EVALUATION OF RATE OF SPACE CLOSURE, ARCH DIMENSIONAL AND AXIAL INCLINATION CHANGES BETWEEN SELF - LIGATING AND CONVENTIONAL BRACKETS – A PROSPECTIVE CLINICAL TRIAL

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled **"EVALUATION OF RATE OF SPACE CLOSURE, ARCH DIMENSIONAL AND AXIAL INCLINATION CHANGES BETWEEN SELF - LIGATING AND CONVENTIONAL BRACKETS – A PROSPECTIVE CLINICAL TRIAL"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. SRIRAM, M.D.S.,** Professor, Department of Orthodontics and Dentofacial Orthopaedics, Ragas Dental College and Hospital, Chennai.

Date: 10/1/17

Place: Chennai

Dr.Veera Sankar.S
Post Graduate Student
Department of Orthodontics and
Dentofacial Orthopaedics,
Ragas Dental College and Hospital,
Chennai

CERTIFICATE

This is to certify that this dissertation titled **"EVALUATION OF RATE OF SPACE CLOSURE, ARCH DIMENSIONAL AND AXIAL INCLINATION CHANGES BETWEEN SELF - LIGATING AND CONVENTIONAL BRACKETS – A PROSPECTIVE CLINICAL TRIAL"** is a bonafide record work done by **Dr.VEERA SANKAR.S** under my guidance during his post graduate study period 2014-2017.

This dissertation is submitted to **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY,** in partial fulfillment for the degree **of MASTER OF DENTAL SURGERY in BRANCH V** - Orthodontics and Dentofacial Orthopedics. It has not been submitted (partially or fully) for the award of any other degree or diploma.

Guided by:

10/01/2017

Dr. Sriram, M.D.S.,
Professor
Department of Orthodontics,
Ragas Dental College and Hospital,
Chennai.

DEPT. OF ORTHODONTICS
RAGAS DENTAL COLLEGE & HOSPITAL
UTHANDI, CHENNAI-600 119

Head of the Department:

10/1/17

Prof. (Dr.) N.R. KrishnaswamyM.D.S.,
M. Ortho R.C.S. (Edin) Dip N.B. (Ortho)
Diplomate-Indian Board of Orthodontics
Professor and H.O.D
Department of Orthodontics,
Ragas Dental College and Hospital,
Chennai.

Dr. N. R. KRISHNASWAMY,
PROFESSOR & HEAD
Dept. of Orthodontics
RAGAS DENTAL COLLEGE & HOSPITAL
2/102, East Coast Road
Uthandi, Chennai-600 119

Dr. N. S. AZHAGARASAN, M.D.S.,
Principal
Ragas Dental College and Hospital, Chennai.

PRINCIPAL
RAGAS DENTAL COLLEGE AND HOSPITAL
UTHANDI, CHENNAI-600 119.

RAGAS DENTAL COLLEGE Chennai

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CONTENTS

Introduction

INTRODUCTION

Self – ligation Brackets were introduced to the field of orthodontics as early as 1935 by Stolzenberg as 'Russel's lock edgewise bracket'.[33]

Only for the past two decades there has been as steady increase in the manufacturing and usage of self-ligating appliances[53]. The use of self-ligating brackets has been increased over time. In 2002, 8.7% of American orthodontists used atleast one self-ligating system; in 2008 the number had increased to 42%[11].

According to the manufacturers these self – ligation brackets are easier to handle while ligation process and also exhibit lower frictional forces than conventionally ligated brackets. Conventionally ligated edgewise brackets incur increased levels of frictional resistance via the elastomeric attachment between bracket and archwire[8,9,33] and also have other limitations which include failure to maintain full arch wire engagement, force decay of elastics, impeded oral hygiene and time consuming clinical procedures[29]. Self ligating brackets claim to have overcome these drawbacks and also have increased rate of tooth movement is a potential clinical advancement.

The term self-ligation in orthodontics refers to orthodontic bracket which has the ability to engage itself to the arch wire without any other additional form of ligations such as modules, ligature wires, etc,. Self-ligating (SL) brackets have a mechanical device built into the bracket to close off the slot. Self ligating brackets (SLB) are broadly classified into Active, Passive, and Interactive Self –ligating brackets.

- ❖ Active brackets, with the labial fourth wall consists of a spring clip which is in contact with the arch wire. These brackets express greater torque control. In the Active SLB system, friction is produced as a result of the clip pressing against the archwire[29].
- ❖ In passive SLB system, the slot is transformed into a tube by means of the labial fourth wall that does not come into contact with the archwire. However, the term "passive" is somewhat a misnomer because it is passive only when teeth are ideally aligned in all the three dimensions, and an undersized wire would not touch the sides of the bracket slot[10].
- ❖ In Interactive bracket system, the clip is passive with the initial lower dimensional wires and as the dimension of the arch wire increases the clip actively engages the arch wire and express greater torque control, which is required in the retraction and finishing stages of treatment[10].

Example of active bracket is, SPEED (Strite Industries, Cambridge, Ontario, Canada). Examples in the passive group are the Damon bracket (Ormco.Glendora, Calif) and the SmartClip bracket (3M Unitek, Monrovia, Calif)[73]. The In-Ovation "R" (GAC International, Bohemia, NY) and Time (American Orthodontics, Sheboygan, Wis) are the SL systems which claim to be interactive. But, as per Kusy et al[38] bracket systems are conventional, and SL active and passive are interactive to some degree - meaning that the wire probably touches some aspect of the bracket throughout the treatment. Bracket manufactures promote patient comfort as an advantage of self ligating brackets in spite of the lack of concurrence in scientific literature[19].

The studies, which are predominantly retrospective, have provided conflicting evidence: on one hand self-ligating brackets produce improved treatment efficiency and on the other hand that they offer no such advantage. For example, Harradine reported a significant 4 month reduction in duration of treatment when Damon SL brackets were compared with an unspecified conventional pre-adjusted twin bracket. More recently, Miles et. al. found no advantage in treatment efficiency when either SmartClip or Damon 2 SL brackets were compared with conventional brackets. There is, however, one consistent finding from these studies which summarizes on efficiency and treatment costs with self-ligating brackets. They also have a higher rate of bond failure than conventional brackets[22].

Reduced friction with self-ligating brackets, claims that it is advantageous than conventional brackets which asserts the fact that low friction allows for sliding mechanics to be accomplished in the truest sense, thereby facilitates alignment, increases the appointment intervals, and thereby reduces the overall treatment time[24].

Also, with friction, the idea that less force is needed to cause tooth movement has led to the presumption that self-ligating brackets produce more physiologically harmonious tooth movement by not interrupting the periodontal blood supply[8]. Therefore, more alveolar bone generation with greater amounts of expansion and less proclination of anteriors that leads to the less need for extractions are claimed to be possible with self-ligating brackets.

Other advantages of the self-ligating bracket system that have been highlighted for more certain full arch wire engagement, less chair-side assistance, and faster arch wire removal and ligation, leading to reduced chair side time[22].

However, a large retrospective[73] study and all prospective[73,13,20] studies, have found no measurable advantages in orthodontic treatment duration, number of treatment visits, or on the time spent in initial alignment with self-ligating brackets over conventional brackets.

Studies investigating arch dimensions and axial inclination changes of the anteriors have shown no significant difference between the two groups for inter-canine and inter-molar widths[72, 34.].

For torque expression, a meta-analysis indicated that self-ligating brackets resulted in slightly less mandibular incisor proclination (1.5 degrees) when compared with the conventional brackets[35].

Thus, evidence on the advantages of self-ligation appears to be jumbled and other well-conducted studies are needed to evaluate the various claims made by proponents of self-ligation.

Studies comparing the failure rate in treatment efficiency between self-ligating and conventional brackets have shown conflicting results[37,31]. Pandis et al. found no significant difference between the two systems[45].

During premolar extraction treatment, the orthodontists have several options for space closure. More commonly used method is en-masse space closure with sliding mechanics with the use of Ni-Ti coil springs. Some self-ligating brackets are labelled as passive and promoted on the premise that elimination of ligatures reduces friction and allows for faster sliding mechanics. If true, self-ligating brackets can leads to the reduction in overall treatment duration[55].

Studies investigating the rate of space closure have also reported no difference between self-ligating and conventional brackets. However, they have only compared passive self-ligating brackets with conventional brackets and either have used a split-mouth design or have measured space closure for only a limited period of time[23]. It has been also proposed that some self-ligating appliances might increase the inter molar widths. The available evidence on the efficiency of self-ligating brackets is derived from a limited number of prospective and randomized clinical trials. Some studies have shown differences in Inter-molar widths, and some have shown no differences between self-ligation and conventional bracket systems[8,9].

Before the advent of Computerized Tomography, it was impossible to visualize the buccal bone due to superimposition that occurred in 2D radiographs. To achieve successful orthodontic treatment, the limits of orthodontic movement must be assessed to prevent iatrogenic effects to the periodontium, such as gingival recessions, dehiscence and bone fenestrations. Studies prior to introduction of the cone-beam computed tomography scans assessed only the dental casts and radiographs, both of which used to be regarded as gold standards. Improvements in CBCT scans proved it as a reliable one that offers an outstanding visualization of the actual structures. Timock et al investigated the accuracy and reproducibility of measurements of alveolar bone height and thickness by using Cone Beam Computed Tomographic images. They found good quality and accuracy for both measurements[42].

The transversal response of the mandibular dental arch treated with CLB has been widely studied in the literature, especially the dento-alveolar response on dental casts. However, little is known regarding CBCT scans used to assess the mandibular alveolar bone of the posterior region, where buccal bone can be detected and quantified[42].

To the best of our knowledge, no previous in vivo studies have compared the retraction efficiency and the arch dimensional changes with use the of active, passive self ligating bracket with conventional bracket in a CBCT and in a dental cast concept.

Thus, the purpose of this study was to compare the retraction efficiency, transverse arch dimensional changes and the torque expression between interactive, passive self ligating bracket system and Conventional bracket system using CBCT and dental casts

Review of Literature

REVIEW OF LITERATURE

Jacob Stolzenburg (1935)[33], first introduced self-ligating bracket system and described the features of Russell Lock attachment which are generally smoother for the patients as there are no steel ligatures present for archwire engagement. The precision arm or the fourth sliding wall completely secures the arch wire within the dimensions of the slot providing robust ligation mechanism and controlled tooth movement.

Tweed (1966)[79] in his philosophy of orthodontic treatment said that the main goal is to preserve the anchorage, right from the start of the treatment and to prevent the major reciprocal reaction that occurs during retraction stage.

Shivapuja (1994)[67] in his comparative study on the effect of self ligation bracket and conventional bracket ligation system found that the self ligation system displayed a significantly lower level of frictional resistance, less chairside time and improved infection control compared to ceramic or metal brackets.

Tselepis M, West VC, Brockhurst P (1994)[77] Compared the dynamic frictional resistance between orthodontic bracket system and arch wires, arch wire material, bracket material, bracket to arch wire angulation and lubrication. The frictional force levels involved in sliding a ligated arch wire through a bracket slot was measured with an universal testing machine. Of the four factors investigated by him, all were found to have significant influence on friction. The polycarbonate brackets showed the highest friction and the stainless steel brackets showed the least. Friction is increased with the bracket to arch wire angulation. Saliva lubrication reduced the friction significantly. A range of 0.9-6.8 N frictional force levels were recorded. The actual force values recorded were most useful for comparing the relative influence of the factors tested for friction, rather than a quantitative assessment of friction in vivo. The force levels observed suggest that friction maybe a significant influence on the amount of applied force required to move a tooth in the mouth.

Dwight H Damon (1998)[8] compared the friction produced by three types of conventional twin brackets with three self-ligating brackets. When a 0.019 x 0.025 inch stainless steel wire were drawn through the bracket, a conventional twin ligated bracket system with elastic modules produced 388 to 609 times the friction of passive self-ligated brackets produced. Conventional twins with metal ligatures had friction values more than 300 times compared to the passive self-ligating brackets. The active brackets produced 216 times the friction of a passive self-ligating bracket.

Luca Pizzoni et al (1998)[40] studied the frictional resistance encountered in two self-ligating bracket systems (Speed, Damon SL) and two conventional brackets (Dentauram). These brackets were tested with four wires (Stainless steel, Beta titanium-round and rectangular). The result showed that round wires had a lower friction than rectangular wires. Beta titanium had higher friction than stainless steel. The self-ligating brackets had markedly lower friction than conventional brackets at all angulations. It was concluded that the selection of bracket design, wire material and wire cross section significantly influences the forces acting in a continuous arch system.

Kusy in 2004[39] explained the frictional behavior of four conventional and four self-ligating brackets were simulated using a mechanical testing machine. Analyses of the two-bracket types were completed by drawing samples of three standardized arch wires through quadrants of typodont models in the dry/wet states. Pretreatment typodonts of an oral cavity featured progressively malocclused quadrants. As nominal dimensions of the arch wires were increased, the drawing forces of all brackets increased at different rates. When coupled with a small wire, the self-ligating brackets performed better than the conventional brackets. For the 0.014- inch wires in the upper right quadrant, the maximum drawing forces averaged 125 and 810 cN for self-ligating and conventional brackets, respectively. When coupled with larger wires, various designs interchangeably displayed superior performance. For the 0.019 x 0.025-inch wires in the upper left quadrant, the maximum drawing forces averaged 1635 and 2080 cN for self-ligating and conventional brackets, respectively. As the malocclusion increased, the drawing forces increased. For example, in the least malocclused quadrant and with the smallest wire, maximum drawing forces for self-ligating and conventional brackets averaged 80 and 810 cN, respectively, whereas in the most malocclused quadrant tested with the same wire size, maximum drawing forces for self-ligating and conventional brackets averaged 870 and 1345 cN, respectively. For maximum values between the dry and wet states, significant differences between ambient states existed only for the In-Ovation brackets in the lower left quadrant. These test outcomes illustrated how bracket design, wire size, malocclusion, and ambient state influenced drawing forces.

