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Dentistry & Otolaryngology

Effect of Sodium Ascorbate

Periodontal Muscle Training

Highlights

Vitro Comparison of Friction

Overview of Surgical Treatment

Discovering Thoughts, Inventing Future

VOLUME 17 ISSUE 2 VERSION 1.0

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Dentistry and Otolaryngology

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Prosthetic Rehabilitation of a Patient with Alzheimers Disease using a Combined Ball, Bar and Clip Retained Implant Supported Overdenture: A Case Report

By David Charles. P & Anusha Sreedharan
David's Dental Care

Introduction- Alzheimer's disease (AD) is a progressive degenerative disease that affects the cognitive skills of an individual. It is a type of dementia which causes difficulty in orientation, emotional instability, loss of abstract thinking, motor skills and personal care.

The common clinical symptoms of the disease are aphasia (loss of the ability to use speech and language), apraxia (loss of ability to perform learned and familiar movements), visual agnosia (inability to recognize familiar visual stimuli) and memory disorders1. The individual affected with AD tend to have coated hairy tongue, angular cheilitis, ulcerations, caries, periodontitis and finally tooth loss due to poor oral hygiene maintenance.

Due to improper oral hygiene the patients affected by AD tend to lose their teeth and have difficulty in eating. Within a period of time due to reduced intake of food they suffer from weight loss and are highly prone to systemic diseases. Hence rehabilitating such patients is very important as it can help them in restoring the functional chewing abilities.

This case report elaborates the rehabilitation of an Alzheimer's Disease patient using implant supported over denture.

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Prosthetic Rehabilitation of a Patient with Alzheimers Disease using a Combined Ball, Bar and Clip Retained Implant Supported Overdenture: A Case Report

David Charles. P [α] & Anusha Sreedharan [σ]

I. Introduction

Alzheimer's disease (AD) is a progressive degenerative disease that affects the cognitive skills of an individual. It is a type of dementia which causes difficulty in orientation, emotional instability, loss of abstract thinking, motor skills and personal care.

The common clinical symptoms of the disease are aphasia (loss of the ability to use speech and language), apraxia (loss of ability to perform learned and familiar movements), visual agnosia (inability to recognize familiar visual stimuli) and memory disorders[1]. The individual affected with AD tend to have coated hairy tongue, angular cheilitis, ulcerations, caries, periodontitis and finally tooth loss due to poor oral hygiene maintenance[2].

Due to improper oral hygiene the patients affected by AD tend to lose their teeth and have difficulty in eating. Within a period of time due to reduced intake of food they suffer from weight loss and are highly prone to systemic diseases. Hence rehabilitating such patients is very important as it can help them in restoring the functional chewing abilities.

This case report elaborates the rehabilitation of an Alzheimer's Disease patient using implant supported over denture.

II. Case Report

A 68-years-old female was brought to our speciality dental clinic by her care taker with a chief complaint of completely missing upper and lower teeth and wanted replacement of the same as she was not able to chew her food properly and eat because of which she was mal-nourished. Patient had a past medical history of Alzheimer's diseaseand was under treatment for the same. Intraoral examination revealed multiple root stumps and grade three mobile teeth in the upper and lower jaw (fig-1). Patient had a pale oral mucosa with dark pigmentation in her tongue which was diagnosed as dark hairy tongue (fig-2).

Considering her past medical and dental history, patient was advised for a removable prosthesis as she had difficulty in maintaining proper oral hygiene due to her illness.The patient and her care taker was explained elaborately the pros and cons of a conventional complete denture and also why it will be a better option for her than a fixed prosthesis.

Finally, an upper conventional complete denture and lower implant supported lower denture was decided after radiographic evaluation, as the patient wanted her lower denture to be more retentive. Patient was advised for complete extraction of the root stumps and mobile teeth in the maxilla and one root stump in the mandible to be removed at the time of implant placement. Following proper healing of the maxilla (fig-3) a maxillary primary and secondary impression was made.

Based on the patient's radiographic measurements implant placement was planned in the 33, 44 regionswith implant diameter of 3.75mm and 13mm length (Genesis Implant) for both the regions and implant placement was done following medical fitness.

After 3 months, the implant site was opened and healing abutment was placed. Later implant level impression was made using open tray impression technique (fig-4) and jig tryin (fig-5) was done prior to the fabrication of the final frame. Later the male component was milled using Ti with two distal micro ball attachmentand clip in the middle (fig -6,7).The frame was tried in patient's mouth and checked radiographically for precise fit (fig-8, 9). The counter female component was made and acrylization was done using injection moulding technique (Ivoclar vivadent) (fig – 10). Finally, the denture was placed in the patient mouth and checked for the fit and occlusion (fig – 11, 12, 13, 14). The patient was given all the post denture placement instructions and the patients care taker was instructed to keep a check on the maintenance of the denture as per the instructions given. The patient was advised to report initially once in three months for evaluating the maintenance of the prosthesis for a year and later once in every six months.

III. Discussion

Primarily, in patients with Alzheimer's disease (AD) communicative and cognitive skill are affected so

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they require a care taker to assist them in performing their day today task. In the above mentioned patient, considering the difficulties in oral hygiene maintenance the simplest and a best replacement option for her in comparison with other treatment options was a removable complete denture as the maintenance can easily be performed by a care taker even if the patient is unable to do the same. Difficulty in maintaining oral hygiene, ruled out the possibility of fixed prosthesis. Since the lower ridge was Atwood's order 5 type of ridge, achieving proper retention and stability was questionable. Based on the study by Laidlaw et al where he demonstrated in a case that the patients with AD usually tend to neglect mandibular dentures mainly due to its loss of retention[3]. Conventional mandibular dentures demonstrate problems with prosthesis stability and retention, with retention being the single most important problem [4].

Hence, considering the possibility for compromised retention and stability in the lower denture patients was advised for an upper conventional removable complete denture and lower implant supported overdenture. Implants-supported overdentures have practical advantages over conventional complete dentures as it shows decreased bone resorption, reduced prosthesis movement, better esthetics and phoenetics, improved occlusion, patient psychological outlook that improves the quality of life[5]. Feine and Carlsson advocated the 2-implant retained overdenture as the standard of care for the edentulous mandible in a consensus conference held in 2002[6-8] The design of the mandibular over denture was made to have two distal micro balls and a clip in the anterior region combined in a single screw retained Ti metal bar frame.

The splinting of implants has always proved to have better load distribution, good dissipationof forces, less screw loosening and crestal bone loss in implantsand there by increasing the success rate of the implant[9]. Wright et al. found that there is a low resorption rate (0.5 mm average bone loss) in 21 patients wearing overdentures supported by two implants and a bar in the mandible after a mean period of observation of 5 years[10]. Various studies concluded that the ball attachments are the best regarding soft tissue complications, and patient satisfaction. When comparing the load transfer and denture stability in mandibular implant retained over denture among ball, magnet, and bar attachments, the studies suggested that the use of ball attachment was advantageous in regards to optimizing stress and minimizing denture movement[11]. Incorporating all the above mentioned concepts a new design was made with the combination of a bar containing two micro balls and an anterior clip which can provide the combined benefits of bar, ball and clip retained prosthesis. In this case report, patient had several physical, emotional and social challenges, which she had to overcome. With the use of this design, the patient was able to efficiently chew her food with improved retention in the lower denture and within few weeks she started to gain weight and that improved her self-confidence.

IV. Conclusion

Older adults with increasing population of Alzheimer's Disease need proper oral health care. Their improving life expectancy demands them a proper dental care. The above mentioned patient is one of the classical example with appreciable intraoral findings. This report shows how efficiently she was managed and rehabilitated.

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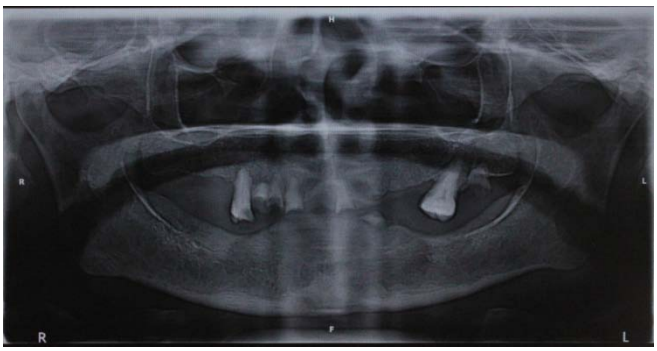

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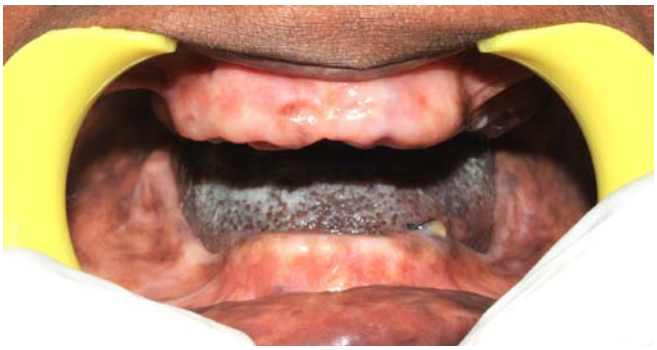

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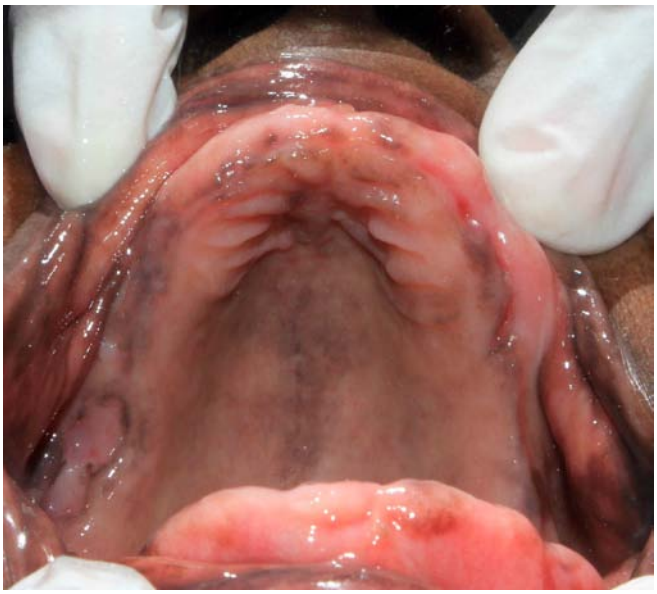

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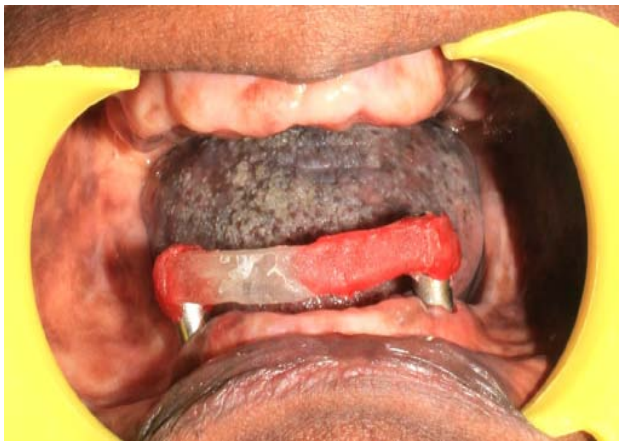

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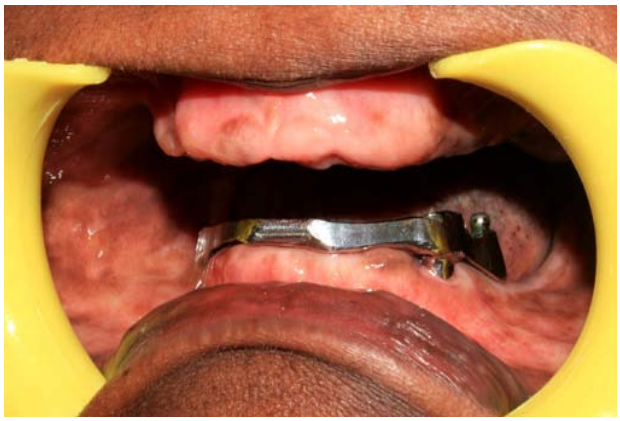

