unconditionally need braces treatment; the determining factors (age, extent of maxillofacial and dentofacial deformities, patients' preferences, etc.); the types of braces used more commonly by orthodontic specialists (aesthetic, metal, vestibular, lingual or various combinations of those); the methods used when braces are being put on (direct or indirect); the presence of complaints on the patients' behalf during their orthodontic treatment.

Orthodontic science and practice is on a high level in Bulgaria and Bulgarian orthodontic specialists actively participate in world conferences where the newest and most modern orthodontic techniques and trends are presented. The very fact that Orthodontics is constantly developing indicates the need of further research in that area of knowledge.

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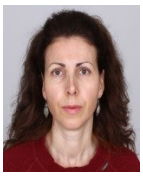

Ani Atanasova Born in the town of Provadiya, Republic of Bulgaria on March 11-th 1974. In 1994 she graduates Medical College- Varna, obtaining her college degree with specialty 'Dental technician'. From 1997 to 2003 she studies for a Master's degree in 'Health management' at Medical University of Varna. In 2013 she obtains a Master's degree in 'Management of health care' at Medical University of Varna. From 1994 to 2013 she works as dental technician in Independent medical technical laboratory. From 2013 till now she participates in the practical tutoring of students in 'Dental technician' at Medical College of Varna, a part of Medical University of Varna. She teaches Orthodontics, Maxillofacial prosthetics, Technology of dental prosthesis, Anatomy and morphology of teeth. She is the author of over 20 scientific publications. She has attended 5 scientific conferences and over 10 professional courses in Orthodontics, as well as in the field of management and pedagogy. Her previous and present research interests are in the following spheres: orthodontic techniques, orthodontics, maxillofacial prosthesis, technology of dental prosthesis, historical evolution of dental medicine and orthodontics, human resources management in dental technician laboratories.

Michaela Varneva, Ph.D. Born in the town of Varna, Bulgaria, on November 16-th, 1963. She has very rich teaching experience of over 31 years which is connected with tutoring 'Dental technician' students and it starts in 1986 as a practice teacher in Orthodontics and Maxillofacial prosthesis at Medical college of Varna. In 2013 she obtains her Doctor's degree after defending her dissertation: 'Retrospection, analysis and socio-psychological problems in the education and professional realization of 'Professional Bachelor' in the specialty 'Dental Technician' at Medical University-Varna. After winning a contest, in 2015 she is assigned as Associate professor at Medical college of Varna in its educational sector 'Dental technician'. From November 2015, she is a member of the faculty team of Dental medicine at Medical University-Varna and teaches Orthodontics and Maxillofacial prosthesis to 'Dental technician' students in Medical College of Varna. She is the author of over 79 scientific pieces of work and publications and currently she has 40 citations of authors in the Republic of Bulgaria. She possesses two 'useful models', registered at the Patent office of Republic of Bulgaria (№ BG 2145 и № BG 2705) in 2015 and 2017. She is the author of the following books: Varneva, M., Dental technician (now and then), Slavena, Varna), 2014; Varneva, M., Teaching aids for college applicants, Inventive, Varna, 2015; Varneva, M., Teaching aids for practice on anatomy and morphology of teeth by drawing, sculpturing and modeling for 'Dental technician' students, Inventive, Varna, 2015. Her previous and ongoing interests of research are in the field of Dental technician (practice and teaching), Orthodontics, Maxillofacial prosthetics, History of dental medicine and dental technician practice and education. With an order by the Rector of Medical University - Varna, in 2016 and 2018 is assigned to be a part of the jury of scientists who award scientific degrees 'Doctor' and 'Associate professor'. She is a recensor of the monograph by M.Milev 'Aesthetics in contemporary dental medicine through the sight of the dental technician', 2017. She is a member of the General Assembly of Medical College-Varna and of the Dental faculty of Medical University of Varna - both main managerial departments in the university. She has received two awards from the management of Medical College and Medical University of Varna: a Diploma of honour for exceptional merits towards the development of Medical College of Varna, 2017 and a Diploma of honour for contribution to scientific activities, 2017.