Daniel Rinchusea and Peter G Miles (2007)[10] elucidated that the ligation force is not transmitted to the tooth but is counteracted by the equal and opposite force of the self-ligating brackets against the arch wire. A module exerting 50g force pulling the wire into the base of the slot is the load or normal force, so it is pertinent in friction when sliding but does not place a direct force on the tooth. The deflection of the arch wire exerts the force on the tooth. Friction, which impedes the sliding movements is determined by multiplying the coefficient of friction of the materials in contact by the normal force, which is the force of ligation. Therefore, friction is directly proportional to the force of ligation. The force applied to the tooth comes from the deflection of the arch wire, so if the module does not deflect the arch wire, then it is passive and no force is applied to the tooth. This normal force is avoided by using a Damon or a Smart Clip bracket or passive ligation only when the brackets and wire are ideally aligned. Any deflection of the arch wire that engages the bracket due to rotation, tip or torque creates a normal force and therefore classical friction. If this deflection is greater, eventually binding and notching occur; these event cannot be avoided by any bracket design whatsoever. So, a possible SLB in future could be a combination bracket with both a spring clip and a passive slide. It could be also tied conventionally. If low resistance to sliding is desired, the passive slide could be used, but, if high resistance to sliding is appropriate, then the active spring clip could be used. For example, the passive slide to reduce frictional resistance could be used in the initial stages of treatment, and the spring clip can be utilized later in treatment for three dimensional control. Therefore, this bracket system could take advantage of an active spring clip or a passive slide at the orthodontist's discretion. Keeping in mind this idea, the clinician could determine the particular needs and vary the type of control for each tooth. Another possibility he stated was that of a hybrid system in various combinations of conventional brackets and ligation, SL spring clip and SL passive slide brackets that could be integrated into the patient's treatment by using the same slot size for all teeth. For instance, in the extraction space closure method of Gianelly, with crimpable hooks and the anterior brackets could have been conventional brackets and ligation or an active SL clip for 3D tooth control, whereas, the posterior teeth could have passive SLB to reduce friction for space closure by sliding. The conventional bracket, spring clip and passive slide scheme could be modified for extraction and non-extraction patients. Perhaps for certain non-extraction cases, all teeth could have brackets with spring clip. Depending on the desired choice, SLB could be used selectively with conventional brackets. For example, SLB could be used only on teeth distal to extraction sites when closing the spaces by sliding or distal to open coil springs when opening spaces.

Harradine (2003)[26] reported that currently available self-ligating brackets offer the valuable combination of low friction and secure full bracket engagement. These developments offer the possibility of a significant reduction in average treatment times and also in anchorage requirements, particularly in cases requiring large tooth movements.

Kapur et al (1998)[36] conducted a study to compare the kinetic frictional force of a new self-ligating bracket (Damon SL) with that of a conventional bracket. The results he revealed were that the self-ligating brackets had lower kinetic friction coefficient. They concluded that self-ligating brackets could offer a substantial clinical advantage to orthodontists employing sliding mechanics.

Goonewardene in 2008[63] determine if self-ligating brackets are more efficient than conventional pre-adjusted brackets when used in a specialist practice setting seven hundred and sixty two patients, consecutively treated with fixed appliances, were evaluated retrospectively. All patients were treated by one orthodontist in a private orthodontic practice. Three hundred and eighty three patients were treated using a conventional pre-adjusted bracket system and 379 patients were treated with active self-ligating brackets. The total treatment time, number of appointments, appointment intervals, number of bracket breakages and number of unscheduled emergency appointments were recorded. Pretreatment characteristics identified by the ICON were related to these variables .The average treatment duration was 15.7 months (Range: 4.1- 40.5 months; SD: 5.6 months). Comparable amounts of time were spent in rectangular and round arch wires by both appliances. Overall, there was no advantages in orthodontic treatment time, number of treatment visits and time spent in initial alignment over conventional pre-adjusted orthodontic brackets.

Profit and Fields (2000)[61] discussed the methods of anchorage control. The extent to which the anchorage should be reinforced depends on the tooth movement that is desired. For significant differential tooth movement, the ratio of periodontal ligament area in the anchorage unit to periodontal ligament area in the tooth movement unit should be at least 2 to 1 without friction, 4 to 1 with friction. Anything less produces something close to reciprocal movement. A common way to improve the anchorage control is to pit resistance of a group of teeth against the movement of a single tooth, rather than dividing the arch into more or less equal segments. For all four extraction cases with maximum anchorage consideration the three possible approaches for space closure are:

- One step closure with friction less appliance
- A two step closure sliding the canine along the arch wire, then retracting the incisors(like original Tweed technique) Two step closure, tipping the anterior segment with some friction, the uprighting the tipped teeth (as in Begg technique)

Jeffrey L. Berger (1990)[2] showed the basis for the SPEED Design. In 1980, Dr. G. Herbert Hanson invented a miniaturized self-ligating bracket with a super elastic nickel titanium spring clip to entrap the archwire. This flexible spring clip can occupy either of two resting positions: “slot closed” to capture the archwire, or “slot open” to release the arch-wire. This active spring clip is also capable of storing energy, which is gently released as corrective tooth movement occurs. This fully pre-adjusted edgewise appliance, was available in both 0.018” and 0.022” slot size. Benefits for the clinician include:

- Highly flexible nickel titanium spring clip provides precise 3-D tooth control,
- Minimal friction during sliding mechanics
- Large interbracket span,
- Spring clip will not fatigue or plastically deform under normal treatment conditions.

John R. Valant (2008)[80] described a system which is interactive, that is, they can exhibit either passive or active properties during any stage of treatment at the discretion and direction of the clinician. There were principle problems with a bracket system which is entirely active or passive, such as difficulties in either achieving complete rotational corrections or maintaining them once corrected, Inadequate torque control, Patient discomfort, Lessened levels of hygiene due to bracket size and profile. This bracket system and its mode of function, appeared to incorporate all of the desirable features that were lacking in the systems previously used:

- Minimal force and friction (passive) in the early stage of treatment
- Torque and rotational control (active) in the middle and finishing stages of treatment
- Low profile (low in-out relationships)

An interactive mechanism has the inherent capacity to interact with different arch wires in varying degrees and the amounts of force, friction, and control that it can express. Furthermore, it is differentiated from an active mechanism by virtue of the physical design and positional relationship of the wire restraining and controlling element. Interactive clips are fabricated to allow for varying degrees of contact with the archwires. As the wire dimensions change, there is a gradual level of contact (variable amounts of force and control) between the archwire and the clip. For example, in the Time system, when 0.016 smaller round wires are used, the appliance is passive and yields very low levels of friction and force. However, when larger rectangular wires (eg, 0.017 x 0.025) are placed, the appliance becomes active in that it is then able to control and finalize rotations and torque.

Chen et al in 2010[73] from his systematic review were to identify and review the orthodontic literature with regard to the efficiency, effectiveness, and stability of treatment with self-ligating brackets compared with conventional brackets. An electronic search in 4 data bases was performed from 1966 to 2009, with supplemental hand searching of the references of retrieved articles. Quality assessment of the included articles was performed. Data were extracted by using custom forms, and weighted mean differences were calculated. Sixteen studies met the inclusion criteria, including 2 randomized controlled trials with low risk of bias, 10 cohort studies with moderate risk of bias, and 4 cross-sectional studies with moderate to high risk of bias. Self-ligation appears to have a significant advantage with regard to chair time, based on several cross-sectional studies. Analyses also showed a small, but statistically significant, difference in mandibular incisor proclination (1.5° less in self-ligating systems). No other differences in treatment time and occlusal characteristics after treatment were found between the 2 systems. No studies on long-term stability of treatment were identified. Despite claims about the advantages of self-ligating brackets, evidence is generally lacking. Shortened chair time and slightly less incisor proclination appear to be the only significant advantages of self-ligating systems over conventional systems that are supported by the current evidences.

Johansson and Fredrik Lundström (2012)[35] conducted a prospective and randomized study of the efficiency of orthodontic treatment with self-ligating edgewise brackets (SL; Time2 brand, American Orthodontics) and conventional edgewise twin brackets (CE; Gemini brand, 3M). The participants were treated by one of three specialists in orthodontics and with continuous instructions alternately by five orthodontic assistants according to our normal treatment routine (ie, modified 0.0220 MBT pre adjusted edgewise technique). The treatments were evaluated in terms of overall treatment time, number of visits, and treatment outcome using the Index of Complexity, Outcome and Need (ICON). The number of emergency appointments, number of archwires, overjet, relative space, and extractions at treatment start were noted. After dropouts, the analyzed material consisted of 44 patients treated with SL and 46 patients treated with conventional. It was found that were no statistically significant differences between the SL and CE groups in terms of mean treatment time in months (20.4 Vs 18.2), mean number of visits (15.5 Vs 14.1), mean ICON scores after treatment (13.2 Vs 11.9), or mean ICON improvement grade (7.9 Vs 9.1) thereby, they concluded saying that orthodontic treatment with SL brackets does not reduce treatment time or number of appointments and does not affect post treatment ICON scores or ICON improvement grade compared with Coventional Edgewise brackets.

Smita B Patil in 2014[71] compared the aligning efficiency, rate of retraction and torque expression of Self-ligating bracket (SLB) system with Conventional Pre adjusted Edgewise bracket (CLB) system. Twelve patients were selected and divided into two groups treated with self-ligating brackets (SLB, n=6) and conventional ligating brackets (CLB, n=6). The brackets used were 0.22 slot McLaughlin Bennet Trevesi (MBT) prescription. Aligning was evaluated with 0.14 NiTi followed by 19x25 Heat Activated NiTi and then 19x25 stainless steel wires for retraction within 4 months. The rate of retraction was evaluated per month and torque loss after space closure was also estimated. Results showed significant changes with SLB compared to CLB and also save more than 30% of chair side time during wire adjustments while rate of en masse retraction in SLB shows statistically non significance as compared to CLB system. In case of upper incisor changes when compared between two groups showed less torque loss in SLB than CLB although which was statistically no significant but % difference show SLB have better improvement result than CLB.

Wang Yi in 2014[5] assessed the long-term stability of treatment with self-ligating brackets compared with conventional brackets. The long-term follow-up retrospective study sample consisted of two groups of patients; group SL (including passive and interactive self-ligating braces) comprised 30 subjects treated with self-ligating brackets at a mean pre-treatment (T0) age of 13.56 years, with a mean follow up period for 7.24 years; group CL comprised 30 subjects treated with conventional brackets at a mean pretreatment age of 13.48 years, with a mean follow up period for 7.68 years. Relapse were evaluated by dental casts examination using the Peer Assessment Rating (PAR) index and the Little's Irregularity Index. The two groups were evaluated for differences in the changing of PAR and Little irregularity index using paired-t tests. Inter-observer and intra-observer reliability was assessed by means of the Pearson's correlation coefficients method. There were no significant differences changed in PAR and the Little's Irregularity Index between groups for the long-term follow-up period. The study revealed that brackets type did not affect the long-term stability. Considering self-ligating brackets were expensive, given comprehensive consideration for the patients to choose suitable orthodontic bracket type was of critical importance.

Michael Bertl in 2013[67] did a Meta-analysis of differences between conventional and self-ligating brackets concerning pain during tooth movement, number of patient visits, total treatment duration, and ligation times.Online search in Medline, Embase, and Central focused on randomized clinical trials and controlled clinical studies published between 1996 and 2012. Four studies on pain met our inclusion criteria, two on the number of appointments, two on overall treatment time but none on ligation times. Pain levels did not differ significantly between patients treated with conventional or self-ligating brackets after 4 hours, 24 hours, 3 and 7 days. The number of appointments and total treatment time revealed no significant differences between self-ligating and conventional brackets. The lack of significant overall effects apparent in this meta-analysis contradicts evidence-based statements on the advantages of self-ligating brackets over conventional ones regarding discomfort during initial orthodontic therapy, number of appointments, and total treatment time. Due to the limited number of studies included, further randomized controlled clinical trials are required to deliver more data and to substantiate evidence-based conclusions on differences between the two bracket types considering orthodontic pain, number of visits, treatment, and ligation times.

Andrew T. DiBiase, Inas H. Nasr (2011)[11] conducted a prospective randomized clinical trial comparing the effect of bracket type on the duration of orthodontic treatment and the occlusal outcome as measured by the peer assessment rating (PAR) where sixty-two subjects with a mean pre treatment

PAR score of 39.40, along with mandibular irregularity from 5 to 12 mm, and subjects who were prescribed extractions including mandibular first premolars were randomly allocated to treatment with either the Damon3 self-ligated or the Synthesis conventional ligated pre adjusted bracket systems (both, Ormco, Glendora, Calif). An identical archwire sequence was used in both groups excluding the finishing archwires: 0.014-in, 0.014 x 0.025-in, and 0.018 x 0.025 in copper-nickel-titanium aligning archwires, followed by 0.019 x 0.025-in stainless steel working archwires. Data collected at the start of treatment and after appliance removal included dental study casts, total duration of treatment, number of visits, number of emergency visits and breakages during treatment, and number of failed appointments. Accounting for pretreatment and in-treatment covariates, bracket type had no effect on the overall treatment duration, number of visits, or overall percentage of reduction in PAR scores. The time spent in space closure had an effect on treatment duration, and the pretreatment PAR score influenced only the reduction in PAR as a result of treatment. Thus, the use of Damon 3 bracket does not reduce overall treatment time or total number of visits, or result in a better occlusal outcome when compared with conventional ligated brackets in the treatment of extraction patients with crowding.

Prettyman et al (2012)[60] evaluated the significant clinical differences between self-ligating brackets and conventional brackets during orthodontic treatment, as perceived by orthodontists. They conducted a survey to assess how

SLB was compared to CB in terms of orthodontists' perceptions (n= 430). Results showed that Self-ligating Brackets were preferred during the initial stage of treatment based on the shorter adjustment appointments and faster initial treatment progress they provided (P < 0.001). On the other hand, practitioners preferred CB during the finishing and detailing stages of treatment (P <0.001). CB were also preferred over SLB because they were cheaper.

Nigel Harradine (2013)[30] summarized the advantages of self ligation system thus, contribuiting to increased efficiency of the brackets. The advantages included full secured ligation without the problems of force decay in elastomeric modules, faster ligation and arch wire removal which saves upto 9 minutes per visit compared to the conventional, rapidity of treatment due to lower resistance to sliding inside the bracket slot.

Padhraig S. Fleming and Kevin O'Brien (2013)[16] contradicted the advantages put forth by other authors saying that there was no significant time difference for slide closure and replacement of ligatures and it is controversial to say that self-ligating brackets helps in faster alignment or in rapid space closure.