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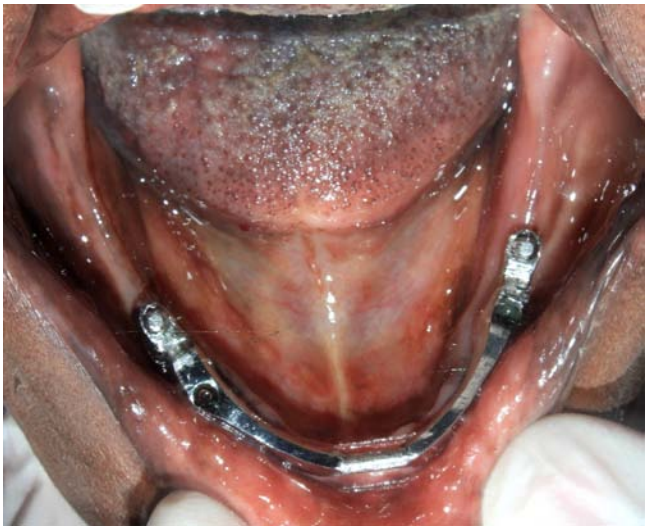

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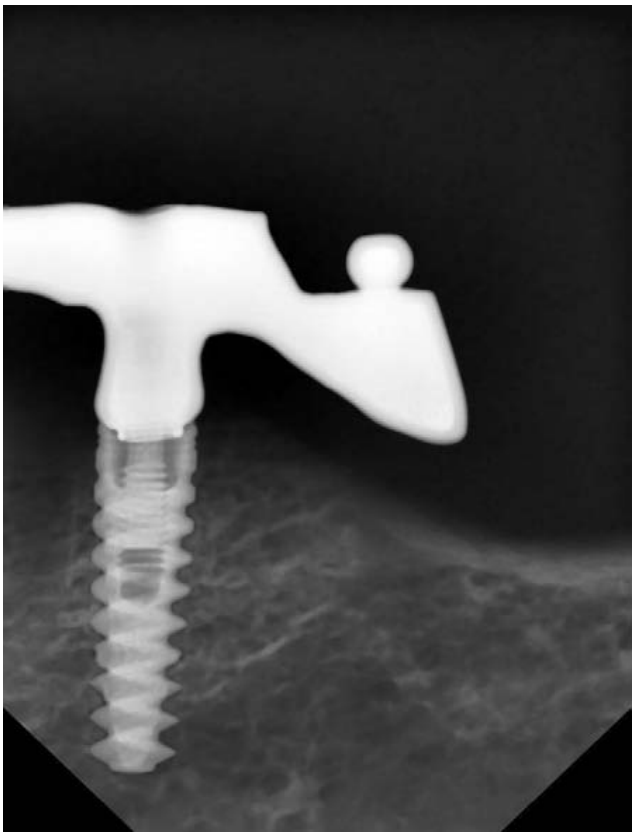

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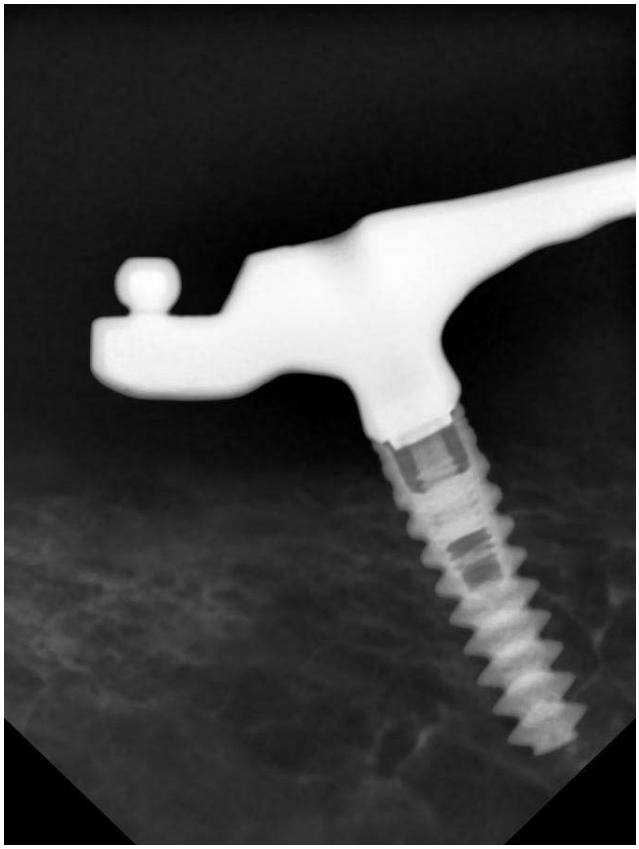

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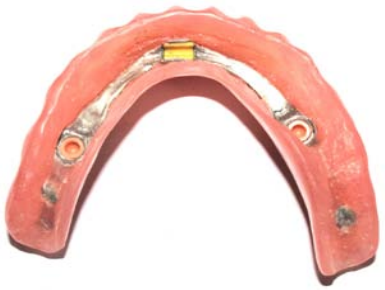

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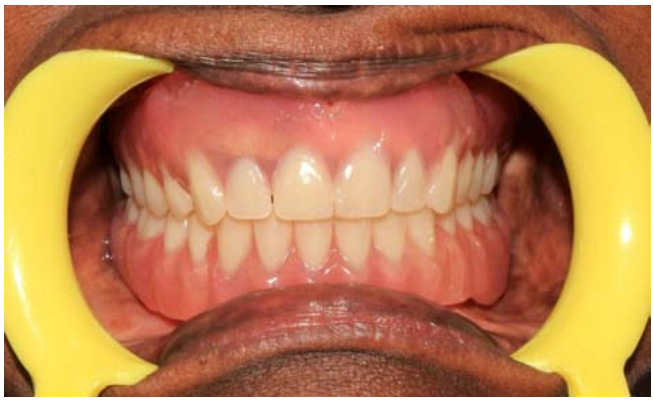

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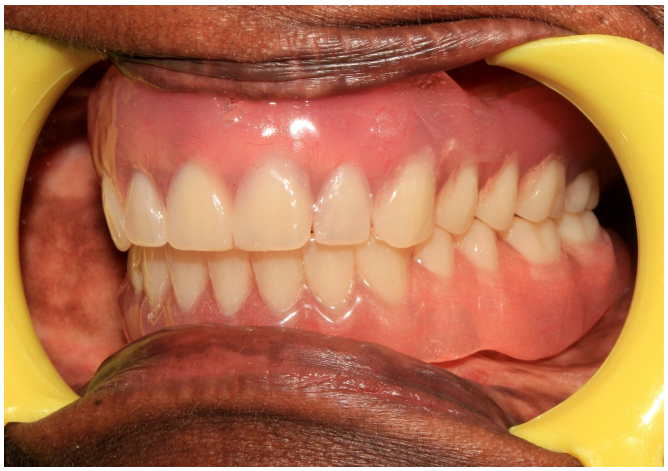

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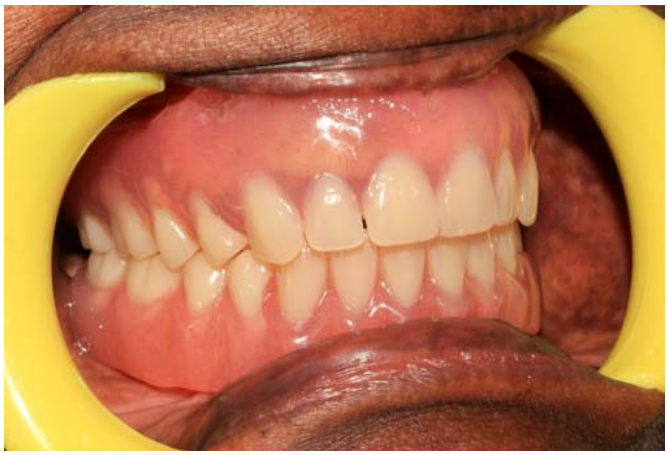

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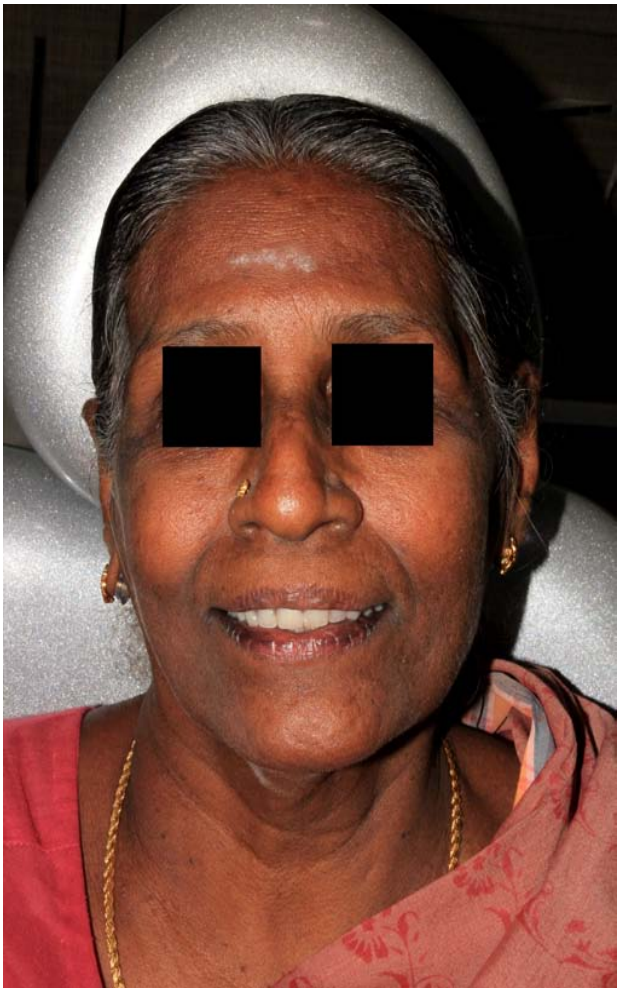

Figure 14

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Periodontal Muscle Training can Strength the Periodontal Support, Fit your Teeth

By Nima Sabzchamanara
National Medical University

Abstract- A total of 505 patients in general practice were asked to respond to a list of 25 obligatory nourishments for a child while going to have the first teeth, for its effectiveness in dealing with patient's periodontal health especially include chewing hard food. They were also asked to select the three effective nutrition for periodontal tissue. The indicts of patient perceived importance of the periodontal health were derived and each compared with actual effectiveness as determined from a sample of 250 patient's opinion.

Although the majority of patient's 18 of 25 nutritions as being very effective, there was no significant association with patient perceived nourishment effectiveness and actual effectiveness. The implications for patient training are discussed.

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I. Introduction

By comparing the effect of longterm workout in the fitness gyms and the habit of consuming hard rational food daily with a weekly schedule, could be very likely and would be support the oral health indeed. What to do to have esthetically and functionally prevention method for further gum and periodontal diseases, which could be less aggressive and conservative, cheap and home treating methods. In case one cares about his body's physique, also he can care about the Gum structure as well.

II. Materials and Methods

To have a review, Bundels attached to teeth and their disattachments provoke further injuries. Lets take a look at these bundles, if we peal away alveolar septa and papillae & marginal part, we can see the budles (periodontal ligament),(1) which is composed of bundles of connective tissues fiber that anchor the teeth within the jaw. Each bundle is attached to cementum covering the root of the tooth. The other end is embedded in bony tooth sockets (alveolar socket). These bundles of fibers allow the tooth to withstand the forces of biting and chewing.

Endomysium, the connective tissue sheaths that surround each skeletal muscle fiber separating the muscle cells from one another. It also contains capillary nerves and lymphatics.

As an illustration, Organization of skeletal tissues, Intact skeletal muscle. Biceps brachi are attached to bones through tendons. connective tissue.

The entire muscle is surrounded by connective tissue called epimysium.(2) The muscle is organized into bundles called premysium. Each fasciculus contains many individual fibers surrounded by connective tissue called Endomysium.

In some muscles there might only be relatively few fibers such as in muscle of the eye in which these are only 10 of fibers.

In some of the bigger muscles in the body there may be thousands of fibers, for instance, there can be up to 400000 fibers in the bicep muscle in front of the arm.

Each of these fibers is surrounded by sheaths of fibrous tissue membrane or fascia called Endomysium (endo- means within).

Therefore, by having regular training in fitness centers our extremities muscles can strength and can have an esthetic and supportive function for skeletal system.

III. Results

As within skeletal growth, the muscles in the body also grow at irregular rates. The enlargement of muscles (hypertrophy) makes them thicker but muscle fibers can also get longer. With certain types of training and genetics, muscle mass can change.(3)

According to the aging of muscular system, one reason is reducing the strength and power of the muscles, therefore, by training the endomysiums within the periodontal ligament with special trainings as well as eating hard foods and chewing them we can train them exactly like fitness club.

The experiment above 18-25% of those patient who had answered to the test satisfactory had a healthier gum structure in comparing with the unsatisfactory ones. By making some clinics besides gyms and sport centers which prescribe daily, weekly, monthly schedules to fit the gum muscles with special measurement individually for each patient can make a revolution in gum and oral health history.

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Overview of Surgical Treatment for Maxillary Constriction

By Dr. Anthony Kevin Fernandes & Dr. Faizan Ahmed Khan

Yenepoya Dental College

Introduction- The general indications for surgically assisted rapid maxillary expansion (SARME) are skeletal maturity, (extreme) transverse maxillary hypoplasia, either uni- or bilateral, anterior crowding and buccal corridors, the so called black corridors, when smiling. Furthermore the indications for SARME include any case where orthodontic maxillary expansion has failed and resistance of the sutures must be overcome. Transverse maxillary hypoplasia, in adolescents and adults, is frequently seen in non-syndromal and syndromal patients including cleft patients. In skeletally matured patients the uni- or bilateral transverse hypoplasia can be corrected by means of SARME. The treatment is a combination of orthodontics and surgical procedures and provides dental arch space for alignment of teeth. The procedure also causes a substantial enlargement of the maxillary apical base and of the palatal vault, providing space for the tongue for correct swallowing and thus preventing relapse. In addition, a distinct subjective improvement in nasal breathing associated with enlargement of the nasal valve towards normal values is seen with an increase of nasal volume in all compartments.

GJMR-J Classification: *NLMC Code: WO 500*

OVERVIEWOFSURGICALTREATMENTFORMAXILLARY CONSTRICTION

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Overview of Surgical Treatment for Maxillary Constriction

Dr. Anthony Kevin Fernandes [α] & Dr. Faizan Ahmed Khan [σ]

I. Introduction

The general indications for surgically assisted rapid maxillary expansion (SARME) are skeletal maturity, (extreme) transverse maxillary hypoplasia, either uni- or bilateral, anterior crowding and buccal corridors, the so called black corridors, when smiling. Furthermore the indications for SARME include any case where orthodontic maxillary expansion has failed and resistance of the sutures must be overcome. Transverse maxillary hypoplasia, in adolescents and adults, is frequently seen in non-syndromal and syndromal patients including cleft patients. In skeletally matured patients the uni- or bilateral transverse hypoplasia can be corrected by means of SARME. The treatment is a combination of orthodontics and surgical procedures and provides dental arch space for alignment of teeth. The procedure also causes a substantial enlargement of the maxillary apical base and of the palatal vault, providing space for the tongue for correct swallowing and thus preventing relapse. In addition, a distinct subjective improvement in nasal breathing associated with enlargement of the nasal valve towards normal values is seen with an increase of nasal volume in all compartments. Transverse expansion of the maxilla was first done in 1860 by means of an orthodontic appliance. In the following decennia the orthodontic treatment evolved. The theory of distraction was first published in 1905 by Codivilla[1]. The combined surgical and orthodontic treatment for maxillary expansion was introduced in 1938 for skeletally matured patients. The first successful use of distraction on the femur of a significant group of patients was published in 1990[2]. In 1999 the first bone-borne distractor was introduced[3]. Maxillary expansion by means of distraction is a nowadays widely used treatment.

However, there is no consensus in the searched literature regarding the surgical technique, the type of distractor used (tooth-borne or bone-borne), the existence, cause and amount of relapse and whether or not overcorrection is necessary.

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II. History

a) History of orthodonticfor maxillary constriction

Growth at the suture occurs through deposition of new bone at the sutural margin by the adjacent cellular layer. Toward the end of fetal life the cellular layers decrease in thickness, indicating that the rate of growth is slowing down, and the number of fibers in the intermediate layer uniting the capsular layers decreases. In a study of human sutures from birth to 18 years, Latham and Burston33 concluded that after about 2 of 3 years the sutures of the skull in general functioned primarily as sites of union of bones, but localized remodeling is a continuing process.

Cranial sutures are unified before complete eruption of the third molar. Soon after this, facial sutures close, and the sutures connecting the cranial and facial complexes are the last to close[4]. Regarding the facial sutures, Sicher[5] states that the closure of sutures in human beings starts, as a rule, in the middle 30s at the posterior end of the median palatine suture but that some facial sutures, including the frontozygomatic, may remain open even in older age groups. This view is supported by Wright[6], who claimed the intermaxillary and palatine sutures to be unossified and susceptible to comparatively easy separation at as late an age as 35 years.

A conflicting view is expressed by Persson[7], who found evidence of bony union at 17 years in the midpalatal suture. Latham and Burston[8], however, found no evidence of synostosis in the same suture by the age of 18 years. An over-all view is expressed by Scott[9], who believes that, although most facial sutures appear open on the surface of old skulls, some degree of union may be present in the substance of the suture. It is obvious therefore, that the available literature is inconclusive and conflicting. In clinical practice, skeletal correction of the transverse discrepancy via orthodontics (orthopedics) is successful until the age of approximately 14-15 years depending on the gender of the patient. After this age, orthodontic widening becomes virtually impossible and very painful[10,11,12] . In general, it is assumed that closure of the midpalatal suture prevents this type of expansion[10,12].

In the first part of nineteenth century, Lefoulon[13,14] and Talma[15] reported on maxillary expansion with a palatal or buccal C-shaped spring. A method, reserved for less severe cases, consisted of

lateral thumb pressure, 'every morning and even many times daily', by the parent or the child itself. The first documented case of orthodontic correction of maxillary width discrepancies was by Angell[16]. He performed rapid maxillary expansion with the use of a jackscrew appliance in a 14-year-old girl. He observed that by turning the jackscrew daily, he was able to open the maxillary suture sufficiently in a period of 2 weeks. Angell[16] mentions correction of maxillary width discrepancies by opening the midpalatal suture. In 1913, Schröder-Benseler[17] presented the still-popular all-wire frame with a non-spring-loaded jackscrew, the hygienic appliance. Derichsweiler16 uses bonds to the premolar and molar, which are embedded into a split acrylic base plate with an incorporated conventional orthodontic expansion screw. In 1961 Haas 'Reintroduced' rapid maxillary expansion (RME) and mentions in 1970 that the use of RME is ideally during the growth spurt[18,19]. Reichenbach & Brückl[20] published an excellent survey on orthodontic treatment of maxillary transverse hypoplasia in 1967.

b) History of surgical treatment for maxillary constriction

Once skeletal maturity has been reached, orthodontic treatment alone cannot provide a stable widening of the constricted maxilla in cases of deficiencies of more than 5 mm. In general, an orthodontist can camouflage transverse discrepancies less than 5 mm with orthopedic forces alone[21]. The literature mentions several problems accompanied by RME on mature patients, such as failure and or relapse and periodontal problems with the tooth-borne appliances[22]. Timms & Vero[23] mention that 33-50% of the expansion has relapsed before stability is achieved. Others report the lack of movement of the maxillary halves; excessive tipping of the anchor teeth; buccal root resorption of the anchor teeth or even periodontal defects as the teeth are pushed though the buccal cortical plate, which lead to bony defects and gingival recession; unequal expansion and unpredictable relapse and the sensation of pain and necrosis of oral mucosa under the appliance. Bell and Starnbach[24,25,26] report that activation of an appliance against mature sutures can lead to the sensation of pain and necrosis of oral mucosa under the appliance. These forces can also result in periodontal defects as the teeth are pushed though the buccal cortical plate, which lead to bony defects and gingival recession. These complications can be avoided by surgically releasing the osseous structures that resist the expansive forces[24,26]. Therefore the combination of surgical and orthodontic treatment is advocated for widening of the maxilla in skeletally matured patients. Advantages of SARME include improvement of periodontal health; improved nasal air flow; elimination of the negative space, which results in less visible tooth and gingival structures upon smiling[27]. There is also a cosmetic improvement of the buccal hollowing secondary to post-expansion prominence at the site of the lateral wall osteotomy[24,26]. Tooth extractions for alignment of dental arches are often unnecessary[21]. Brown[28] probably first described a technique of SARME with midpalatal splitting in his textbook. Heiss25 probably first inaugurated the midline splitting in the anterior maxilla for the extension of the compressed maxillary arch for orthodontic reasons. In 1961, Haas[19] described the downward and forward movement of the maxilla that occurs during RME because of the location of the Cranio Maxillofacial sutures. He believed that the maxillary halves separated from each other rather in a tipping than in a parallel fashion due to the strength of the zygomatic buttresses[19]. Isaacson & Ingram[29] and Isaacson et al.[30] mention that historically, the midpalatal suture was thought to be the area of resistance to expansion, but the facial skeleton increases its resistance to expansion as it ages and matures, and that the major site of resistance is not the midpalatal suture but the remaining maxillary articulations. Wertz[31] advocated that resistance of the zygomatic arch prevents parallel opening of the midpalatal suture. In 1975, Lines[32] and in 1976 Bell & Epker[24] demonstrated that the area of increased facial skeletal resistance to expansion was indeed not the midpalatal suture, but the zygomaticotemporal, zygomaticofrontal and zygomaticomaxillary sutures. Identification of these areas of resistance in the craniofacial skeleton stimulated the development of various maxillary osteotomies to expand the maxilla laterally in conjunction with orthodontic RME appliances4. The areas of resistance to lateral forces in the midface are the piriform aperture (anterior), the zygomatic buttress (lateral), the pterygoid junction (posterior) and the midpalatal synostosed suture (median). In the early reports all four are transsected [25,33,34,35] . In 1972 Steinhauser[36] reports a maxillary expansion osteotomy technique without the use of distraction, a Le Fort I type of osteotomy in combination with the surgical splitting of the palate in the midline, after which a triangular unicortical iliac graft is inserted into the void created by the expansion. More recently, with the emphasis on decreased morbidity and ambulatory surgery, fewer supports are osteotomized; the anterior, lateral and median, the lateral and median, the anterior, posterior and lateral, the anterior and lateral. Most reports note that surgically assisted maxillary expansion is more stable than orthodontic RME alone [24,34,35,37].

Glassmann et al.[38], Alpern & Yurosko[39] and Lehmann & Haas [37] reported successful expansion in humans performed with a Hyrax appliance following a lateral osteotomy from the piriform rim to the pterygoid plate without palatal surgery. Their study did not consider the amount of skeletal versus dental expansion and the corresponding relapse following a retention period[40]. In 1984 Glassmann et al. postulates that

uniform palatal expansion can be achieved without sectioning of either palate or the pterygomaxillary fissure[38].

In the year 1999, Mommaerts45 presented the Trans Palatal Distractor (TPD), which is a bone-borne device for SARME. After surgical release of the areas of maxillary support the tooth-borne devices used for SARME cause undesired movements of the abutment teeth during expansion and retention phases that could lead to periodontal problems [35, 38, 41]. Prolonged retention and overcorrection is advisable to counteract skeletal relapse. The TPD avoids all of these aforementioned problems, since fixation is sought in palatal bone[32]. Recently, the Magdenburg Palatal Distractor (PD) was presented, also a bone-borne device which claims to have no relapse[42].

c) History of Distraction

As mentioned before SARME is a form of distraction that was applied before its biological healing principles were known. Codivilla[1] was the first to describe the technique of distraction osteogenesis for the shortened femur in 1905. Ilizarov described the use of distraction osteogenesis in the field of Orthopedics to lengthen the leg bones in a large group of patients in 1990[2]. The technique is based on a 5-day period of rest after corticotomy before the expansion starts. This gives the tissue time to form the first callus but is too short for consolidation. Four phases of new bone formation can be described. The first is a fibrovascular heamatoma; between day 5 and 7 collagen fibers are formed that will arrange parallel to the distraction vector. Second, the bone formation follows the collagen fibers through intramembranous ossification; from the outside to the inside. Third, remodeling phase of the new bone. Fourth, formation of solid compact bone with the same texture as the surrounding (old) bones. When the distraction is performed too fast, the collagen fibers might lose contact and there is no in growth of new bone, providing non- or mal-union. In cases of a too slow distraction premature consolidation can occur and the requested elongation cannot be reached.

d) Surgical technique

Since early in the 20th century various techniques have been developed for SARME. The main considerations have opposing interests. One side is a more invasive technique with maximal mobility of the maxillary halves for correction over larger distances with less force but with more possible complications. The other side is less invasive with less possible complications but with more relapse, more periodontal problems, and unexpected fractures. The opinions vary about the site of major resistance in transverse distraction in the midface and also about the method of releasing it. Most methods consider the zygomaticomaxillary junction the major site of resistance and perform a corticotomy through the zygomatic buttress from the piriform rim to the maxillopterygoid junction (fig 1).

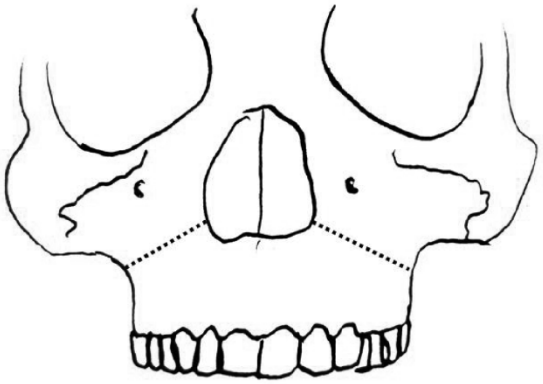

Figure 1: Schematic drawing showing the corticotomy from the piriform rim to the maxillopterygoid junction.