Goldie Songra, Matthew Clover(2014)[23] compared the time to initial alignment and extraction space closure using conventional brackets and active and passive self-ligating brackets. They selected one hundred adolescent patients 11 to 18 years of age undergoing maxillary and mandibular fixed appliance therapy after the extraction of 4 premolars who were randomized with stratification of 2 age ranges (11-14 and 15-18 years) and 3 maxillo mandibular plane angles (high, medium, and low) with an allocation 29 ratio of 1:2:2. Allocation was to 1 of 3 treatment groups: conventional brackets, active self-ligating, or passive self-ligating brackets. All subjects were treated with the same arch wire sequence and space-closing mechanics. Labial-segment alignment and space closure were measured on study models taken every 12 weeks throughout treatment. Results demonstrated a significant effect of bracket type on the time to initial alignment (P = 0.001), which was shorter with the conventional brackets than either of the self-ligating brackets. There was no statistically significant difference between any of the 3 bracket types with respect to space closure. Space-closure times were shorter in the mandible, except for the Damon 3MX bracket (Ormco, Orange, Calif), where active and total space-closure times were shorter in the maxilla. The following conclusions that were drawn from this study was there was no statistically significant difference in the time to initial alignment between active and passive self-ligating brackets. The time taken for alignment was significantly shorter with conventional brackets. There was no significant difference in the time to passive, active, or total space closure among all bracket types.There was a statistically significant difference in the time to initial alignment between the mandible and the maxilla, with a shorter time to alignment in the maxilla. There was a statistically significant difference in space closure with time between the mandible and the maxilla.

Megha Anand, David L. Turpin (2015)[45] did a retrospective cohort study to assess the effects and efficiency of self-ligating brackets compared with conventional brackets along with a secondary purpose was to identify the pre-treatment factors associated with the choice of self-ligating or conventional brackets. The subjects were treated by 2 private practitioners who used both self-ligating and conventional brackets in their practices. The self-ligating subjects were consecutively identified (treatment completed between January 2011 and April 2012), and then an age- and sex-matched control group was chosen from the same office. The outcome measures were changes in arch dimensions, changes in mandibular incisor inclinations, final peer assessment rating (PAR) scores, percentages of PAR reduction, overall treatment times, total number of visits, and number of emergency visits. The final sample comprised 74 patients. Results found were that the practitioners had significant differences for several treatment parameters; therefore, the data from the 2 clinicians were analyzed separately. For clinician 1, no significant differences were observed between the self-ligating and conventional groups, other than increased arch length in the self-ligating group. The self-ligation patients treated by clinician 2 demonstrated significant increases in transverse dimensions, lower percentages of reduction in PAR scores, shorter treatment times, fewer visits, and more wire-sliding emergencies than the conventional bracket group. Therefore, the study suggested that the bracket system, per se, may not have a major effect on arch dimensions, mandibular incisor inclinations, occlusal outcomes and treatment efficiency and it is possible that the variations in these parameters may depend more on patient characteristics, such as initial crowding or military population, or on treatment choices made by the clinician, such as arch wire sequence and form, mechanics or technology, such as SureSmile.

Srinivas (2003)[72] has demonstrated that passive self-ligating appliances use less anchorage than conventional appliances. This supports the reduction in the use of anchorage devices experienced by users of passive self-ligation. Use of intraoral expansion auxiliaries such as quad helixes or W-springs because the force of the archwire is not transformed or absorbed by the ligatures and the necessary expansion can be achieved by the force of the archwires. Need for extractions to facilitate orthodontic mechanics because alignment is not hindered by frictional resistance from ligatures and can therefore be largely achieved with small diameter copper nickel titanium archwires. Tooth alignment therefore places minimal stress on the periodontium as it occurs and so the possibility of iatrogenic damage to the periodontium is reduced. In addition, a passive edgewise self-ligation system provides three key features:

- Very low levels of static and dynamic friction
- Rigid ligation due to the positive closure of the slot by the gate or slide
- Control of tooth position because there is an edgewise slot of adequate width and depth.

Coubourne et al in 2008[7] compared the degree of discomfort experienced during the period of initial orthodontic tooth movement using Damon3 self-ligating and Synthesis conventional ligating pre-adjusted bracket systems. Sixty-two subjects were recruited from two centers (32 males and 30 females; mean age 16 years, 3 months) with lower incisor irregularity between 5 and 12 mm and a prescribed extraction pattern, including lower first premolar teeth. These subjects were randomly allocated for treatment with either bracket system. Fully ligated Damon3 0.014-inch Cu NiTi arch wires were used for initial alignment in both groups. Following arch wire insertion, the subjects were given a prepared discomfort diary to complete over the first week, recording discomfort by means of a 100 mm visual analogue scale at 4 hours, 24 hours, 3 days, and 1 week. The subjects also noted any self-prescribed analgesics that were taken during the period of observation. Data were analyzed using repeated measures analysis of variance. There were no statistically significant differences in perceived discomfort levels between the two appliances; discomfort did not differ at the first time point and did not develop differently across subsequent measurement times. Overall, this investigation found no evidence to suggest that Damon3 self-ligating brackets are associated with less discomfort than conventional pre-adjusted brackets during initial tooth alignment, regardless of age or gender.

Robert J Weyant in 2006[47] compared the effectiveness and comfort of Damon2 brackets and conventional twin brackets during initial alignment.

Sixty consecutive patients participated in a split mouth design. One side of the lower arch was bonded with the Damon2 bracket and the other with a conventional twin bracket. The sides were alternated with each consecutive patient. The irregularity index was measured for each half of the arch at baseline, at 10 weeks at the first arch wire change, and at another 10 weeks at the second arch wire change. Any difference in discomfort was assessed within the first few days of arch wire placement and again at the first arch wire change. Comfort on the lips, preferred look, and bracket failure rates were also recorded. The twin bracket was more uncomfortable with the initial arch wire. However, at 10 weeks, substantially more patients reported discomfort with the Damon2 bracket when engaging the arch wire. At both arch wire changes at 10 and 20 weeks, the conventional bracket had achieved a lower irregularity index than the Damon2 bracket by 0.2 mm, which is not clinically significant. Patients preferred the look of the twin bracket over the Damon2 and more Damon2 brackets debonded during the study. The Damon2 bracket was no better during initial alignment than a conventional bracket. Initially, the Damon2 bracket was less painful, but it was substantially more painful when placing the second arch wire and had a higher bracket failure rate.

Harradine in 2008 [29] described about the combination of low friction and secure full engagement is particularly useful in the alignment of very irregular teeth and the resolution of severe rotations, where the capacity of the wire to release from binding and slide through the brackets of the rotated and adjacent teeth would be expected to significantly facilitate alignment.Low friction therefore permits rapid alignment and more certain space closure, whereas the secure bracket engagement permits full engagement with severely displaced teeth and full control while sliding teeth along an arch wire. It is this feature that greatly facilitates the alignment of crowded teeth, which have to push each other along the arch wire to gain alignment

Padhraig S, Fleming, Andrew. T.DiBase (2009)[49] compared the effects of two pre adjusted appliances on angular and linear changes of the mandibular incisors, and transverse mandibular arch dimensional changes over a minimum of 30 weeks. Sixty six consecutive patients allocated to treatment with a SLB (Smartclip) and conventional pre adjusted edgewise brackets (Victory). Initial study models and cephalograms were obtained within a month of starting the study. All subjects received treatment with the following arch wire sequence: 0.016-in round, 0.017 x 0.025-in rectangular, 0.019 x 0.025-in rectangular martensitic active nickel-titanium arch wires and 0.019 x 0.025-in stainless steel arch wires. Final records, including study models and a lateral cephalograms, were collected after a minimum of 30 weeks after initial appliance placement. Lateral cephalograms were assessed for treatment related changes in mandibular incisor inclination and position. Transverse dimensional changes in intercanine, and intermolar distances, and the amount of crowding alleviated during the study period were assessed by comparison of pre treatment and post treatment models. There was little difference overall in the pattern of arch alignment and leveling related to the two PEA. However, there was a statistically greater increase in intermolar width in the group treated with SLB, although the difference was only 0.91mm.

Padhraig S. Fleming; Ama Johal (2010)[51] evaluated the clinical differences in relation to the use of self-ligating brackets in orthodontics. 6 RCTs and 11 CCT were identified from the electronic databases which investigated the influence of bracket type on alignment efficiency, subjective pain experience, bond failure rate, arch dimensional changes, rate of orthodontic space closure, periodontal outcomes, and root resorption were selected. Both authors were involved in validity assessment, and data extraction. Meta analysis of the influence of bracket type on subjective pain experience failed to demonstrate a significant advantage for either type of appliance. Authors concluded that it was difficult to assess the efficiency at this stage because there is insufficient high quality evidence to support the use of self-ligating brackets over conventional bracket system.

Emily Ong and Hugh McCallum (2010)[14] compared the efficiency of self-ligating and conventionally ligated bracket system during the first 20weeks of extraction treatment. Fifty consecutive patients who had premolar extractions in the maxillary and/or mandibular arch, 0.022 x 0.028-in slot brackets, and similar arch wire sequences were studied. Forty four arches received Damon 3MX brackets, and 40 arches received Victory Series or Mini Diamond brackets. The models were evaluated for anterior arch alignment, extraction spaces, and arch dimensions at pre treatment (T0), 10weeks (T1), and 20weeks (T2). They concluded that there were no significant differences between the self-ligating and conventionally ligated groups at 20 weeks in irregularity scores. There were no significant differences in passive extraction space closures between the groups.

PM Cattaneo, M Treccani, LHS Cevidanes, B Melsen (2011)[59] evaluated the transversal tooth movements and buccal bone modeling of maxillary lateral segments achieved with active or passive self-ligating bracket systems in a randomized clinical trial. Sixty-four patients, with Class I, II, and mild Class III malocclusions, were randomly assigned to treat with passive (Damon 3 MX) or active (In-Ovation R) SLBs. Impressions and cone- beam CT-scans were taken before (T0) and after treatment (T1). Displacement of maxillary canines, premolars and molars, and buccal alveolar bone modeling were blindly assessed. Twenty-one patients in the Damon and 20 in the In-Ovation group completed treatment according to the prescribed protocol. Transversal expansion of the upper arch was achieved by buccal tipping in all but one patient in each group. There were no statistical significant difference in inter-premolar bucco-lingual inclination between the two groups from T0 to T1. The bone area buccal to the 2nd premolar decreased on average of 20% in the Damon and 14% in the In-Ovation group. Only few patients exhibited widening of the alveolar process. They concluded saying that the anticipated translation and buccal bone modeling using active or passive SLBs could not be confirmed in the majority of the cases. Individual pre-treatment factors, like initial teeth inclination and occlusion, seemed to be important in determining the final outcome of the individual treatment, and CBCT-technology combined with digital casts is important to analyze 3D treatment outcomes both at dental and bone level in large study groups.

Hisham M. Badawi and Roger W. Toogood (2008)[32] measured the difference in third-order moments that can be delivered by engaging 0.019 x 0.025-in stainless steel archwires to active self-ligating brackets (In-Ovation, GAC) and 2 passive self-ligating brackets (Damon2, Ormco and Smart Clip, 3M Unitek). A bracket/wire assembly torsion device was developed. This novel apparatus can apply torsion to the wire while maintaining perfect vertical and horizontal alignment between the wire and the bracket. A multi-axis force/torque transducer was used to measure the moment of the couple (torque), and a digital inclinometer was used to measure the torsion angle. Fifty maxillary right central incisor brackets from each of the 4 manufacturers were tested. Conclusions drawn were that the active self-ligating brackets seemed to have better torque control, due to a direct result of their active clip forcing the wire into the bracket slot. The amount of arch wire bracket slop was considerably less for active self-ligating brackets than passive self-ligating brackets. The active self-ligating brackets expressed higher torque values than the passive self-ligating brackets at clinically usable torsion angles (0°-35°). The passive self-ligating brackets produced lower moments at low torsion angles and started producing higher moments at high torsion that cannot be used clinically. The clinically applicable range of torque activation was greater for the active self-ligating brackets than for the passive self-ligating brackets. All the brackets showed significant variations in the torque expressed; this seemed to be attributed to the variation in bracket slot dimensions. Damon2 and Speed brackets were relatively more consistent than Smart Clip and In-Ovation brackets.

Turnbull. N.R, David J Birne,(2007)[78] in their prospective clinical study, authors assessed the relative speed of arch wire changes in a patient, comparing self-ligating brackets with conventional elastomeric ligation methods, and further assessed this in relation to the stage of orthodontic treatment represented by different wire sizes and types. The time taken to remove and ligate arch wires for 131 consecutive patients treated with either self-ligating or conventional brackets was prospectively assessed. The main outcome measure was the time to remove or place elastomeric ligatures or open/close self-ligating for two matched groups of fixed appliance patients: Damon 2 SLB and a conventional mini twin bracket. The relative effects of various wire sizes and materials on ligation times were investigated. The study was carried out by one operator. Authors found that ligation of an arch wire was approximately twice as quick with self-ligating brackets. Opening a Damon slide was on average 1 second quicker per bracket than removing elastic modules from the mini twin brackets, and closing a slide was 2 seconds faster per bracket. This difference in ligation time became more marked for larger wire sizes used in later treatment stages.

Tae – kyung Kim, Ki-Dal Kim (2008)[74] compared the frictional force generated by various combinations of SLB types, arch wire sizes, and alloy types and the amount of displacement during the initial leveling phase of orthodontic treatment, by using a custom-designed typhodont system. Two passive (Damon 2 and Damon 3), and 3 active SLBs (Speed, In-Ovation R, Time 2), and Smart Clip were tested with 0.014-in and 0.016-in austenitic nickel-titanium and copper-nickel-titanium arch wires. To simulate malocclusion status, the maxillary canines were displaced vertically, and mandibular lateral incisors horizontally from their ideal positions up to 3mm with 1mm intervals. Two conventional brackets (Mini Diamond MD and Clarity CL) were used as controls. Frictional forces were least in Damon and IN-Ovation R brackets in the typodont, regardless of arch wire size and alloy type. The A-Ni-Ti wire showed significantly lower frictional forces than Cu-Ni-Ti wire of the same size. As the amounts of vertical displacement of the maxillary canine and horizontal displacement of the mandibular lateral incisors were increased, frictional forces also increased.

Kusnoto & Begole in 2011[62] tested the hypotheses that the Damon system will maintain inter-canine, inter-premolar, and inter-molar widths. To test subsequent hypotheses that the Damon system will not produce a significant difference in maxillary and mandibular incisor position/angulation when compared with control groups treated with conventional fixed orthodontic appliances for similar malocclusion. Subjects treated with the Damon system (N = 27) were compared with subjects treated with a conventionally ligated edgewise bracket system (N = 16). Subject's pretreatment and post treatment lateral cephalometric radiographs and dental models were scanned, measured, and compared to see whether significant differences exist between time points and between the two groups. Results did not support the claimed lip bumper effect of the Damon system and showed similar patterns of crowding alleviation, including transverse expansion and incisor advancement, in both groups, regardless of the bracket system used. Maxillary and mandibular inter-canine, inter-premolar, and inter-molar widths increased significantly after treatment with the Damon system. The mandibular incisors were significantly advanced and proclined after treatment with the Damon system, contradicting the lip bumper theory of Damon. Posttreatment incisor inclinations did not differ significantly between the Damon group and the control group. Patients treated with the Damon system completed treatment on average 2 months faster than patients treated with a conventionally ligated standard edgewise bracket system.