The midpalatal suture is historically considered the major place of resistance but this was proven to be untrue by Isaacson & Ingram[29], Isaacson et al. [30] and Kennedy et al. [34] (Fig. 2). Still many, but not all, release the midpalatal suture to improve mobility and to prevent deviation of the nasal septum.

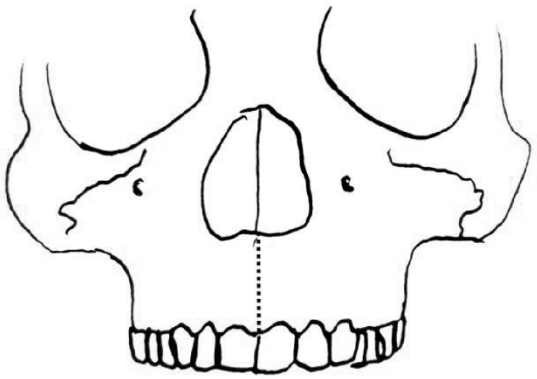

Figure 2: Schematic drawing showing the osteotomy of the midpalatal suture.

Several authors describe two paramedian palatal osteotomies from the posterior nasal spine to a point just posteriorly of the incisive canal (Fig. 3) 9,11,57.

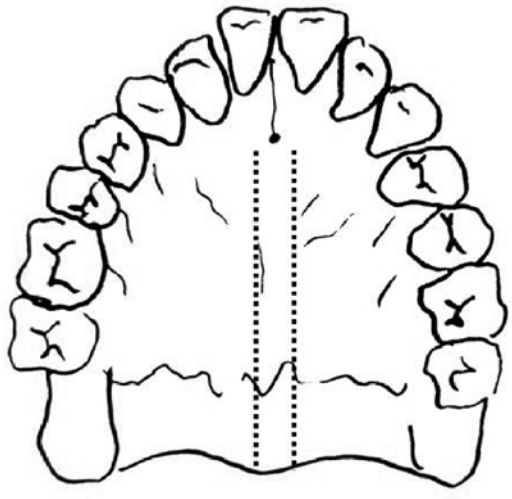

Figure 3: Schematic drawing showing the two paramedian palatal osteotomies from the posterior nasal spine to a point just posteriorly of the incisive canal.

The pterygoid plates are also a considerable site of resistance but because of the increased risk of injuring the pterygoid plexus by the osteotomy, some chose not to, without losing much mobility (Fig. 4). By not releasing the pterygoid junction, the pattern of opening of the maxillary halves is more V-shaped with the point of the V dorsally and it might be considered as an individual treatment to achieve more distraction either on the posterior or anterior level.

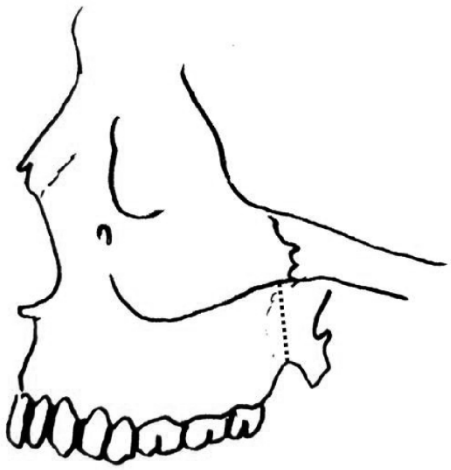

Figure 4: Schematic drawing showing the osteotomy of the pterygoid plates.

The nasal septum is often released from its palatal base to avoid shifting to either side and thereby causing changes in nasal flow (Fig. 5). A tomographic study by Schwarz showed no significant change in nasal septum position in SARME without sectioning of the nasal septum and an increase nasal airway space60.

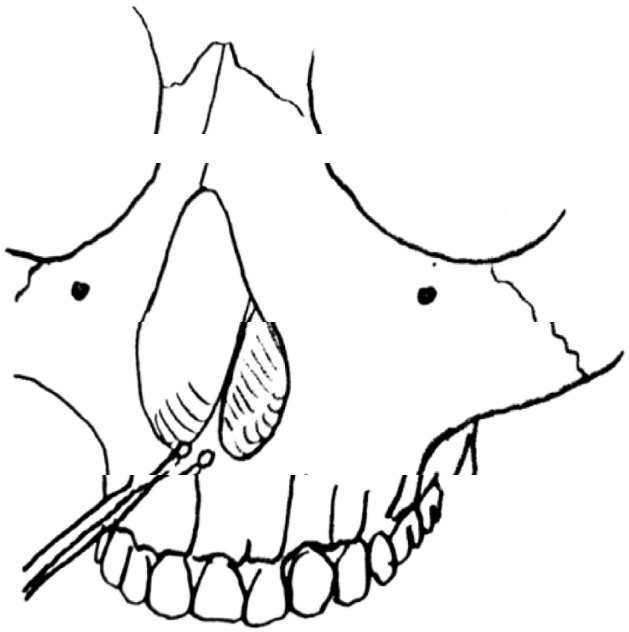

Figure 5: Schematic drawing showing the release of the nasal septum with the use of a septum osteotome.

Of the studies on SARME mentioned in international literature, the mean age of the patients undergoing SARME varied from 19 to 29 years[33,35,38,40,41,43,44]. The groups studied were quite small and mostly contained not more than 20 patients. The period of retention after expansion varies from 2 to 12 months. Generally, a period of three month is used. The amount of distraction at the canine level mentioned varies from 3.4 mm to 5.0 mm, in the first premolar region 4.7 mm to 5.9 mm and in the first molar region 3.4 mm to 8.0 mm. SARME is considered a procedure with little risk of serious complications , however several complications are mentioned in literature varying from life threatening epistaxis to a cerebrovascular accident, skullbase fracture with reversible oculomotor nerve pareses and orbital compartment syndrome[12,35]. Less serious complications reported are postoperative hemorrhage, pain, sinusitis, palatal tissue irritation/ulceration, asymmetrical expansion, nasal septum deviation, periodontal problems and relapse[46].

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In Vitro Comparison of Friction Generated by Various Models of Self-Ligating and Conventional Brackets While Performing Retraction with Sliding Mechanics

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Abstract- *Introduction:* In vitro studies suggest that certain variables such as friction coefficient, archwire size and force decay affect the effectiveness of sliding mechanics. To maximize the efficiency of sliding mechanics one should seek to control these variables.

Objective: This *in vitro* study aimed to compare frictional forces in several models of self-ligating brackets, conventional systems, as well as different ways to tie the wire to the brackets during a simulation of sliding mechanics using 0.019"X0.025" stainless steel wire.

Material and Methods: The study evaluated the levels of dynamic and static friction in sixdifferent types of brackets andthree different ligation systems were used with conventional brackets: elastomeric modules, unconventional elastomeric ligature low friction system, and 0.20mm stainless steel-ligature.

Keywords: *friction; in vitro; orthodontic brackets; self-ligating brackets, sliding mechanics.*

GJMR-J Classification: *NLMC Code: WU1*

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Results: **The results showed that for both static and dynamic friction all other ligating systems exhibited statistically less friction than Gemini brackets with conventional elastomeric. Systems with lower levels of friction were as follows: SmartClip (E0.08N; D0.00N), Gemini brackets with Leone ligature (E0.08N; D0.04N), and Vision LP (E0.04N; D0.00N).**

Conclusion: **During sliding mechanics frictional forces generated by the conventional ligation system were significantly higher than the forces generated by self-ligating brackets and other ligation systems.**

Keywords: friction; in vitro; orthodontic brackets; self-ligating brackets. sliding mechanics.

I. Background

Premolar extraction is a common treatment option in orthodontics. Space closure can then be achieved with sliding mechanics, which consists in pulling or pushing a tooth along a straight archwire using an appropriate system of forces to produce a sustained movement. Elastomeric materials or springs are often employed to produce this force. *In vitro* studies[1] suggest that certain variables such as friction coefficient, archwire size and force decay impair the effectiveness of sliding mechanics. Other factors that affect friction include saliva, material and wire size, and angulation between bracket, wire and ligation system[2]. To maximize the efficiency of sliding mechanics one should seek to control these variables[1]. In orthodontic movement, friction (static or dynamic) results from the interaction of an archwire with the walls of the bracket slots or the ligatures[3]. Moreover, the forces generated at the bracket/wire interface may hinder the achievement of optimal force levels in the supporting tissues. Therefore, a decrease in this response is likely to benefit the response of hard and soft tissues. Frictional force is classified into static and kinetic. Static friction is the smallest force needed to start a movement between solid objects at rest and the kinetic friction force resists the sliding motion of a solid object against another at a constant speed[3]. It has been reported that 50% of the force applied to slide a tooth is used just to eliminate friction.

With the increase in the use of self-ligating brackets[4], many studies have been conducted using self-ligating brackets and reported advantages including increased patient comfort, improved oral hygiene, less chair time, anchorage conservation, and reduction of the friction[5-7]. Although reports of reduced friction are one of the advantages of self-ligating brackets when compared with conventional brackets[8,9], this issue is still controversial. The term self-ligation in orthodontics implies that the bracket has the ability to engage itself to the archwire by a mechanical device (clip) built into the bracket to close off the slot[10] and the clip could be active when the ligation clip exerts a pressure on the arch wire or passive when the clip transforms the slot to a tube.

This *in vitro* study aimed to compare static and dynamic friction frictional forces in self-ligating brackets, conventional systems with different methods to tie the

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wire to the brackets during a simulation of sliding mechanics devised by Bennett & McLaughlin[11] using 0.019"X0.025" stainless steel (NiCr) wire.

II. Methods

Six different types of brackets - 0.022 x 0.027 -in slots, were selected both self-ligating and conventional appliances: Gemini (3M Unitek® Monrovia, California, USA), SmartClip (3M Unitek® Monrovia, California, USA), Empower (American Orthodontics®), Quick (Forestadent®), In-Ovation (GAC®), Vision LP. (Table 1)

Three different ligation systems were used with conventional brackets, i.e., conventional elastomeric modules (EMs) manufactured by Morelli® unconventional elastomeric modules (Slide by Leone® Italy) and 0.10-in ligatingstainless-steel ligature also manufactured and marketed by Morelli®.

The tests were conducted using 0.019"x0.025" (Morelli®) steel wire on all brackets or ligation systems. Five observations were carried out for each brackets-ligation system combination. To eliminate the influence of wear, a wire sample was drawn only once through a brackets-ligation system combination and news brackets, ligation and wire were used in each test run.This generated a trial with 200 brackets and 40 tests readings were taken for the study. Altogether, there were eight separate groups of brackets and ligation systems (Table 2).

a) Friction assessment device

To evaluate the friction levels a device[12] was created specifically designed for this purpose. It was adapted to an EMIC DL2000 machine to simulate retraction movements commonly used in orthodontic sliding mechanics at a constant speed of 10 mm/min (Fig 1). The device consisted of a stainless-steel base fixed with screws, and cylindrical rods each with a cavity where each bracket was bonded. This set of grouped rods simulates a group of teeth.

The brackets were attached to a bonding guide with 0.10-in steel ligatures (Morelli). This guide consisted of a stainless-steel plate with a thickness of 0.019-in where the brackets were placed. Once positioned at the same distance, height and with the same buccolingual relationship, which neutralized any expression of torque or tip preadjusted in the brackets, the latter were bonded to the cylinders with Transbond XT (3M Unitek®) adhesive and light-cured for 20 seconds. The brackets were all aligned and leveled so as to avert any factors that might generate friction and thereby impair the accuracy of the data[12] and the effect of different forms of ligation could be isolated with greater precision[13,14]. (Fig. 2 a, b, c)

b) Statistical analysis

Statistical analysis of all data collected in this research was initially performed descriptively by calculating some summary measures such as mean, median, minimum, maximum and standard deviation values. Additionally, one-dimensional scatter diagram charts were built[15].

The Kruskal-Wallis test was employed as inferential analysis in order to compare static and dynamic friction between the eight types of brackets[16].

A significance level of $\alpha = 5\%$ was applied to all conclusions reached through inferential analyses.

The data were entered spreadsheets in Excel 2010 for Windows software for proper information storage. The statistical analyses were performed with R software version 2.15.2.

III. Results

The sample in this study consisted of 40 specimens, 5 each of 8 different types of brackets (Gemini/EMs, Gemini/Ligature, Gemini Leone, Empower, Vision, Quick, GAC and SmartClip).

Static and dynamic friction was measured for each of the specimens (see details in Table 1 and Graphs 1 and 2).

Gemini/EMs brackets showed a mean static friction of 5.86N, ranging from 5.31 to 6.70N, with a standard deviation of 0.59N. Mean dynamic friction was 5.12N, ranging from 4.80 to 5.50N, with a standard deviation of 0.29N.

Gemini/Ligature brackets showed a mean static friction of 3.27N, ranging from 2.58 to 4.38N, with a standard deviation of 0.73N. Mean dynamic friction was 2.76N, ranging from 2.20 to 3.80N, with a standard deviation of 0.67N.

Gemini/Leone brackets displayed a mean static friction of 0.08N, ranging from 0.06 to 0.08N, and a standard deviation of 0.01N. Mean dynamic friction was 0.04N, ranging from 0.00 to 0.10N, with a standard deviation of 0.05N.

Gemini/Ligature brackets showed a mean static friction of 3.27N, ranging from 2.58 to 4.38N, with a standard deviation of 0.73N. Mean dynamic friction was 5.12N, ranging from 4.80 to 5.50N, with a standard deviation of 0.29N.

Vision LP brackets showed a mean static friction of 0.04N, ranging from 0.03 to 0.06N, and a standard deviation of 0.01N. All five specimens of this type of bracket showed no dynamic friction.

BioQuick brackets showed a mean static friction of 2.78N, ranging from 2.62 to 3.11N, with a standard deviation of 0.19N. Mean dynamic friction was 2.56N, ranging from 2.50 to 2.80N, with a standard deviation of 0.13N.

In-Ovation brackets exhibited a mean static friction of 1.83N, ranging from 1.61 to 2.06N, and a standard deviation of 0.16N. Mean dynamic friction was 5.12N, ranging from 4.80 to 5.50N, with a standard deviation of 0.29N.

SmartClip brackets displayed a mean static friction of 0.08N, ranging from 0.07 to 0.08N, with a standard deviation of 0.01N. All five specimens of this type of bracket showed no dynamic friction.

Inferential results showed that the static ($p<0.001$) and dynamic ($p<0.001$) friction levels are not statistically identical across the different types of brackets (Graphs 1 and 2).

- Gemini/EMs brackets have higher static friction than Gemini/Ligature ($p<0.001$), Gemini Leone ($p<0.001$), Empower ($p<0.001$), Vision LP ($p<0.001$), BioQuick ($p<0.001$), In-Ovation ($p<0.001$) and SmartClip ($p<0.001$) brackets.
- Gemini/EMs brackets have higher dynamic friction than Gemini/Ligature ($p<0.001$), Gemini Leone ($p<0.001$), Empower ($p<0.001$), Vision LP ($p<0.001$), BioQuick ($p<0.001$), In-Ovation ($p<0.001$) and SmartClip ($p<0.001$) brackets.

IV. Discussion

In preparing the patient for sliding mechanics, one should insert rectangular steel archwires as of one to two months prior to applying the mechanics itself. This preparation allows all brackets to express their torques and angulations more efficiently. The goal is to make the archwire as passive as possible to avoid interfering with the archwire as it slides along the bracket slot. Thus, the brackets were placed passively, applying sliding mechanics as much as possible in its clinical form as well.

During *in vivo* sliding mechanics, the steel wire slides along the molar and premolar brackets performing incisor and canine retraction while simultaneously closing spaces. This study used incisor, canine and premolar brackets to minimize bonding errors since it would be quite a challenge to place the appliance passively with tubes bonded to the molars. This may have slightly altered the absolute results, but given that the intention was to compare ligation systems, any changes would apply to all systems.

In a critical review of the literature in 2009 Burrow[3] defined friction as a minor component in the set of forces that cause resistance to tooth movement. Possibly, sliding mechanics is an exception to this rule, given (a) the way in which the wire slides along the premolar and molar brackets with no forces being applied directly to the tooth, but rather to a hook welded to the wire, and (b) preparation involves the use of rectangular steel wires. These factors help to reduce the binding effect, which occurs when force is applied directly to the tooth being moved, rendering this type of mechanics highly dependent on the friction between wire and bracket. Some forms of sliding mechanics described in the literature[1] apply force to the tooth being moved, such as canines. This would completely change the force components of the system, making binding its major component.

Other limitations stem from not considering the moment caused by the elastomeric modules during movement. As described in the study by Budd et al[17] in 2008, a typodont with brackets bonded to it, and dipped in a fluid would undergo variations in the movements that occur during the mechanics. Pliska et al[18] in 2014 concluded that friction induced by ligation has little influence on the overall resistance to slinding when moment forces are combined. It should be underscored that the main objective of this investigation was to compare ligation systems. If rotation were to be incorporated during movement the variables would be far too numerous making it impossible to compare the systems themselves. Thus, not all clinical conditions were simulated in their entirety, and the number of variables was deliberately reduced to facilitate the study. For example, Leal et al[19] in 2014, clarified the significant role of lubricant, like artificial saliva in friction forces between self-ligating brackets and wires. Nevertheless, the main results agreed with those reported by Budd et al[17] in 2008, which included momentum in their laboratory model.

Furthermore, there is no denying that there are limitations in this study given that the laboratory environment does not provide clinical factors such as: The action of saliva, possible occlusal forces, muscle interference, interferences with oral functions such as mastication and swallowing, different degrees of malocclusion, thickness and compressibility of the periodontal ligament, rotated teeth, torque at the wire/bracket interface, angulations and temperature.

Many studies[2,17,20] used various wire sizes for comparison. The goal here was to simulate sliding mechanics, which is always performed with 0.019"x0.025" steel wire. Most studies also test the friction in a single bonded bracket and not in a set of brackets, as was done here. Future research should consider other rectangular steel wire sizes, such as 0.018"x0.025".

The static friction is the force that opposes the beginning of movement at the moment when activation is performed. The results showed a statistically significant difference ($p<0.001$) between the Gemini/EMs group and the other groups. These results demonstrate that during sliding mechanics other ligation systems are better suited than elastomeric modules given the substantial difference in the friction force generated. It should be remembered that the lower the friction force, the less force is required to initiate movement, and the more optimized and physiological this movement will be.

Ehsani et al[2] in a review of the literature written in 2009 report that five studies were conducted and found no significant differences between self-ligating and conventional brackets in terms of friction force when

rectangular wires of greater caliber are utilized. Moreover, in seven other studies, self-ligating brackets produced lower friction than conventional brackets. All seven agree with the results of this study, if one considers conventional brackets tied with elastomeric modules. Regarding metal ligatures and Slide ligatures, the results agree with the first group. A 2007 study[20] compared the use of metal ligatures with SmartClip self-ligating brackets and found no statistically significant difference during en masse sliding mechanics. The literature review's conclusions disagree with the results of this investigation by admitting that there was not enough evidence to prove that self-ligating brackets produce lower friction forces than conventional brackets with rectangular archwires. This divergence may have occurred due to the fact that the authors could not specify comparisons amidst such an overwhelming number of articles. In this study, for example, if one were to compare the ligature system with the Empower or BioQuick brackets, no differences would be found. Holtmann et al[12] in 2014 demonstrated that self-ligating and steel-ligated brackets are more effective to correct misalignment and exertion of lower forces at the same time, than brackets with elastic ligatures. However, since the comparison was made with elastomeric modules the difference was statistically significant. Perhaps because literature reviews are so comprehensive one may miss some important details that might clarify certain issues.

As shown in Table 3, the mean static friction forces of the Gemini Leone (0.08N), Vision LP (0.04N) and SmartClip (0.08N) ligation systems are clearly lower than the forces found in the other groups. This may be related to the fact that in these three ligation systems the wire is tied to the brackets passively. Slide ligatures (Leone®,Italy) cover the open part of the slot leaving the wire completely passive within it. Vision LP brackets feature an opening with the same passive cover design to keep the wire into the slot. Moreover, SmartClip brackets also have clips that appear not to compress the archwire inside the slot. Studies comparing active and passive self-ligating brackets concluded that passive brackets produce statistically lower friction forces[21].

With the Gemini/Ligature ligation system (3.27N), Empower brackets (3.24N) and BioQuick brackets (2.78N) have also been shown to generate similar mean values of static friction forces during sliding mechanics. These forces are obviously higher than in the groups discussed above, but still lower than in the Gemini/EMs group.

Metal ligatures push the wire against the base of the slot but because they are made from stainless steel they produce less friction. The Empower bracket is equipped with a chromium cobalt clip which with thicker wires acts by pressing the wire against the bracket base. The BioQuick bracket, in turn, has a steel clip that also exerts a continuous force on the wire.

The In-Ovation bracket has a mean static friction of 1.83N. This bracket also features a chromium cobalt spring that compresses the wire inside the bracket slot when thicker wires are inserted. This spring, however, can exert forces that are lighter than the springs. These data agree with Budd et al[17], who in 2008, after analyzing several variables, concluded that the binding mechanism is the main variable affecting frictional forces in the different ligation systems.

Dynamic friction is here defined as the force that opposes the force that allows the movement to continue. It is known that in sliding mechanics the force intensity applied in the initial activation usually weakens with each passing hour, and will probably be extinguished before the next activation. Thus, the lower the dynamic friction, the longer it takes this force to subside completely. Additionally, it is more effective, which optimizes the mechanics.

The results found in this study were very similar to the results found for static friction. Elastomeric ligatures (5.12N) showed a dynamic friction force statistically higher ($p=0.001$) than all other ligation systems. These other systems are therefore not indicated for use with sliding mechanics.

With the Gemini/Leone group (0.04N), SmartClip (0.00N) and Vision LP (0.00N) brackets exhibited the lowest mean dynamic friction. This is probably since these are passive systems.

On the other hand, the Gemini/Ligature group (2.76N), as well as the Empower (2.66N) and BioQuick (2,56N) brackets also showed values that are similar to dynamic frictional forces.

The In-Ovation bracket group showed a mean friction force of 1.44N, which was remained unchanged between the lowest and the intermediate values.

It is the authors' view that due to similarities between the results for static vs. dynamic friction, the arguments expressed in the literature probably apply to both types of friction. A study conducted in 2010 by Stefanos et al[21] also found significant similarities between the results of both types of friction. A 2009 literature review by Burrow[3] argued that for practical purposes dynamic friction is irrelevant in orthodontic tooth movement. The author goes on to explain that the continuous movement of a tooth along an archwire is a rare phenomenon and that in sliding mechanics one is dealing with a quasi-static thermodynamic process. This means that the process occurs slowly and leads to a sequence of quasi-equilibrium states. Force and resistance to sliding change as the tooth moves along the archwire. It then inclines and responds by producing a biological response, i.e., bone remodeling, then inclines once again[3]. This process is seen by Burrow[3] as quasi-static, although for many other researchers it could be considered as an ongoing process. The results showed a striking similarity between the two types of friction, which led the authors to believe that regardless

of its relevance or irrelevance dynamic friction can be considered as complementary to static friction. It can be present on rare occasions during orthodontic movement but should never be ignored, irrespective of relevance.

Certain types of materials used in this study could influence friction. The first such material is steel, sliding underneath elastomeric modules present in the Gemini/EMs and Gemini Leone groups, since the steel archwire slides along a metal slot covered with an elastomeric module. The second type is steel with steel, as in the Gemini/Ligature and Quick groups. The third type is steel and chromium cobalt alloy in the Empower and In-Ovation groups, since the covers are made of cobalt chromium. The fourth and last type is steel with nickel-titanium, as in the Vision and SmartClip groups.

It became unequivocally clear that in types 1 and 3 substantial differences were found in the results, which rules out the possibility that the materials affected the tests in any way. These findings contrast with some studies[17] that consider the material from which the cover was made as a factor capable of influencing the amount of friction that occurs in each bracket type. This may have occurred since this study involved at least two different ligation systems for each type of material, which was not the case in the study by Budd in 2008, which examined a more limited range of brackets[17].

V. Conclusions

Friction was influenced by the type of bracket and by the ligating systems. During sliding mechanics, frictional forces generated by the conventional ligation system (Gemini brackets + elastomeric modules) were statistically higher than the forces generated by self-ligating brackets and other ligating systems. Specifically, SmartClip and Vision LP brackets as well as Leone's Slide ligating system generated the lowest frictional forces during sliding mechanics.