David Birnie (2008)[25] stated that The Damon philosophy is based on the principle of using just enough force to initiate tooth movement-the threshold force. The underlying principle behind the threshold force is that it must be low enough to prevent occluding the blood vessels in the periodontal ligament to allow the cells and the necessary biochemical messengers to be transported to the site where bone resorption and apposition will occur and thus permit tooth movement. A passive self-ligation mechanism has the lowest frictional resistance of any ligation system. Thus the forces generated by the archwire are transmitted directly to the teeth and supporting structures without absorption or transformation by the ligature system. Compared with conventional pre-adjusted edgewise appliances, it is suggested that the use of passive self-ligation results in a significant reduction in the use of anchorage devices because the frictional resistance generated by ligatures is not present.

Stephanie Shih-Hsuan Chen, Geoffrey Michael Greenlee (2010)[73] did a systematic review to identify and review the orthodontic literature with regard to the efficiency, effectiveness, and stability of treatment with self-ligating brackets compared with conventional brackets. Self-ligating appears to have a significant advantage with regard to chair side time, based on several cross- sectional studies. Analysis also showed a small, but statistically significant difference in mandibular incisor proclination (1.5° less proclination with self–ligating brackets compared with conventional brackets). No other differences in treatment time and occlusal characteristics after treatment were found between the two systems that are supported by the current evidence. Retraction efficiency is not significantly efficient compared to conventional. Long term studies are required with the greater sample size for better understanding of the efficiency of self-ligating brackets.

Ezgi Atik, Bengisu Akarsu-Guven (2016)[15] compared different bracket types (conventional, active self- ligating, and passive self-ligating) combined with broad archwires in terms of maxillary dental arch widths and molar inclinations. Forty-six patients aged 13 to 17 years with moderate maxillary and mandibular crowding and a Class I malocclusion were included in this prospective clinical trial. The primary outcome measures were changes in maxillary arch width dimensions and molar inclinations. The secondary outcome measures were changes in maxillary and mandibular incisor inclinations. Group I included 15 patients treated with 0.022-in active self-ligating brackets. Group II included 15 patients treated with 0.022-in Roth prescription conventional brackets. Group III was a retrospective group of 16 patients previously treated with 0.022-in passive self-ligating brackets. Each participant underwent alignment with the standard Damon archwire sequence. The maxillary intercanine, interpremolar, and intermolar widths were significantly greater after treatment in each bracket group. However, when the levels of expansion achieved among the 3 groups were compared, no significant difference was found. Although all posteroanterior cephalometric variables showed significant changes during treatment in all groups, these changes were not significant among the groups. A statistically significant labial proclination of the teeth was seen in each group. No differences in maxillary-arch dimensional changes or molar and incisor inclination changes were found in conventional and active and passive self-ligating brackets used with broad archwires.

Woo-Sun Jung, Kyungsun Kim (2016)[81] analyzed the adhesion of periodontopathogens to self-ligating brackets (Clarity-SL [CSL], Clippy-C [CC] and Damon Q [DQ]) and identified the relationships between bacterial adhesion and oral hygiene indexes. Central incisor brackets from the maxilla and mandible were collected from 60 patients at debonding after the plaque and gingival indexes were measured. Adhesions of Aggregatibacter actinomycetemcomitans (Aa), Porphyromonas gingivalis (Pg), Prevotella intermedia (Pi), Fusobacterium nucleatum (Fn), and Tannerella forsythia (Tf) were quantitatively determined using real-time polymerase chain reactions. Factorial analysis of variance was used to analyze bacterial adhesion in relation to bracket type and jaw position. Correlation coefficients were calculated to determine the relationships between bacterial adhesion and the oral hygiene indexes. Total bacteria showed greater adhesion to CSL than to DQ brackets, whereas Aa, Pg, and Pi adhered more to DQ than to CSL brackets. CC brackets showed an intermediate adhesion pattern between CSL and DQ brackets, but it did not differ significantly from either bracket type. Adhesion of Fn and Tf did-not differ significantly among the 3 brackets. Most bacteria were detected in greater quantities in the mandibular than in the maxillary brackets. The plaque and gingival indexes were not strongly correlated with bacterial adhesion to the brackets. Because Aa, Pg, and Pi adhered more to the DQ brackets in the mandibular area, orthodontic patients with periodontal problems should be carefully monitored in the mandibular incisors where the distance between the bracket and the gingiva is small, especially when DQ brackets are used.

Materials and Methods

MATERIAL AND METHODS

In the present study totally 18 patients, out of 42 patients undergoing orthodontic treatment with different self ligating bracket system and 72 patients with conventional twin bracket system in our department, were selected. These 18 patients, who met our selection criteria, were later divided into three different groups of 6 each as Group A, B and C in which 1 patient from each group was eliminated due to multiple breakage of brackets and irregular visits, so the final group comprised of 5 patients in each.

Group A – Study group with self-ligation Interactive brackets (American Orthodontics, Empower SL) comprises of 4 females and 1 male,

Group B - Study group with self-ligation Passive brackets (3M, Gemini SL) comprises of 3 females and 2 males,

Group C - Control group with Conventional brackets (American Orthodontics, mini/master series) comprises of 3 females and 2 males, who were selected according to the inclusion criteria.

Inclusion Criteria:

1. Patients between 10 to 25 years old of either gender
2. Skeletal Class I malocclusion warranting all 4 - first bicuspids extraction during start of the treatment and who have completed alignment and leveling phase of orthodontic treatment
3. Patients who have pre- treatment CBCT 's

Exclusion Criteria:

Patients with

i. Previous history of orthodontic treatment,

ii. Any missing tooth other than third molars,

iii. Temporo Mandibular Joint dysfunction

iv. Any systemic disorders

Informed written consent was obtained from all patients and parents who participated in this study. The studied was approved by the Institutional Review Board Of Ragas Dental College And Hospital

Once the leveling and alignment is completed, 19x25 inch stainless steel archwire with soldered hooks (figure 11) were left in place for 5 weeks, the retraction was commenced using Ni-Ti closed coil springs(G & H) (figure 12) of 150 gms measured using dontrix gauge (figure 13) in all 4 quadrants simultaneously at the same time for all patients. Stainless steel ligatures or elastomeric modules were used to secure archwires into the conventional brackets group.

Post treatment CBCT images were taken to assess the buccal bone thickness, changes in intercanine, inter second premolar and intermolar widths. CBCT generated lateral cephalograms (Figure 7) were also assessed to find out the axial inclination changes of the anterior teeth. All these measurements were done by one Primary investigator using Dolphin 3D software program and a set of study models were taken at the beginning (T_1) and after completion of the retraction (T_2)

MEASUREMENTS ON CBCT

IMAGE PLACEMENT :

MULTIPLANAR RECONSTRUCTION – visualization of sections in 3 spatial dimensions

Reference line used to standardize

i) Axial & sagittal plane – BISPINAL LINE (figure 1)

ii) Coronal plane – INFRA ORBITAL LINE (figure 2)

IMAGE SELECTION:

For Mandible: Axial sections should be parallel to the functional occlusal plane (figure 3)

Coronal slices were selected for the bone measurements and 1-mm thick cross-sections were made through the second premolar (P2) (figure 3) and first molar (M1) (figure 4), in the right and left mandibular arches.

IMAGE MEASUREMENT:

The selected axial section of the image is zoomed and measurements can be taken in buccal, palatal and lingual aspect using digital method

In coronal section, point selected for buccal bone measurement was the most external prominence of the buccal bone (EBB) in the root most apical portion (apex). (Figure 3,4)

Measurements are made in millimetres from buccal cusp tips of canine and II pre-molar and mesio-buccal cusp tips were selected for the first molars in maxilla (Figure 5) and in mandible (Figure 6)

Landmarks and Reference planes used in CBCT generated lateral cephalograms:

NASION (N) – The most anterior point of the fronto – nasal suture in the median plane

SELLA (S) – The midpoint of the hypophyseal fossa. It is a constructed point

S-N PLANE – it's the cranial line between the center of stella tursica and the anterior point of the fronto – nasal suture (nasion). It represents the anterior cranial base. (Steiner's analysis)

POINT A – It is the most deepest midline point on the premaxilla between ANS and sup. Prosthion.

POINT B – It is the most posterior point in the concavity between the chin and the mandibular process.

MANDIBULAR PLANE – A line drawn form anatomic gonion to gnathion.

U1 – Incisal tip of the upper incisor

L1 – Incisal tip of the lower incisor

NF – Nasal floor drawn between anterior nasal spine to posterior nasal spine

MEASUREMENTS ON DENTAL CASTS

The rate of retraction was defined as the distance travelled, divided by the time required to complete space closure. This was recorded in millimeters per interval. An interval was defined as a 4 week period. The widths of the extraction spaces and time of retraction were recorded (figure 9 and 10). Measurements were performed by direct- technique from casts with the help of Vernier Caliper (figure 8) with sharpened tips that were accurate to 0.01mm.

All stage models and CBCT measurements were evaluated by the Primary investigator and a secondary assessor who was blinded to the patient's group.

STATISTICAL ANALYSIS

Data analysis was performed by a private biostatistics expert who was blinded to the groups using SPSS for Windows (version 20; SPSS, Chicago, Ill).

The arch dimensional changes were assessed by using the mean differences among the 3 groups were compared using 1-way analysis of variance (ANOVA) among the three groups A, B and C.

The buccal bone thickness were assessed by using the difference between post and pre treatment measurements and the mean differences between the groups were compared using the one way ANOVA test to find the significance between the three groups.

The axial inclinations were assessed by using the difference between pre and post measurements and the mean differences between the groups were compared using the one way ANOVA test to find the significance between the three groups.

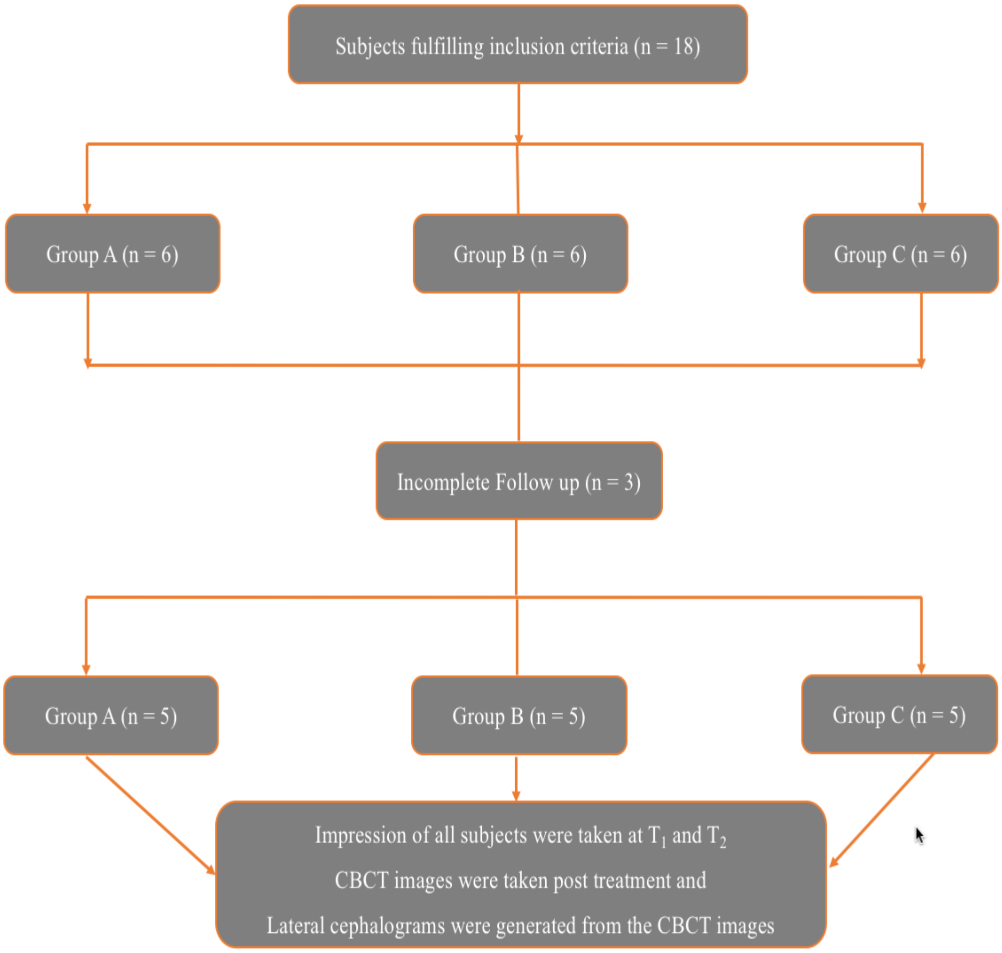
The rate of retraction as mm of movement per month which comprises of 4 week interval basis and the rate between three groups were compared using 1 way ANOVA test.

If the P value from the 1-way ANOVA was statistically significant, the post hoc Tukey honestly significant difference test was used to determine which group differed from which others.

The intra and inter-rater reliability of the dental model measurements was assessed by comparing the difference in measurements done by the primary investigator and a secondary assessor who were blinded about the study and groups involved at 4-week interval. Reliability was calculated by intra-class correlation coefficients and 95% confidence intervals for each clinical parameter

P value less than 0.05 was considered statistically significant. For all possible multiple comparisons, the Bonferroni correction was applied to control for type I error.

CONSORT DIAGRAM - Showing the Flow Of Participants Through The Trial



Consent Form

I, ………………………………………………………….. aged about………. years, ………………………………….residing at ………………………………………………………………………………………
…, do hereby solemnly and state as follows :

I am aware of the facts stated here under.

I state that I had come to Ragas Dental College and Hospital, Chennai for treatment.

I was examined by Dr……………………………….. and was requested to do the following Treatment procedures :

1. Fixed appliance therapy
2. CBCT scans

- The features of this treatment procedure has been explained to me.
- I assure that I shall agree for the procedure.
- I authorize the doctor to proceed with the above mentioned treatment procedure or any other/suitable/alternative method for the study.
- I have given voluntary consent to undergo treatment procedure without any individual pressure or stress.
- I am also aware that I am free to withdraw the consent given at any time during the study in writing

----

Signature of the Patient

The patient and the parent/guardian/teacher was explained the procedure by me and he/she has understood the same and signed in (English/Tamil/Hindi/Telugu/………….……………………) before me.