Table 1: Brackets used in the study and their key features

Group	Brackets	Torque	Angulation (tip)	In/out
Gemini/EMs, Gemini/Ligatures and Gemini Leone	Maxillary right central incisor	17	4	0.82
Gemini/EMs, Gemini/Gemini Leone and Ligatures	Maxillary right lateral incisor	10	8	1.06
Gemini/EMs, Gemini/Gemini Leone and Ligatures	Maxillary right canine	-7 or 0	8	0.8
Gemini/EMs, Gemini/Gemini Leone and Ligatures	Maxillary first right premolar	-7	0	0.83
Gemini/EMs, Gemini/Gemini Leone and Ligatures	Second right pre-molar	-7	0	1.06
Empower	Maxillary right central incisor	17	4	-
Empower	Maxillary right lateral incisor	10	8	-
Empower	Maxillary right canine	0 or -7	8	-
Empower	Maxillary right first premolar	-7	0	-
Empower	Maxillary right second premolar	-7	0	-

Vision LP	Maxillary right central incisor	17	4	-
Vision LP	Maxillary right lateral incisor	10	8	-
Vision LP	Maxillary right canine	0	8	-
Vision LP	Maxillary right first premolar	-7	2	-
Vision LP	Maxillary right second premolar	-7	2	-
Quick	Maxillary right central incisor	17	4	1.1
Quick	Maxillary right lateral incisor	10	8	1.5
Quick	Maxillary right canine	-2	11	0.75
Quick	Maxillary right first premolar	0	0	0.75
Quick	Maxillary right second premolar	0	0	0.75
In-Ovation	Maxillary right central incisor	12	5	-
In-Ovation	Maxillary right lateral incisor	8	9	-
In-Ovation	Maxillary right canine	-2	13	-
In-Ovation	Maxillary right first premolar	-7	0	-
In-Ovation	Maxillary right second premolar	-7	0	-
SmartClip	Maxillary right central incisor	17	4	-
SmartClip	Maxillary right lateral incisor	10	8	-
SmartClip	Maxillary right canine	-7	8	-
SmartClip	Maxillary right first premolar	-7	0	-
SmartClip	Maxillary right second premolar	-7	0	-

Table 2: Groups used in the study divided by ligation system

Group	System	Material	Slot	Ligation System
Gemini/EMs	Gemini™ (® 3M Unitek, Monrovia, California, USA) with conventional elastomeric module ligation	Elastomeric	0.022"	Conventional elastomeric ligature modules Morelli ®
Gemini/Ligature	Gemini™ (3M Unitek ® Monrovia, California, USA) with steel ligatures	Steel	0.022"	0.020" steel ligatures Morelli ®
Gemini Leone	Gemini™ (3M Unitek,® Monrovia, California, USA) with Slide® elastomeric module ligatures (Leone, Italy)	Elastomeric	0.022"	Slide® elastomeric ligatures (Leone, Italy)
Empower	Empower (American Orthodontics,®, Wisconsin, USA)	Chromium cobalt clip	0.022"	Active Clip
Vision	Vision LP (American Orthodontics,® Wisconsin, USA)	NiTi clip	0.022"	Passive design
Quick	BioQuick (Forestadent, ® Germany)	Steel clip	0,022"	Active Clip
In-Ovation	In-Ovation (GAC,® New York, USA)	Chromium cobalt spring	0.022"	Active spring
SmartClip	SmartClip (3M Unitek,® Monrovia, California, USA)	NiTi clip	0.022"	Passive clip

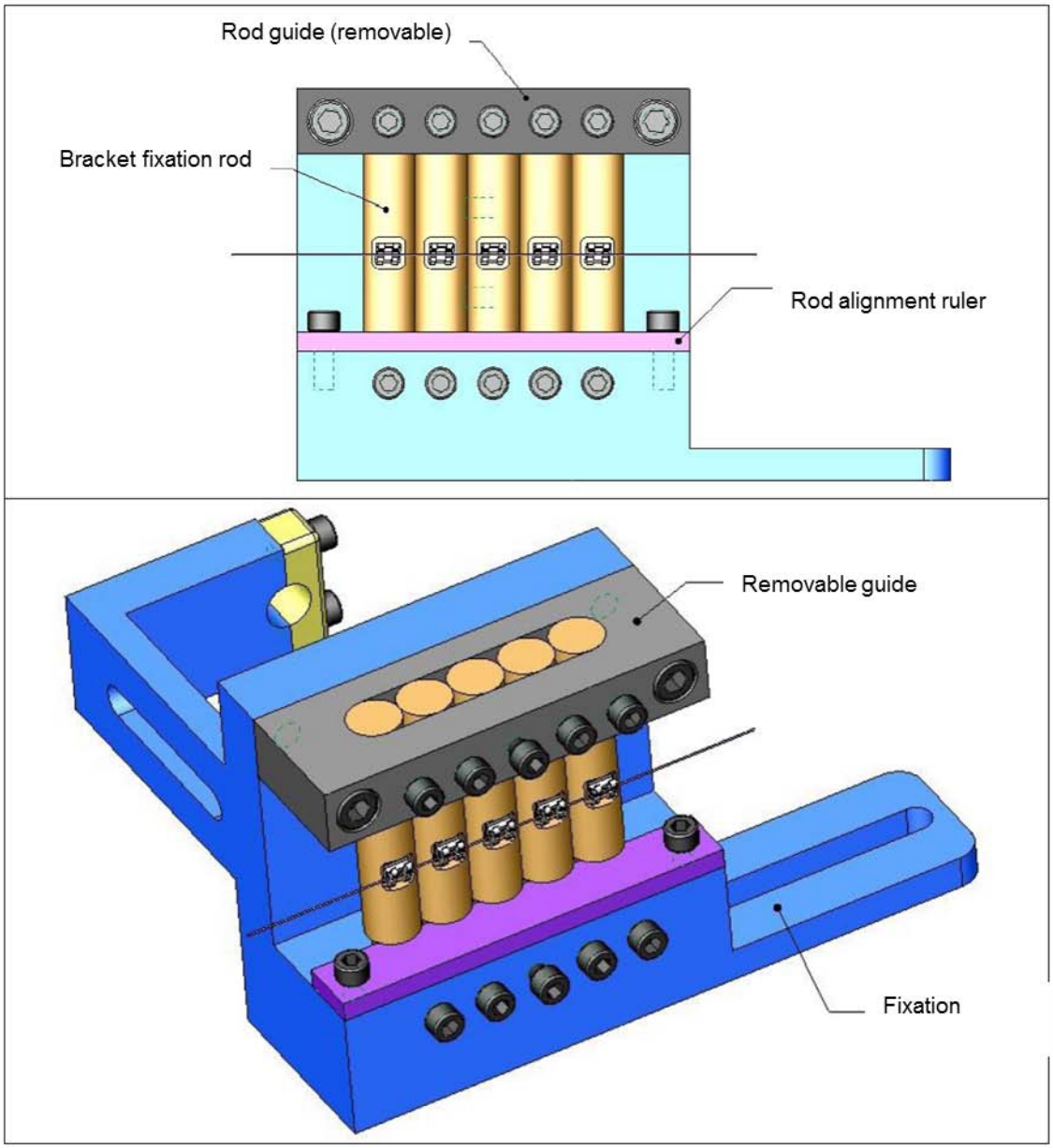
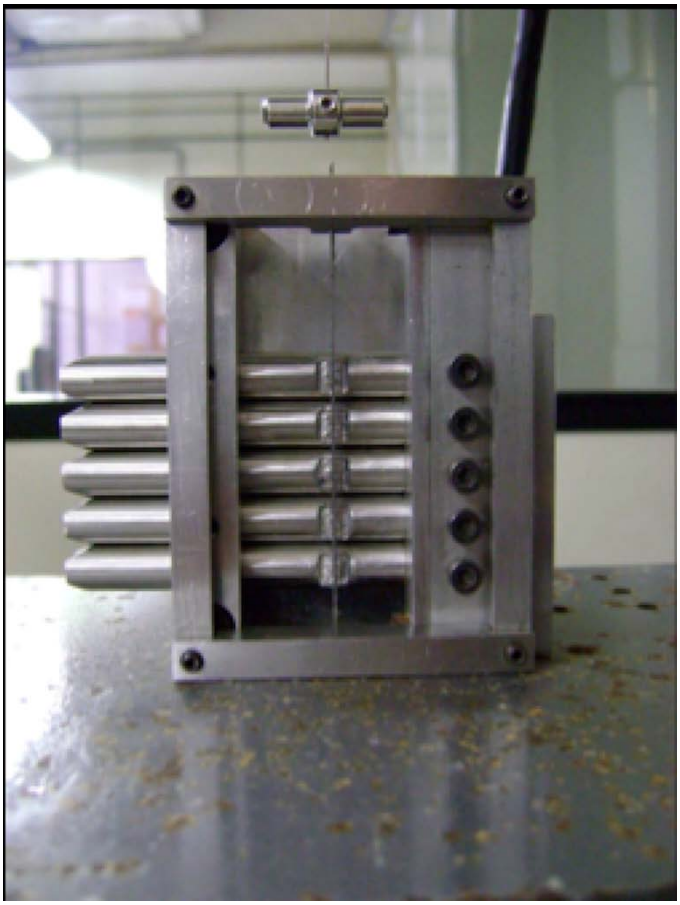


Figure 1: Illustration of the device structuredesigned by Martins (2008) and its parts.