Signature of the Doctor

Date

Figures

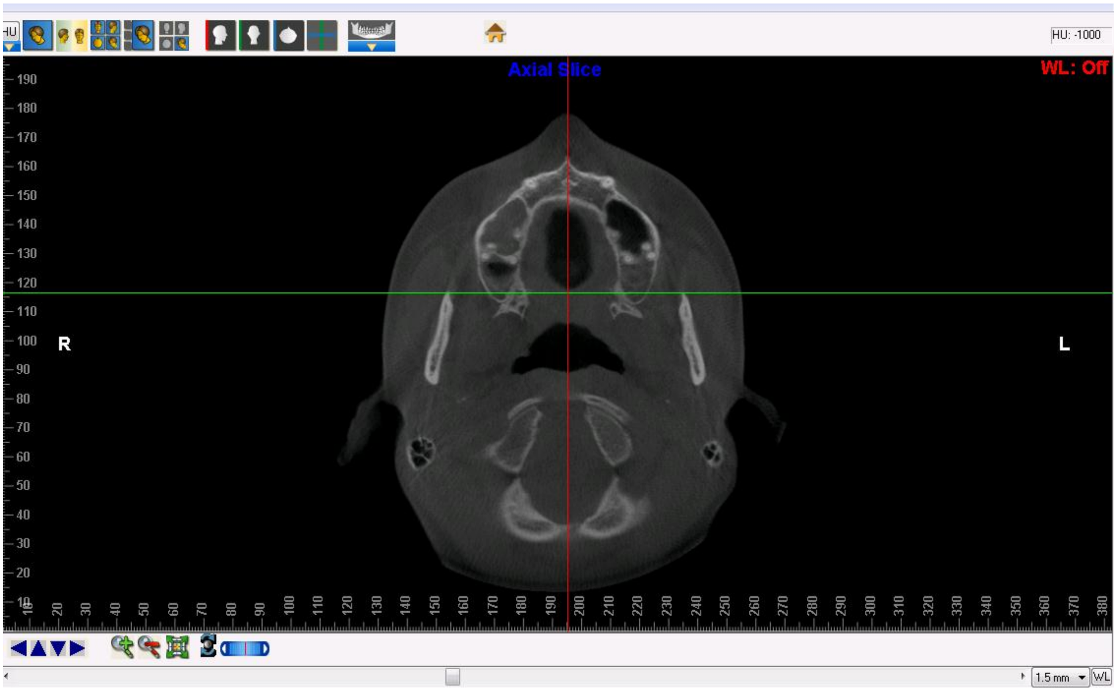


Figure 1

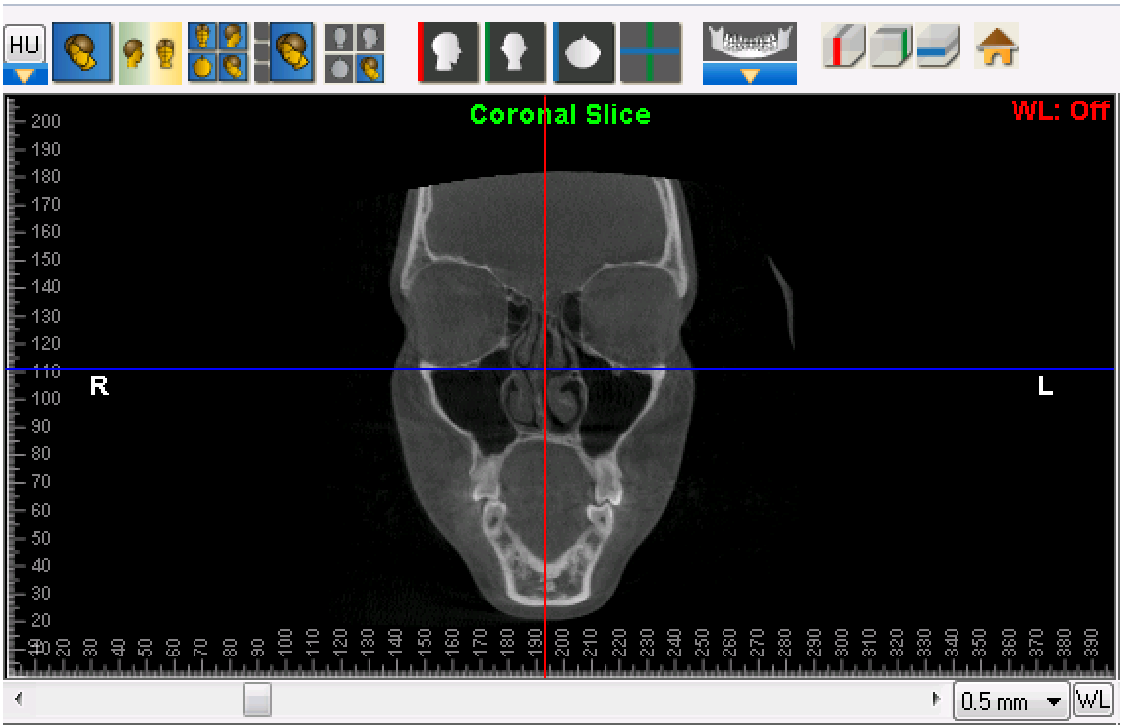


Figure 2

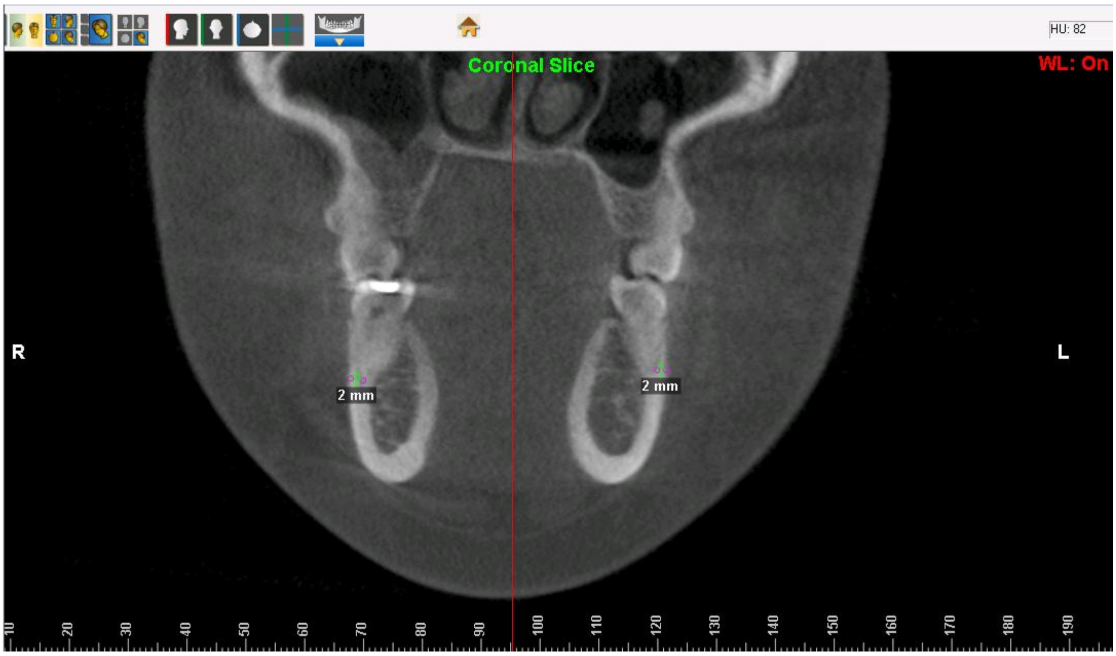


Figure 3

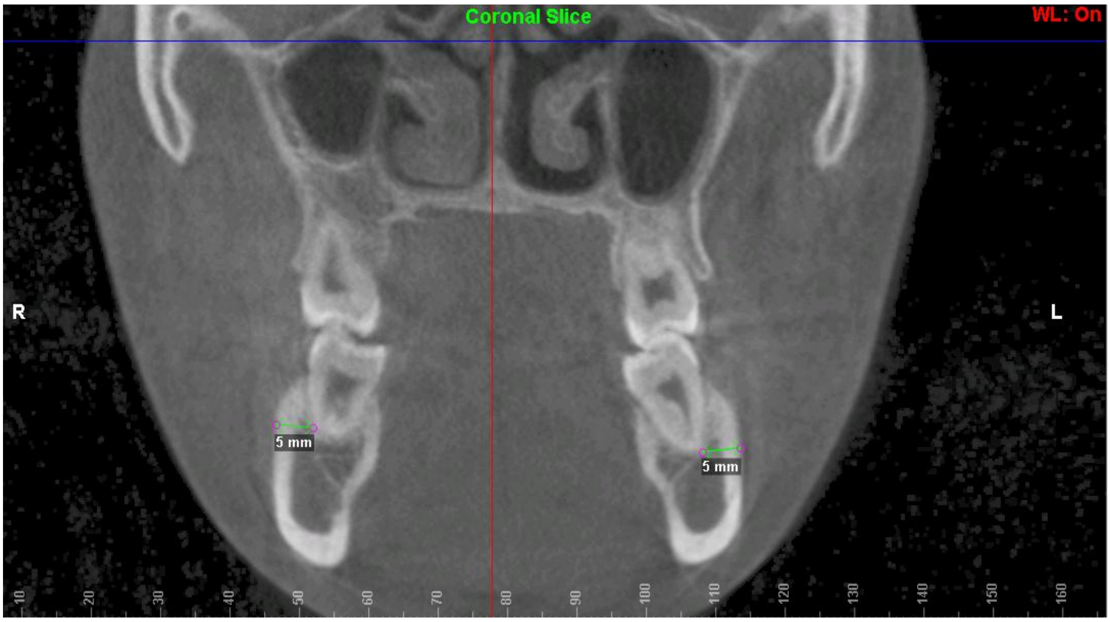


Figure 4

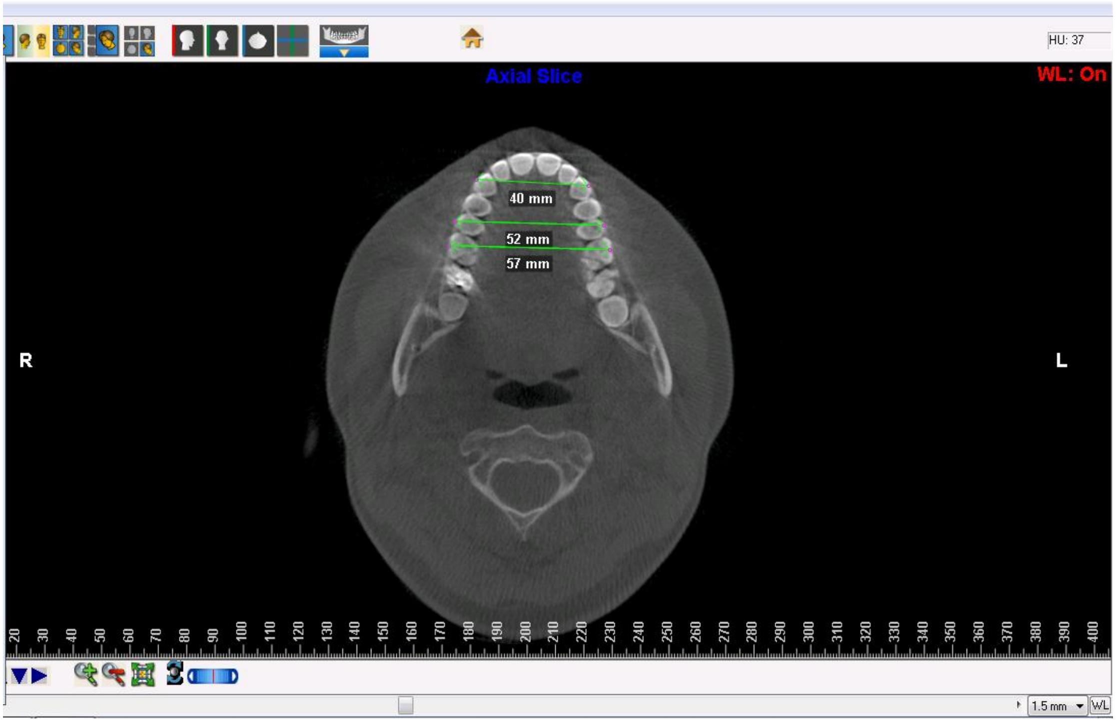


Figure 5

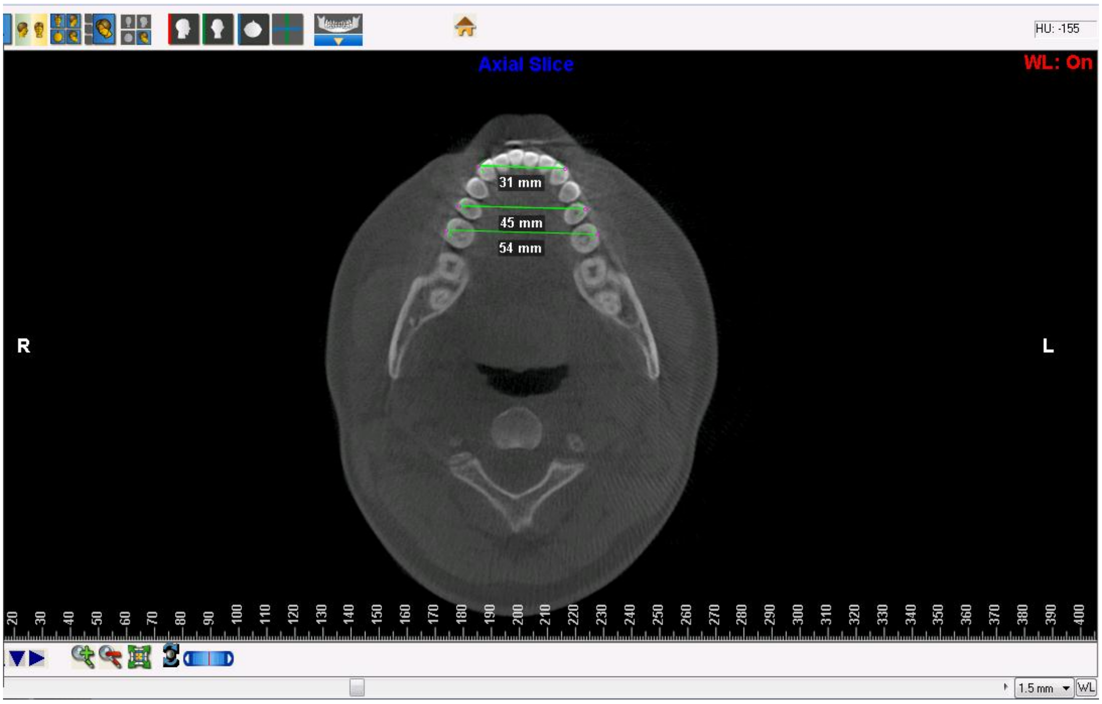


Figure 6

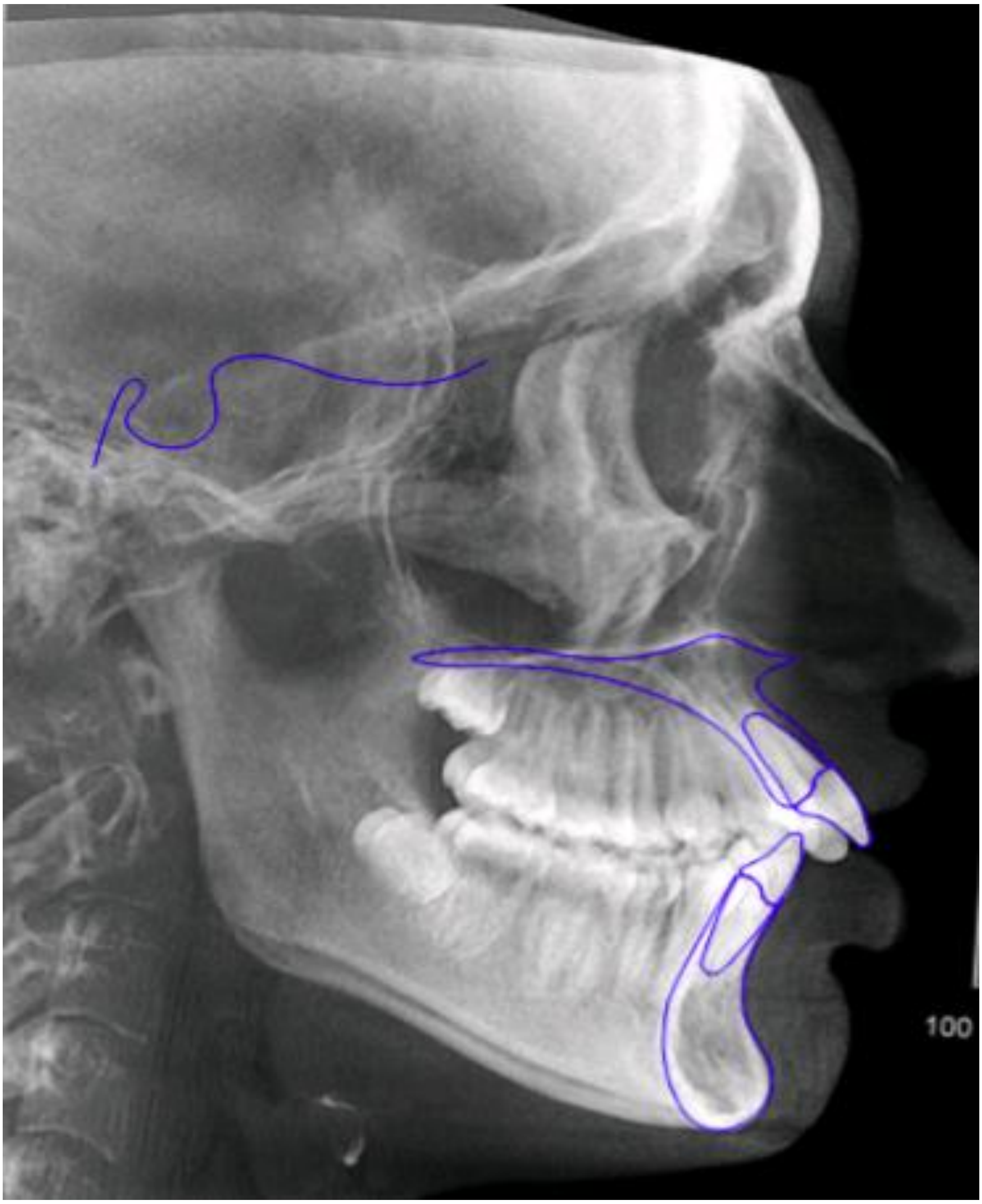


Figure 7

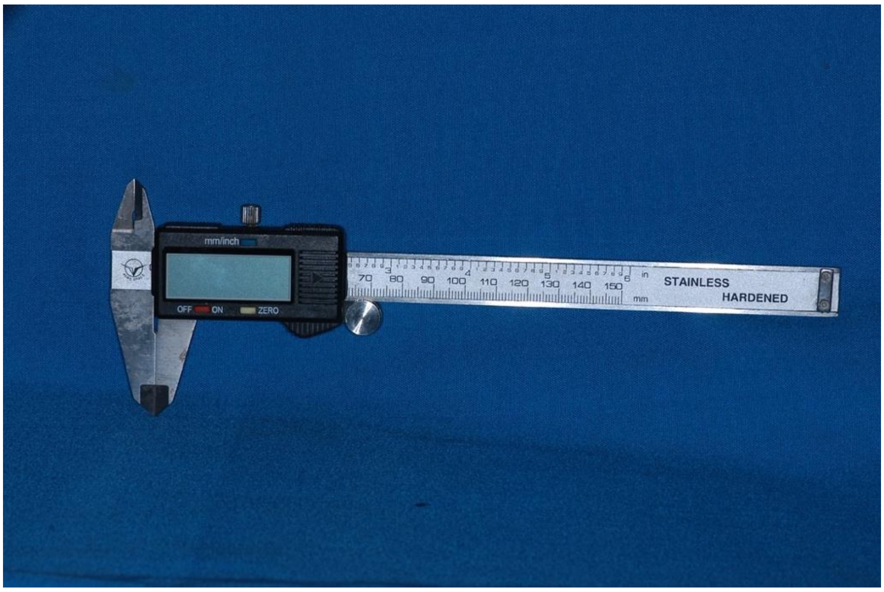


Figure 8

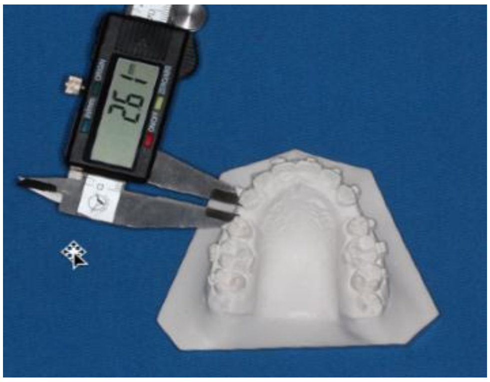


Figure 9

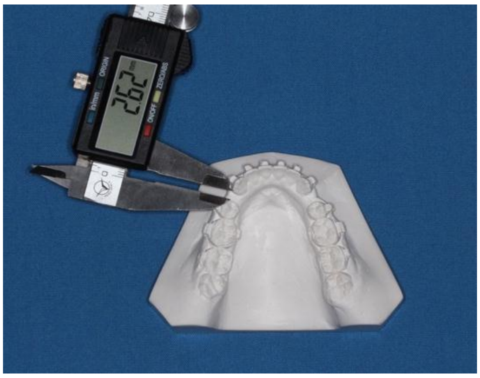


Figure 10

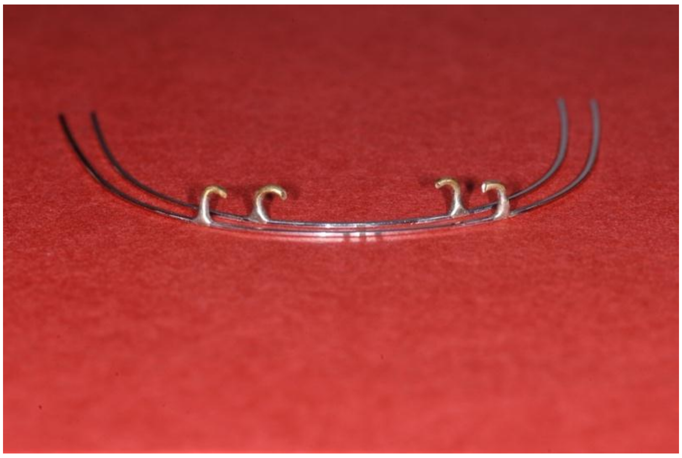


Figure 11

Figure 12

Figure 13

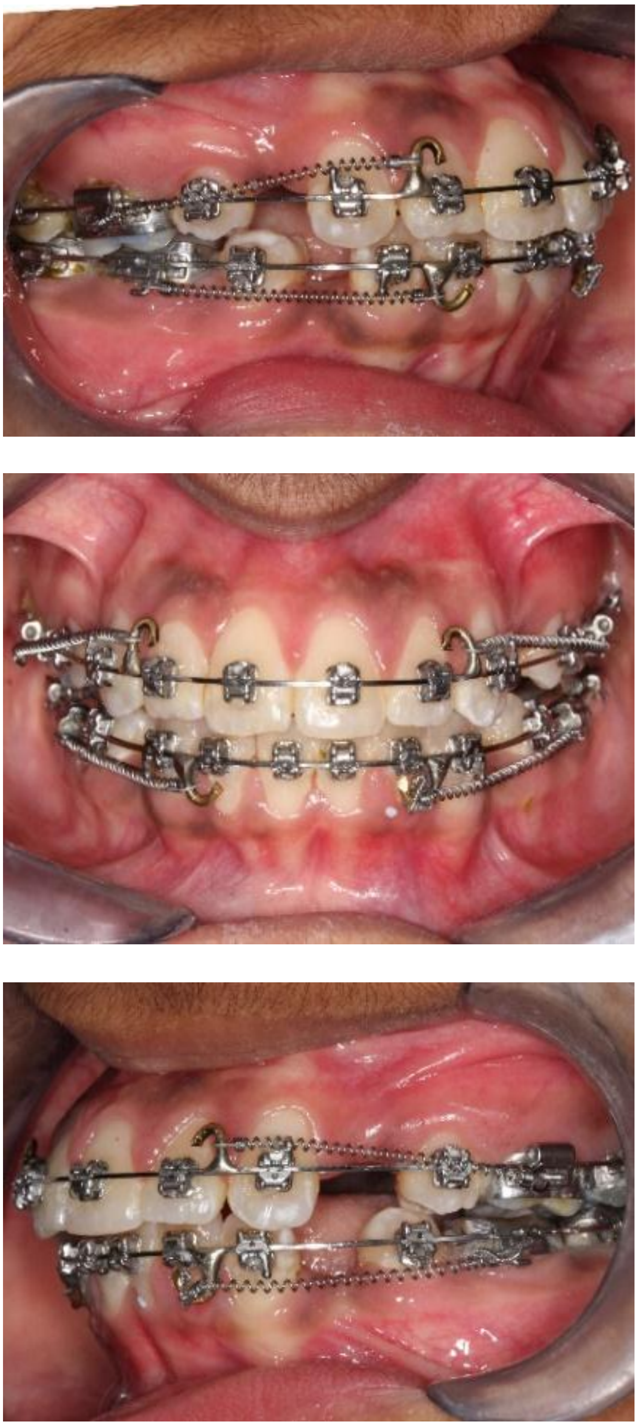
Group – A – Self Ligating - Interactive

Group – B – Self Ligating - Passive

Group – C – Conventional

Intra oral photographs – After levelling and aligning

Intra oral photographs – After levelling and aligning



Intraoral photographs – During retraction

Intraoral photographs – After completion of retraction

Intraoral photographs – After completion of Retraction

Results

RESULTS

This study comprised of 18 patients who were divided into three groups, Group A, B and Group C, each having 6 patients respectively. The mean age of the patients was 16.8 ± 4 years in both the groups. In the study group interactive self-ligating bracket 0.022, Empower American Orthodontics, passive self-ligating bracket Slot 3M Gemini SL with 0.022 slot and in control group pre adjusted edgewise bracket 0.022 Slot Mini/Master Series AO were used for comparison. During the treatment one patient from each group was eliminated due to irregular visits, multiple breakages of brackets and incomplete follow up. So the final study group A, B and C comprises of 5 patients in each group. After the space closure have been completed the results obtained for all measures among the groups were discussed below

1)RATE OF RETRACTION:

Table VIII shows the rate of retraction and its comparison between the three groups with two examiners and shows that there is a difference in inter rater and intra rater reliability which were not statistically significant. There were differences in the rate of tooth movement between the groups for upper right side E1($p<0.168$), for upper left side E1($p<0.722$), lower right side E1($p<0.927$), for lower left side E1($p<0.658$) and for for upper right side E2($p<0.402$), for upper left side E2($p<0.914$), lower right side E2($p<0.914$), for lower left side E2($p<0.772$) which was not statistically significant.

No statistically significant difference was found in all the measurements among all groups

2)AXIAL INCLINATION CHANGES:

Axial inclination changes were assessed from the mean difference between [T0 – T2] for the maxillary and mandibular teeth are shown in table VI

a) Maxillary anteriors:

Table VI-a shows the mean difference in the values of T0 – T2 in U1-NF , Table VI-b shows the mean difference in the values of T0 – T2 in U1- NF, Table VI-c shows the mean difference in the values of T0 – T2 in U1- NA. the table VI-d shows the shows the comparisons of the mean differences in axial inclination changes in maxilla between three groups. For U1- SN for group A (13.220±5.050), for group B (16.060±4.465), and for group C (16.360±4.932), for U1- NF in group A (13.180±7.466), for group B (15.320±5.136), and for group C (17.700±2.997) and for U1 – NA in group A (11.400±6.543), for group B (12.720±5.475), and for group C (14.020±5.416) using one way ANOVA analysis. The results showed that there were a slight increase in the axial inclination changes after treatment in maxilla between the groups but the differences was not statistically significant for U1- SN($p<0.542$), U1- NF($p<0.455$) and for U1-NA($p<0.781$) in all bracket systems.

b) Mandibular anteriors:

Table VII-a shows the mean difference in the values of T0 – T2 in L1-NB , Table VII-b shows the mean difference in the values of T0 – T2 in IMPA, the table VII-C shows the shows the comparisons of the mean differences in axial inclination changes in mandible between three groups. For L1- NB for group A (10.260±4.088), for group B (13.740±2.134), and for group C (11.080±7.233), for IMPA in group A (10.320±4.497), for group B (14.840±3.022), and for group C (8.260±5.181) using one way ANOVA analysis. The results showed that there were a slight difference in the axial inclination changes after treatment in mandible between the groups but the differences was not statistically significant for L1- NB(p<0.528), and for IMPA(p<5.181) in all bracket systems.