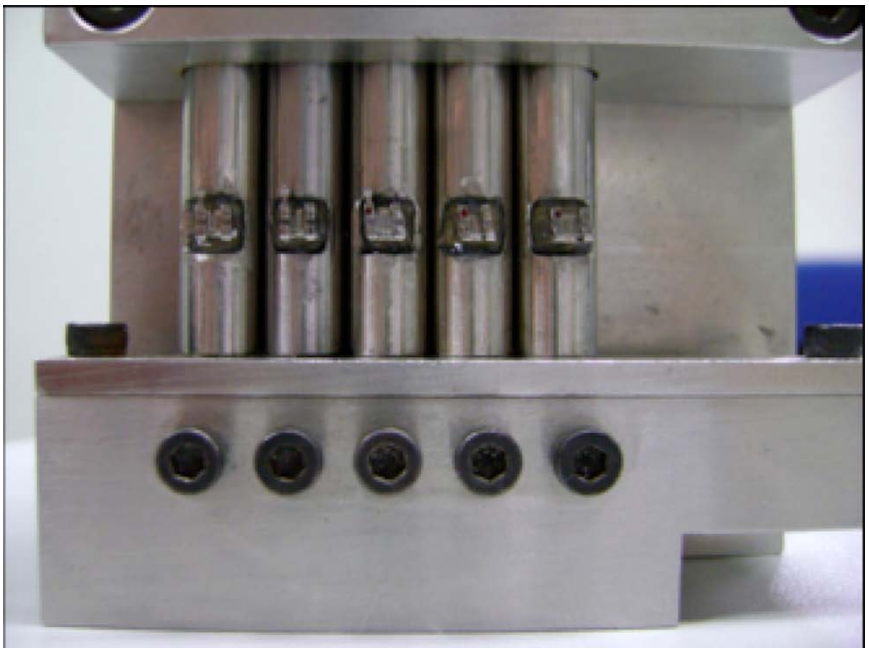
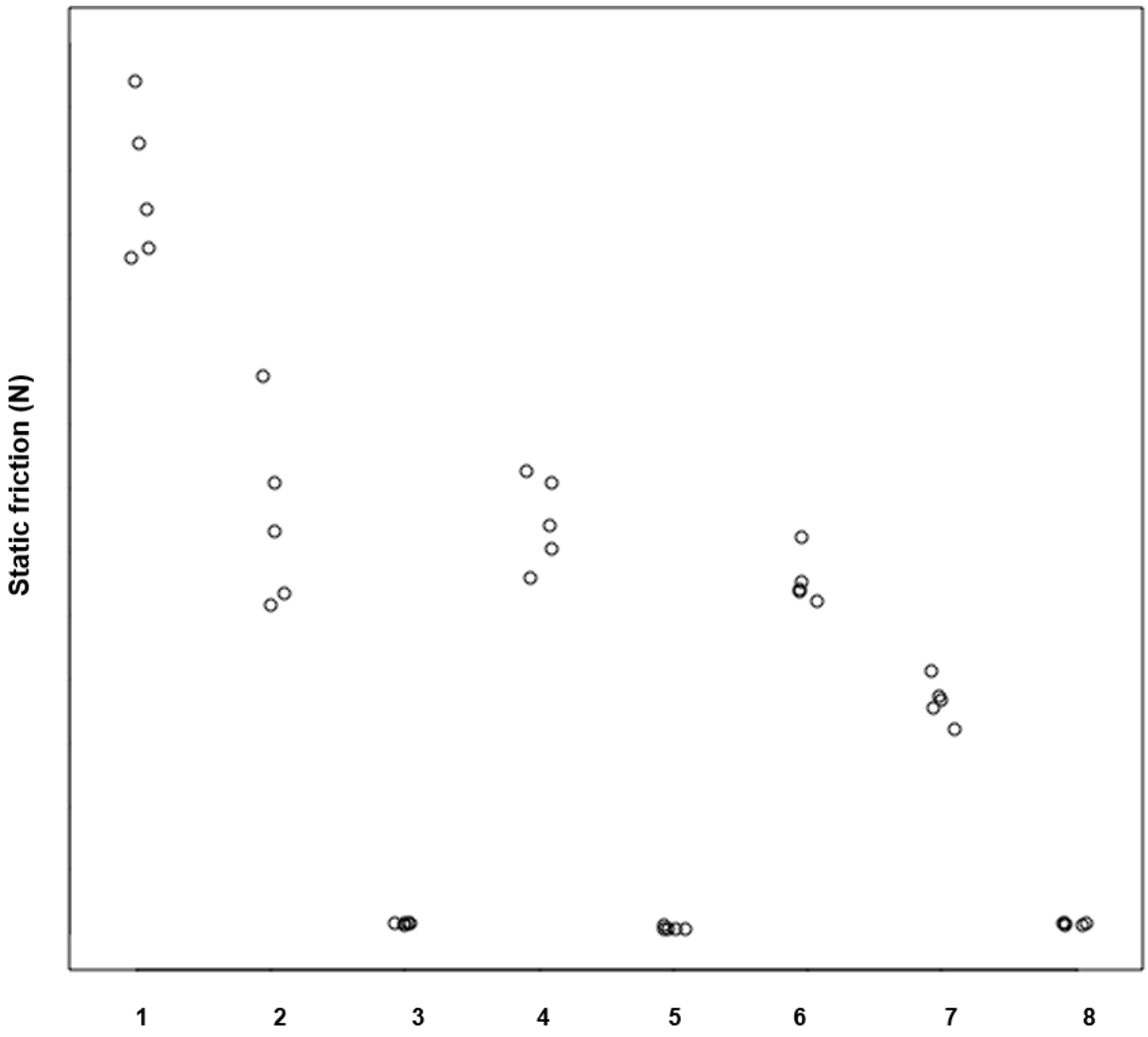
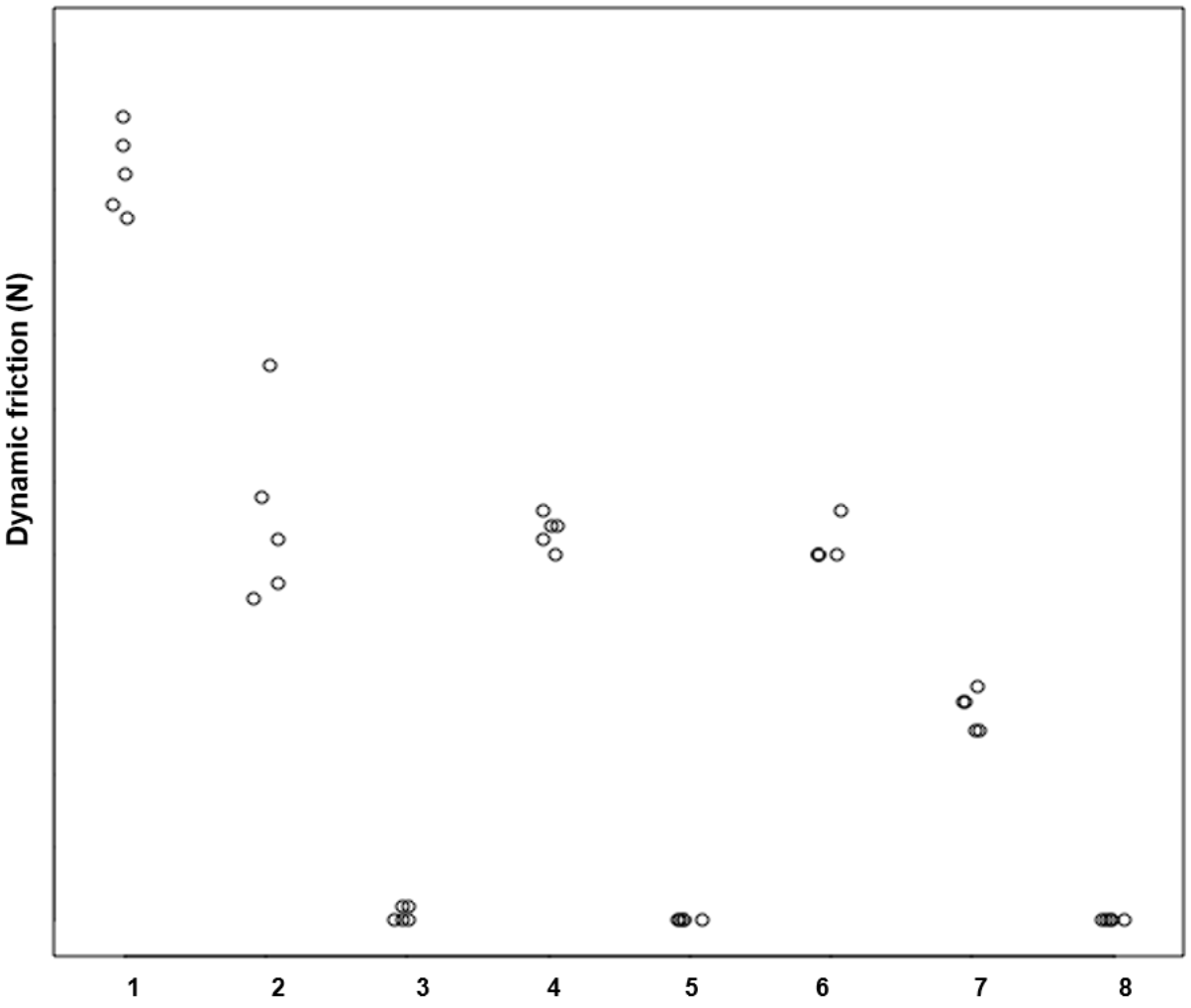


Figure 2: Device structure adapted to a machine EMIC DL2000.



Graph 1: Scatter diagram of one-dimensional static friction of the specimens according to bracket type.



Graph 2: One-dimensional scatter diagram of dynamic friction of specimens according bracket type.

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Effect of Sodium Ascorbate Concentration after Bleaching on the Enamel Shear Bond Strength of Giomer Resin

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Abstract- The aim of this in-vitro study was to evaluate the application of different concentrations of sodium ascorbate (SA) on the strength of bonding to enamel after bleaching with hydrogen peroxide (HP). Forty human anterior teeth were randomly divided into four groups. Group 1 was treated with no bleaching application (negative control), and the treatments applied in the other groups were: Group 2; 35% HP for 30 min + 40% SA for 10 min, group 3; 35% HP for 30 min + 20% SA for 10 min, and group 4; 35% HP for 30 min + 10% SA for 10 min. Specimens were restored with adhesive All-Bond Universal (Bisco, Schaumburg, IL, USA), and a Beautifil-2 (Shofu Inc., Kyoto, Japan) giomer-resin material build-up was created. The specimens were subjected to shear bond testing by a universal machine. The data were analyzed with the Kruskal Wallis test followed by the Mann Whitney test, and $p < 0.05$ was deemed to indicate statistical significance. The unbleached teeth showed the highest shear bond strength, followed by the bleached teeth treated with 40% SA.

Keywords: *sodium ascorbate, shear strength, dental resin, bleaching.*

GJMR-J Classification: *NLMC Code: WU 113*

Strictly as per the compliance and regulations of:

Effect of Sodium Ascorbate Concentration after Bleaching on the Enamel Shear Bond Strength of Giomer Resin

Ali Alabaş [α], Fulya Toksoy Topçu [σ] & Elif Aybala Oktay [ρ]

Abstract- The aim of this in-vitro study was to evaluate the application of different concentrations of sodium ascorbate (SA) on the strength of bonding to enamel after bleaching with hydrogen peroxide (HP). Forty human anterior teeth were randomly divided into four groups. Group 1 was treated with no bleaching application (negative control), and the treatments applied in the other groups were: Group 2; 35% HP for 30 min + 40% SA for 10 min, group 3; 35% HP for 30 min + 20% SA for 10 min, and group 4; 35% HP for 30 min + 10% SA for 10 min. Specimens were restored with adhesive All-Bond Universal (Bisco, Schaumburg, IL, USA), and a Beautifil-2 (Shofu Inc., Kyoto, Japan) giomer-resin material build-up was created. The specimens were subjected to shear bond testing by a universal machine. The data were analyzed with the Kruskal Wallis test followed by the Mann Whitney test, and $p < 0.05$ was deemed to indicate statistical significance. The unbleached teeth showed the highest shear bond strength, followed by the bleached teeth treated with 40% SA. Within the limitations of this study, it can be concluded that SA increased the potential bond strength associated with bleached enamel. Notably however, none of the different concentrations of SA tested restored the bond strength values to those of the unbleached teeth.

Keywords: sodium ascorbate, shear strength, dental resin, bleaching.

I. Introduction

The bleaching of vital teeth is a method used for eliminating the discolorations found on the surface and in the inner structure of teeth. It is a reliable and accepted treatment, and its popularity is on the increase. However, clinicians should be aware of the potential interactions between bleaching treatments and procedures involving adhesives, performed to treat aesthetic irregularities.

Bleaching agents of various concentrations are used to obtain rapid and aesthetic results. Hydrogen peroxide (HP) and carbamide peroxide have been successfully used for many years, to attain the desired tooth color. Postoperative susceptibility, pulpal irritation, changes in tooth structure, and microleakage due to existing restorations may be considered among the contraindications for bleaching treatments. Another important complication that occurs after bleaching is a reduction in the strength of the bond between composite resin and the enamel.[1]

Were a composite resin restoration is planned for a patient after the bleaching process, treatments such as laminate veneers and adhesion of an orthodontic bracket can be adversely affected by the prior bleaching, with regard to bonding to the enamel.[2] Several studies have shown that the bonding values of composite adhesive restorations performed on the surfaces of teeth after bleaching are considerably lower when compared with the surfaces of teeth to which no bleaching has been applied. The reason for this is the presence of a residual oxygen layer that occurs as a result of the bleaching process, and it has been reported that removing this residual oxygen layer increases the strength of bonding between the tooth and the composite material.[3] The general approach for avoiding the compromised bond strength that occurs after bleaching is to observe a waiting period, which can be as little as 24 hours or can extend to up to 3 weeks.[3]

Recently conducted research suggests that the reduction in the strength of the bond between the adhesive and the tooth surface after bleaching can be ameliorated via the application of the antioxidant agent sodium ascorbate (SA). Antioxidant agents neutralize oxygenic free radicals and eliminate their negative biological effects.[4]

The objective of the current study was to evaluate bond strength between the tooth enamel and giomer-resin in teeth that had first been subjected to HP treatment, then treatment with one of three different concentrations of SA, then had the restorations performed.

II. Methodology

The protocol of this study was reviewed and approved by the Gulhane Military Medical Academy Research Ethics Committee (Registration number 08/236), and informed consent was obtained from the tissue donors. Forty undecayed human anterior teeth extracted for orthodontic and periodontal reasons were used in our study. The teeth were randomly divided into 4 groups of 10 teeth per group. In group 1 (negative control), giomer-resin blocks were built over the surface

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of the enamel without applying any bleaching agent or an antioxidant solution to the teeth. In group 2, giomer-resin blocks were built over the surface of the enamel after the application of a 35% bleaching agent containing HP for 30 min and a 40% solution containing the antioxidant agent SA for 10 min. In group 3, giomer-resin blocks were built over the surface of the enamel after the application of a 35% bleaching agent containing HP for 30 min and a 20% solution containing the antioxidant agent SA for 10 min. In group 4, giomer-resin blocks were built over the surface of the enamel after the application of a 35% bleaching agent containing HP for 30 min and a 10% solution containing the antioxidant agent SA for 10 min.

Immediately after being extracted, all teeth used in the study were immersed in a 10% formaldehyde solution, where they were stored until the time of study. Particular attention was paid to ensure that no decay, cracks, or fractures were present on the labial enamel surfaces of the teeth. The teeth were cleaned of debris with the aid of a periodontal curette, and were then immersed in de-ionized distilled water.[5] Under water cooling, with the aid of a low-speed engine (Isomet Buehler Ltd, Chicago, IL, USA) all the dental crowns were cut and detached from the root parts by means of double-sided diamond discs, such that they remained 2 mm below the cementoenamel junction (CEJ). The root canal outlets that had been opened on the cut-off section were closed with a composite resin-based filling material. The crown pieces that were cut were kept in de-ionized distilled water at all non-experimental stages of the trial, to negate any dehydration. The teeth were embedded in cold acryl put into PVC-blocks of 3.0 cm in height and 2.5 cm in diameter, such that the labial enamel surface of each crown fragment was left exposed.[6] The labial surfaces of the teeth were rubbed with 600-grid silicon carbide emery (abrasive) paper under water, and smooth, flat enamel surfaces 3 mm in diameter were obtained. The samples were then put into de-ionized distilled water.

The bleaching gel used incorporates a syringe system. Groups 2–4 were subjected to a bleaching agent containing 35% HP for 30 min (Yotuel Special, Biocosmetics Laboratories, Madrid, Spain). At the end of the bleaching treatment, the gel on the samples was removed with the aid of a surgical aspirator; then, the samples were washed in de-ionized distilled water. The different antioxidant treatments were then performed.