3) Transverse Arch Dimensional Changes:

a) Inter-canine width:

Table I-a shows the mean values of the difference in T2-T0 in three groups for the inter-canine width in maxilla and Table I-b shows the mean values of the difference in T2-T0 in three groups for the inter-canine width in mandible. Table I-c shows the comparison of the mean differences during the time interval of [T2 - T0] between the three groups, for group A (0.200±1.643), for group B (1.000±1.871), and for group C (2.600±3.050) in maxilla and for group A (0.400±2.881), for group B (2.000±2.345), and for group C (2.400±2.608) for mandible using one way ANOVA analysis. The results showed that there was a slight increase in the inter-canine width after treatment in both maxilla and mandible between the groups but the differences were not statistically significant for maxilla ($p < 0.274$) and for mandible ($p < 0.465$)

c) Inter-premolar width:

Table II-a shows the mean values of the difference in T2-T0 in three groups for the inter-premolar width in maxilla and Table II-b shows the mean values of the difference in T2-T0 in three groups for the inter-premolar width in mandible. Table II-c shows the comparison of the mean differences during the time interval of [T2 - T0] between the three groups, for group A (-1.400±0.894), for group B (-1.400±1.140), and for group C (-0.400±2.510) in maxilla and for group A (-3.400±7.092), for group B (-2.800±1.924), and for group C (-1.200±3.421) for mandible using one way ANOVA analysis. The results showed that there was a slight decrease in the inter-premolar width after treatment in both maxilla and mandible between the groups but the differences were not statistically significant for maxilla ($p < 0.567$) and for mandible ($p < 0.750$)

d) Inter-molar width:

Table III-a shows the mean values of the difference in T2-T0 in three groups for the inter-molar width in maxilla and Table III-b shows the mean values of the difference in T2-T0 in three groups for the inter-molar width in mandible. Table III-c shows the comparison of the mean differences during the time interval of [T2 - T0] between the three groups, for group A (1.000±1.000), for group B (0.000±0.707), and for group C (-0.400±1.342) in maxilla and for group A (-2.800±4.087), for group B (-2.800±2.168), and for group C (-1.800±1.304) for mandible using one way ANOVA analysis. The results showed that there was a slight decrease in the inter-premolar width after treatment in both maxilla and mandible between the groups but the differences were not statistically significant for maxilla ($p< 0.136$) and for mandible ($p<0.808$)

4) Buccal Bone Thickness:

The buccal bone thickness were assesed on premolar and in molar region for mandible at two time intervals, Pre(T0) and post treatment (T2) using one way ANOVA - analysis

a) Premolar region

The comparison of the difference in buccal bone thickness between T2-T0 for premolar are shown in Table IV. The Table IV-a shows the mean difference between T2-T0 for right between the three groups A , B and C and IV-b a shows the mean difference between T2-T0 between the three groups A , B and C for left side and table IV-c shows the comparisons of the mean differences in buccal bone thickness for right side of the mandible between three groups for group A (0.600±0.894), for group B (0.400±0.548), and for group C (0.400±0.894) and for group A (0.800±1.095), for group B (0.800±0.837), and for group C (0.400±0.548) for mandible using one way

ANOVA analysis. The results showed that there was a slight increase in the buccal bone thickness after treatment in mandible between the groups but the differences were not statistically significant in mandible for right side ($p < 0.901$) and for mandible left side ($p < 0.703$)

b) Molar region

The comparison of the difference in buccal bone thickness between T2-T0 for molar are shown in Table V. The Table V-a shows the mean difference between T2-T0 for right between the three groups A , B and C and V-b a shows the mean difference between T2-T0 between the three groups A , B and C for left side and table V-c shows the comparisons of the mean differences in buccal bone thickness in molar region on right side of the mandible between three groups for group A (0.200±1.304), for group B (0.600±0.894), and for group C (0.800±1.095) and for group A (0.600±1.517, for group B (0.800±1.304), and for group C (0.200±0.837) for molar region in mandible on left side using one way ANOVA analysis. The results showed that there was a slight increase in the buccal bone thickness after treatment in mandible between the groups but the differences were not statistically significant in mandible for right side ($p < 0.693$) and for mandible left side ($p < 0.748$) for left side

Tables and Graphs

TABLE I. Arch dimensional changes in Maxilla and Mandible

I - Inter-canine width

Table I-a shows the mean value of the differences in T2- T0 in 3 groups for intercanine width in maxilla

Mean value of 5 patients in maxilla

GROUP	N	Subset for alpha = .05
		1
Group A	5	.2000
Group B	5	1.0000
Group C	5	2.6000
Sig.		.256

Means for groups in homogeneous subsets are displayed.

Uses Harmonic Mean Sample Size = 5.000.

Table I-b shows the mean value of the differences in T2- T0 in 3 groups for intercanine width in maxilla

IC - Mandible

Mean value of 5 patients in mandible

GROUP	N	Subset for alpha = .05
		1
Group A	5	.4000
Group B	5	2.0000
Group C	5	2.4000
Sig.		.472

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

Table I-c shows the comparison of the mean differences during the time interval of [T2 - T0] between the three groups By one way ANOVA analysis

	GROUP						p Value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
IC - Maxilla	.200	1.643	1.000	1.871	2.600	3.050	0.274
IC - Mandible	.400	2.881	2.000	2.345	2.400	2.608	0.465

IPM – Maxilla

Table II-a shows the mean values of the difference in T2-T0 in three groups

Mean value of 5 patients in maxilla

GROUP	N	Subset for alpha = .05
		1
Group A	5	-1.4000
Group B	5	-1.4000
Group C	5	-.4000
Sig.		.624

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

IPM – Mandible

Table II-b shows the mean values of the difference in T2-T0 in three groups for the inter-premolar width in mandible

Mean value of 5 patients in mandible

GROUP	N	Subset for alpha = .05
		1
Group A	5	-3.4000
Group B	5	-2.8000
Group C	5	-1.2000
Sig.		.743

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

TABLE II-c - shows the comparison of the mean differences during the time interval of [T2 - T0] between the three groups by one way ANOVA analysis

	GROUP						p Value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
IPM - Maxilla	-1.400	.894	-1.400	1.140	-.400	2.510	0.567
IPM - Mandible	-3.400	7.092	-2.800	1.924	-1.200	3.421	0.750

III- Inter- Molar width

IM - Maxilla

TABLE III-a - shows the mean values of the difference in T2-T0 in three groups for the inter-molar width in maxilla

Mean value of 5 patients in maxilla

GROUP	N	Subset for alpha = .05
		1
Group C	5	-.4000
Group B	5	.0000
Group A	5	1.0000
Sig.		.129

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

IM - Mandible

TABLE III-b - shows the mean values of the difference in T2-T0 in three groups for the inter-molar width in mandible

Mean value of 5 patients in mandible

GROUP	N	Subset for alpha = .05
		1
Group A	5	-2.8000
Group B	5	-2.8000
Group C	5	-1.8000
Sig.		.838

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

TABLE III-c - shows the comparison of the mean differences during the time interval of [T2 - T0] between the three groups by one way ANOVA test

	GROUP						p Value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
IM - Maxilla	1.000	1.000	.000	.707	-.400	1.342	0.136
IM - Mandible	-2.800	4.087	-2.800	2.168	-1.800	1.304	0.808

TABLE IV. Differences in Buccal Bone Thickness in Mandible at T0 and T2 between the three groups:

P2 - Mandible - Right - Difference

TABLE IV-a - shows the mean difference between T2-T0 for right between the three groups

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group B	5	.4000
Group C	5	.4000
Group A	5	.6000
Sig.		.917

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

P2 - Mandible - Left - Difference

TABLE IV-b - shows the mean difference between T2-T0 between the three groups A, B and C for left side

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group C	5	.4000
Group A	5	.8000
Group B	5	.8000
Sig.		.746

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000

TABLE IV-c - shows the comparisons of the mean differences in buccal bone thickness for right and left side of the mandible between three groups by one way ANOVA test

	GROUP						p value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
P2 - Mandible - Right - Difference	.600	.894	.400	.548	.400	.894	0.901
P2 - Mandible - Left - Difference	.800	1.095	.800	.837	.400	.548	0.703

V – difference in buccal bone thickness in relation to the first molar(M1)

M1 - Mandible - Right - Difference

TABLE V-a - shows the mean difference between T2-T0 for right between the three groups for right side

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group A	5	.2000
Group B	5	.6000
Group C	5	.8000
Sig.		.678

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

M1 - Mandible - Left - Difference

TABLE V-b - shows the mean difference in buccal bone thickness between T2-T0 between the three groups A , B and C for left side

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group C	5	.2000
Group A	5	.6000
Group B	5	.8000
Sig.		.735

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

TABLE V-c - shows the comparisons of the mean differences in buccal bone thickness in molar region on right side of the mandible between three groups

	GROUP						P value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
M1 - Mandible - Right - Difference	.200	1.304	.600	.894	.800	1.095	0.693
M1 - Mandible - Left - Difference	.600	1.517	.800	1.304	.200	.837	0.748

Table VI - Differences in Axial inclination changes in Maxilla and Mandible at T0 and T2 between the three groups:

TABLE VI-a - shows the mean difference in the values of T0 – T2 in U1- SN

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group A	5	13.2200
Group B	5	16.0600
Group C	5	16.3600
Sig.		.573

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

TABLE VI-b - shows the mean difference in the values of T0 – T2 in

U1- NF

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group A	5	13.1800
Group B	5	15.3200
Group C	5	17.7000
Sig.		.423

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

TABLE VI-c - shows the mean difference in the values of T0 – T2 in

U1- NA

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group A	5	11.4000
Group B	5	12.7200
Group C	5	14.0200
Sig.		.762

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000

TABLE VI-d - shows the shows the comparisons of the mean differences in axial inclination changes in maxilla between three groups by one way ANOVA test

	GROUP						p Value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
U1 to SN - Max.	13.220	5.050	16.060	4.465	16.360	4.932	0.542
U1 to NF - Max.	13.180	7.466	15.320	5.136	17.700	2.997	0.455
U1 to NA - Max.	11.400	6.543	12.720	5.475	14.020	5.416	0.781

FOR MANDIBLE

TABLE VII-a - shows the mean difference in the values of T0 – T2 in L1-NB

L1 to NB - Mand.

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group A	5	10.2600
Group C	5	11.0800
Group B	5	13.7400
Sig.		.526

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 5.000.

IMPA – Mand

TABLE VII-b - shows the mean difference in the values of T0 – T2 in IMPA,

Mean value of 5 patients

GROUP	N	Subset for alpha = .05
		1
Group C	5	8.2600
Group A	5	10.3200
Group B	5	14.8400
Sig.		.079

Means for groups in homogeneous subsets are displayed.

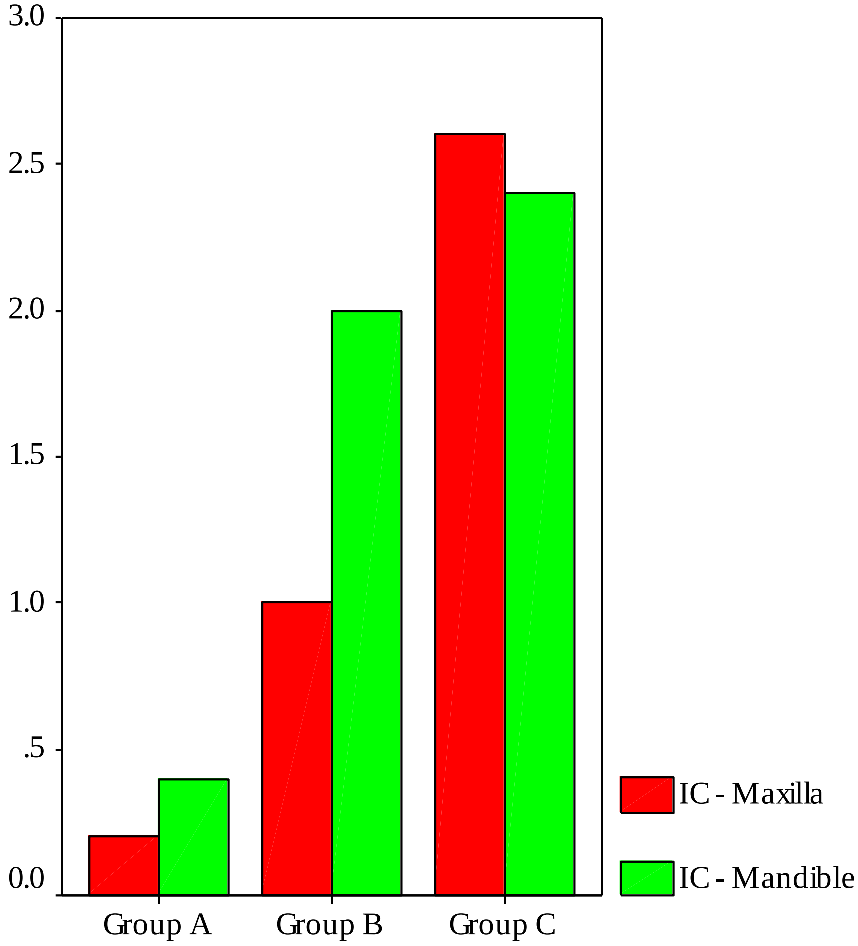
a Uses Harmonic Mean Sample Size = 5.000.