For group 2, 60 mL of de-ionized distilled water was put into a 100-mL glass tube, and SA was added until the volume reached 100 mL; hence, a 40% SA solution was obtained. For group 3, 80 mL of de-ionized distilled water was put into a 100-mL glass tube, and SA was added until the volume reached 100 mL; hence, a 20% SA solution was obtained. For group 4, 90 mL of de-ionized distilled water was put into a 100-mL glass tube, and SA was added until the volume reached 100 mL; hence, a 10% SA solution was obtained.[7] Then, 1 mL of the relevant solution was applied to each of the samples every minute for a period of 10 min, thus, renewal of the solution and constant wetness of the enamel surface were ensured.[8,9] At the end of this 10-min period, the enamel surfaces were washed in distilled water for 30 sec, and immediately thereafter, the construction of giomer-resin blocks over tooth enamels was performed.

At the resin block construction phase, the tooth enamels were first acidified with 37% orthophosphoric acid gel (Super Etch, SDI Ltd., Victoria, Australia) for 15 sec. In order to remove the acid gel after the acidification process, the tooth enamels were washed in water for 15 sec, and the remaining water on the surface was eliminated via a moist cotton pellet. A thin-layered adhesive (All Bond Universal, Bisco Inc., Schaumburg, IL, USA) was then applied to the acidified enamel surface with a micro-brush for 10 sec, after which it was subjected to air-drying for 10 sec, irradiated for 10 sec, and lastly it was polymerized. Following this, cylindrical plastic tubes with an inner diameter of 2.5 ± 0.02 mm and a height of 3.0 ± 0.02 mm were placed onto the tooth enamel surfaces.[2,4] The plastic tubes were then filled with giomer-resin material (Beautifil 2, Shofu Inc., Kyoto, Japan), and polymerization was performed for 20 sec by means of a composite pistol emitting visible blue light with a wavelength of 430–490 nm (Bluephase C5, Ivoclar Vivadent, Liechtenstein, Switzerland). The plastic tubes were cut and removed with a bistoury (scalpel) end; then, resin blocks were obtained. The samples were kept in de-ionized distilled water for a period of 1 day prior to bond strength testing.

Bond strength testing was performed with an Instron 3363 (Norwood, MA, USA) device. The acrylic blocks were positioned such that the specialized end of the Instron device that takes the form of a knife-edge rested in the tooth enamel surface-junction area of the giomer-resin blocks. The samples were subjected to shear force such that the "crosshead" speed/rate was 1 mm/min.[7] The data were recorded in megapascals (mpa).

a) Statistical Analysis

Statistical analyses of the data were performed via the SPSS 22.0 for Windows software package (SPSS Inc., Chicago, USA). As the number of samples in each group was small, the median, minimum, and maximum values were used in descriptive statistical analyses. Kruskal-Wallis analysis, which is the non-parametric equivalent of one-way analysis of variance, was used to compare the groups. As a post-hoc multiple comparison method, the Mann-Whitney U test with Bonferroni correction was performed, to reduce the error level. In the statistical analyses, $p < 0.05$ was deemed to indicate statistical significance.

III. Results

The descriptive statistics derived from each group are shown in Table 1. There was a significant difference in the ultimate strengths between the groups, in terms of mpa values, as identified via the Kruskal-Wallis test.

Table 1: The descriptive statistics derived from each group via the Kruskal-Wallis test

	Median	Minimum	Maximum	*p*
Group1 – Control	28.20	25.28	29.90	< 0.001
Group 2 – 40%	21.19	18.96	25.13	
Group 3 – 20%	13.66	12.81	17.18	
Group 4 – 10%	12.06	10.83	13.59	

Comparisons of the mean scores in each group suggest that the most successful experimental (non-control) group was group 2 (40% SA). When group 2, group 3 (20% SA), and group 4 (10% SA) were compared with one another, a statistically significant difference was observed. The values that were closest to those of group 1 (the control group) were obtained in group 2, and group 4 exhibited the lowest ultimate strength.

IV. Discussion

In today's society, people are aware of the importance of teeth in human aesthetics. Discolored teeth that distort aesthetic appearance can negatively affect the psychological wellbeing and social lives of individuals. For these reasons, interest in tooth bleaching treatments is rapidly increasing.

The bleaching process on its own is not sufficient for achieving the necessary aesthetics in patients with diastema or distortion in the shape and form of their teeth. In such cases, composite restorations along with bleaching and aesthetic adhesive procedures such as laminate veneers are applied as a combined treatment. For better color harmony, adhesive practices such as diastema closure, or adjusting the form of canines or arranging the positions of lateral incisors can be performed following the bleaching process. For the long-term clinical success of adhesive restorations, sufficient adhesion must be ensured in the tooth structure. Any factor likely to adversely affect adhesion will also affect the aesthetic appearance and durability/stability of adhesive restorations.[10]

In the literature, it is stated that bleaching with peroxide reduces the adhesive strength of the composite over the tooth enamel.[11,12] Those reports recommend a waiting period of 1–3 weeks before an adhesive procedure after bleaching. Such waiting periods are not appropriate in cases in which early aesthetic arrangements are required.

It has been suggested that the main reason for the decline in adhesive bond strength after bleaching is that residual oxygenic free radicals remain in the tooth tissue in the wake of bleaching, and these prevent resin polymerization.[13,14] Those studies utilized electron and optical microscopes and showed that the resin tags on bleached enamel surfaces are scattered, weak-looking, and structurally insufficient. It has also been suggested that the adhesive agent applied on the bleached enamel surface is not fully polymerized, such that the mechanical retention weakens and the strength of the adhesive diminishes.[15,16] In those studies, papilla bubble-like structures and gaps were observed within the adhesive layer, and the authors surmised that the reason for this was that the oxygen released from HP remains within the adhesive layer in the course of the irradiation of the bonding agent.

In previous studies, various antioxidant agents have been used to eliminate the oxygen radicals that remain in the hard tissues of teeth after bleaching. These include SA,[1,3,17,19] catalase,[17] glutathione peroxidase,[17] acetone,[17] ethanol,[17] sodium bicarbonate,[17] grape seed extract,[3] pine bark extract,[3] proanthocyanidin,[1] lycopenine,[1] malvidin chloride,[19] pelargonidin chloride,[19] and α–tocoferol.[19] SA is the sodium salt form of ascorbic acid, which is known to be an effective antioxidant, and it has the ability to reduce various oxidative compounds.[7] A previous study suggested the potentially protective effect of SA against damage caused to biological tissues by HP.[20] While ascorbic acid also exhibits a high antioxidant effect, it is not appropriate for use in clinical procedures due to its very low pH of 1.8. In contrast, the pH of SA, the antioxidant activity of which is the same as that of ascorbic acid, is 7.4, which is more compatible with biological tissues.[21] Thus, we deemed it suitable to study SA, which we consider to be a biocompatible antioxidant agent with the potential for use after bleaching.

An appropriate duration period for the application of SA to bleached enamel surfaces has been determined to be 10 min in several studies.[1,3,22] Where restorative tooth therapy is performed on a patient after a procedure with an antioxidant agent, the amount of time that patient will spend in the clinic will be extended accordingly. It is thought that a short span of time with regard to the application of the antioxidant agent will be more convenient in terms of clinical use.

There are several reports of increases in adhesive bonding values when SA was used as an antioxidant agent.[1,19] On the other hand, in the studies in which different methods were applied, increases in adhesive bonding values have not been consistent. There are also studies showing that SA is insufficient for increasing adhesive bond strength.[17]

In the current study, the group that yielded a median value closest to the 28 mpa median of the control group was group 2 (40% SA), with a median of 21 mpa. In the results obtained at the end of our study, SA proved insufficient for increasing bond strength. In other studies, SA has been applied at different concentrations and for different periods of time, in efforts to ameliorate the reduction in bond strength of restorative materials observed after tooth bleaching.[4,17,22]

Subramonian et al.[3] assessed bonding values following office bleaching with 37% HP in two groups, one in which a 3-week waiting period was imposed, and the other in which 10% SA was applied for 10 min directly after bleaching. They reported that the bonding values were similar in both groups, but neither group attained the bonding values observed in the negative control group. Dabas et al.[2] applied 10% and 20% SA for 30, 60, and 120 min, and did not observe any significant differences in bond strengths between the 10% and 20% concentrations. They reported that bonding increased as the application period was extended, and that the adverse effect of bleaching was fully reversed after application periods of 60 and 120 min. Conversely, Tabatabaei et al.[4] reported that 10% SA did not yield any significant increase in bonding strength after application periods of 5 or 10 min; however, they ascertained that compromised bond strength could be completely negated via a 1-week waiting period.

Miranda et al. [23] found that the application of 10% SA for 60 min after bleaching yielded the same results as a 1-week waiting period; which yielded almost the same results as those observed in the negative control (no bleaching) group. Notably however, a 2-week waiting period yielded better results than were observed in either of the aforementioned groups.

In a study in which 35% HP was used, Freire et al.[24] applied 35% SA for different periods of time and compared the resulting bond strength values, and measured the residual oxygen radical rates after waiting periods of 24, 48, 72, 96, 120, and 144 hours in the control group. They reported that residual oxygen radicals had decreased to a large extent after the 72-hour waiting period. The values obtained in the groups in which 35% SA was applied for 10 and 60 min suggested bond strengths approximating those of the control group. In the current study, the median value of 21 mpa observed in the 40% SA for 10 min group was low in comparison with the 28 mpa median in the control group.

Torres et al.[17] reported that the mean bonding strength value in their control group after bleaching with 35% HP was 14.02 mpa, whereas it was 4.98 mpa after applying 10% SA for 20 min. Braz et al.[25] reported median bond strength values of 23.43 mpa in their control group after bleaching with 35% HP and 17.73 mpa after the application of 10% SA for 10 min. Subramonian et al.[3] reported that the mean bond strength in their control group after bleaching with 37% HP was 13.9 mpa, while it was 8.474 mpa after the application of 10% SA for 10 min. The median value of 28.20 mpa in the control group in our study, and the median value observed in group 4, in which 10% SA was applied for 10 minutes, seem to support the value of 12.06 mpa.

V. Conclusion

In the current study, even when a high SA concentration (40%) was applied for 10 min, the resulting bond strength values failed to reach those of the negative control group in which no bleaching was applied. Given that the patient is required to sit in the dental chair for almost 30 min during the bleaching process, we suggest that it will not be practical to apply an antioxidant agent for more than 10 min to enhance bond strength values. As performing a resin-filling process immediately after bleaching reduces the bond strength of adhesive restorations, dentists who aim to attain the best bond strength should take this situation into consideration.

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Figure Legend

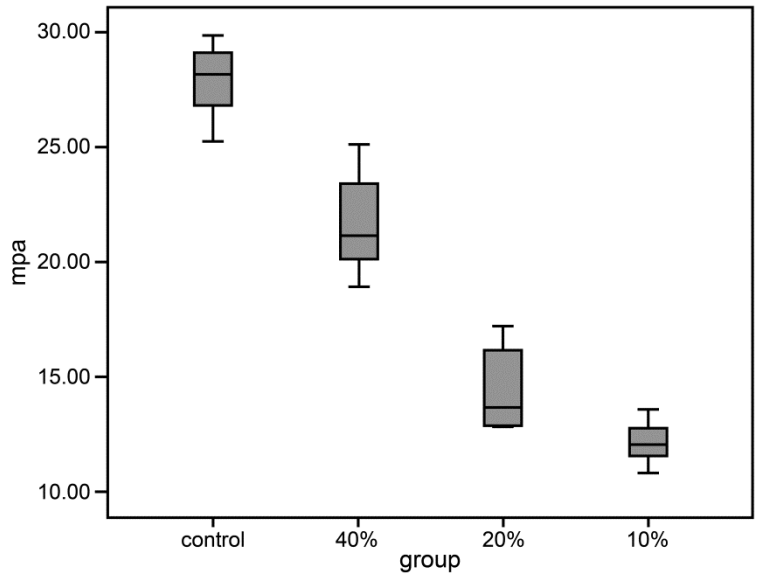

Figure 1: Box-plot comparison of the results of the control group and the experimental groups

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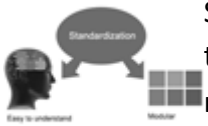

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- Font type of all text should be Swis 721 Lt BT.
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- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
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- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
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- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
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You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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Complete support for both authors and co-author is provided.

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Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

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(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

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(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

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(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

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References

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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

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30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

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Key points to remember:

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- Please note the criterion for grading the final paper by peer-reviewers.

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- To the point depiction of the research
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- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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	A-B	**C-D**	**E-F**
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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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