TABLE VII-c - shows the shows the comparisons of the mean differences in axial inclination changes in mandible between three groups by ANOVA test

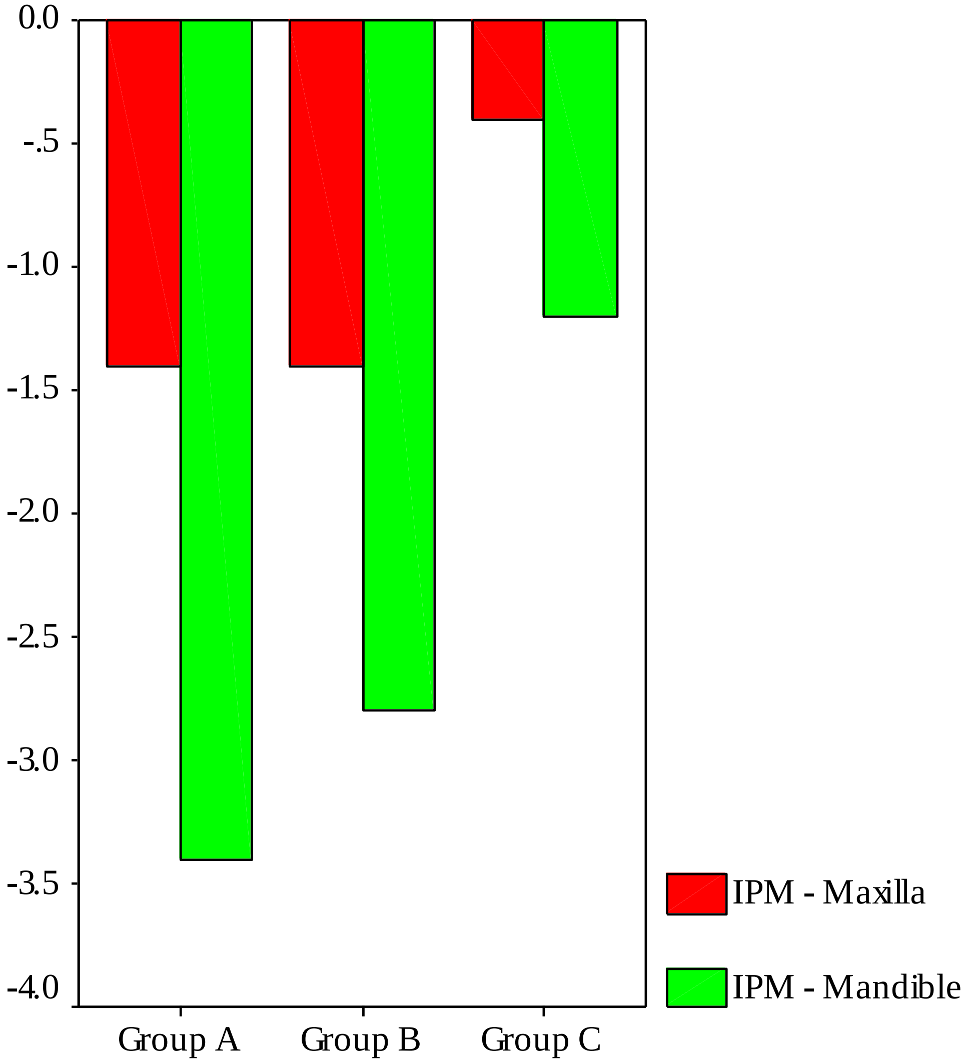
	GROUP						P Value
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
L1 to NB - Mand.	10.260	4.088	13.740	2.134	11.080	7.233	0.528
IMPA - Mand.	10.320	4.497	14.840	3.022	8.260	5.181	5.181

TABLE VIII. shows the rate of retraction in maxilla and mandible and its comparison between the three groups with two examiners

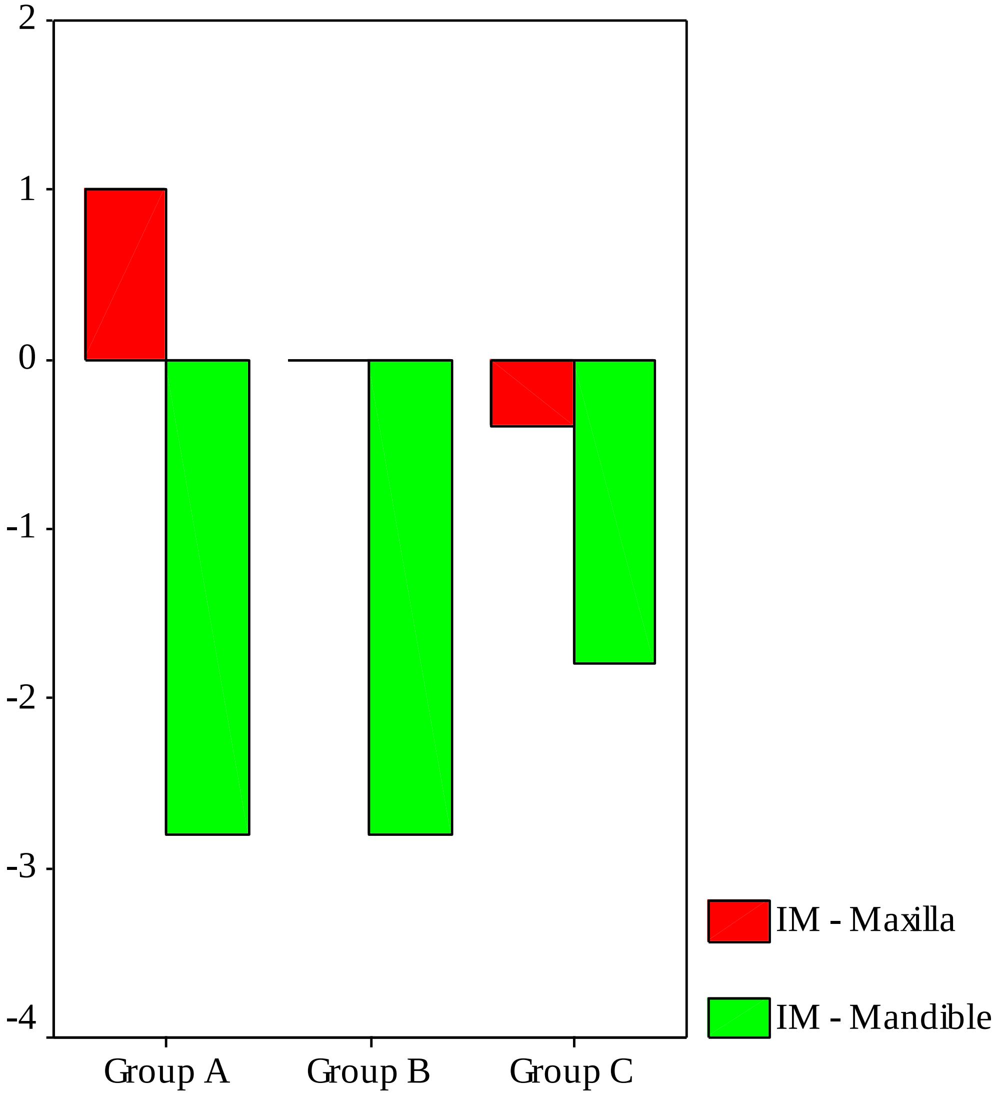
	GROUP						pValue
	Group A		Group B		Group C		
	Mean	SD	Mean	SD	Mean	SD	
Maxilla - Right - E1	.736	.041	.760	.207	.902	.117	0.168
Maxilla - Left - E1	.817	.178	.822	.201	.734	.193	0.722
Mandible - Right - E1	.709	.168	.779	.303	.740	.349	0.927
Mandible - Left - E1	.681	.162	.780	.207	.667	.252	0.658
Maxilla - Right - E2	.758	.123	.759	.209	.880	.127	0.402
Maxilla - Left - E2	.793	.154	.836	.207	.798	.154	0.914
Mandible - Right - E2	.717	.181	.791	.286	.766	.342	0.914
Mandible - Left - E2	.690	.175	.772	.230	.668	.296	0.772



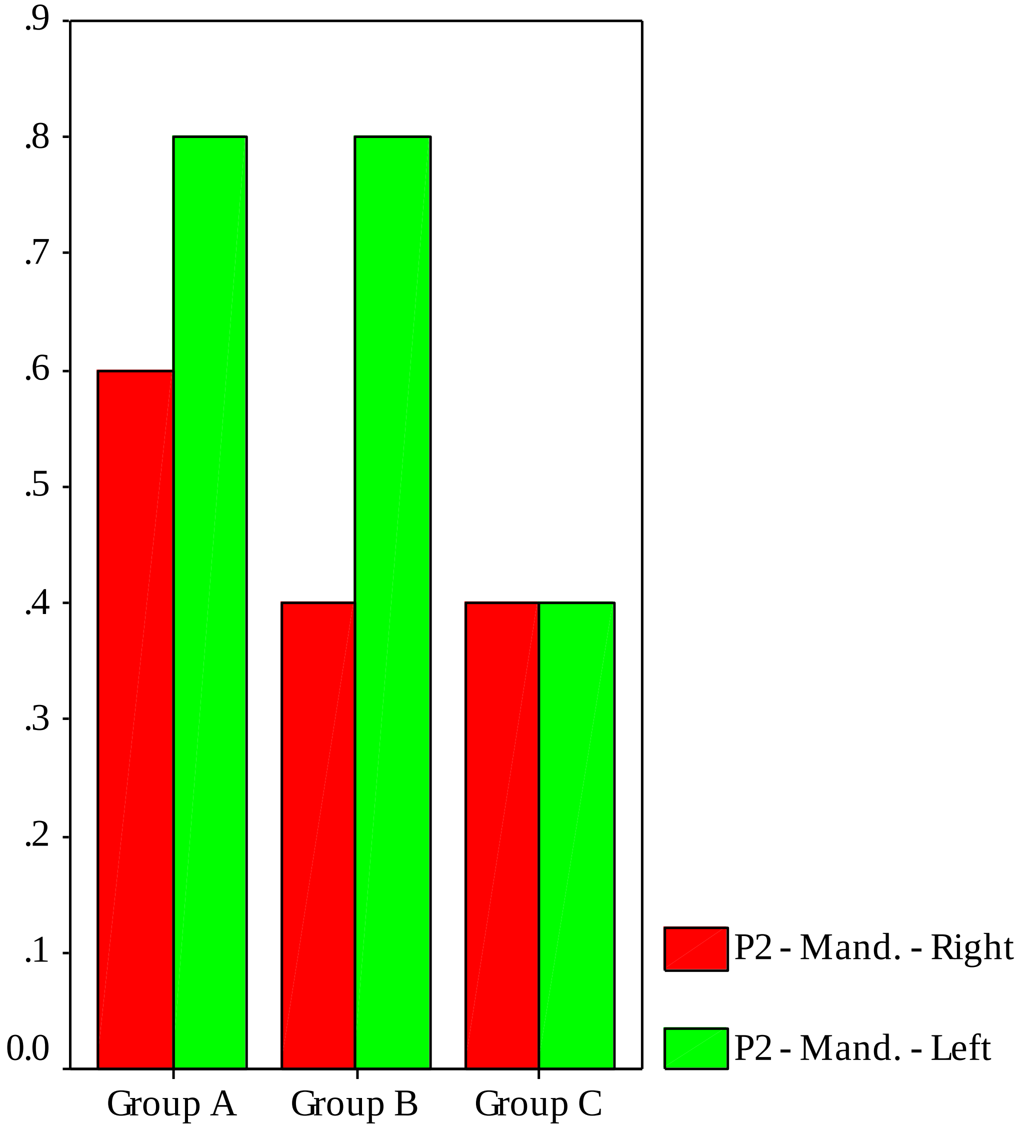
GRAPH 1: SHOWS COMPARISON OF THE MEAN DIFFERENCE IN INTERCANINE WIDTH BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



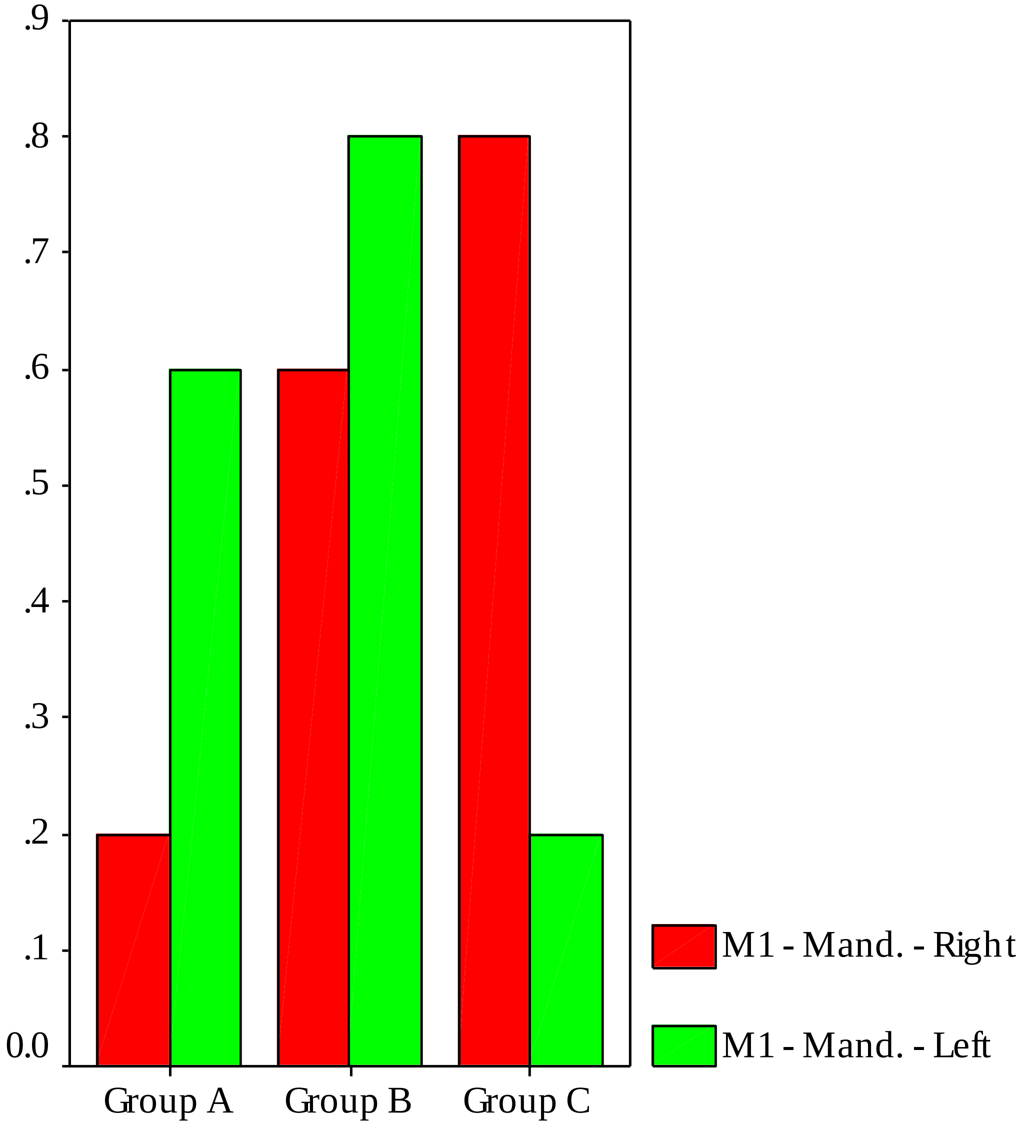
GRAPH 2: SHOWS COMPARISON OF THE MEAN DIFFERENCE IN INTERPREMOLAR WIDTH BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



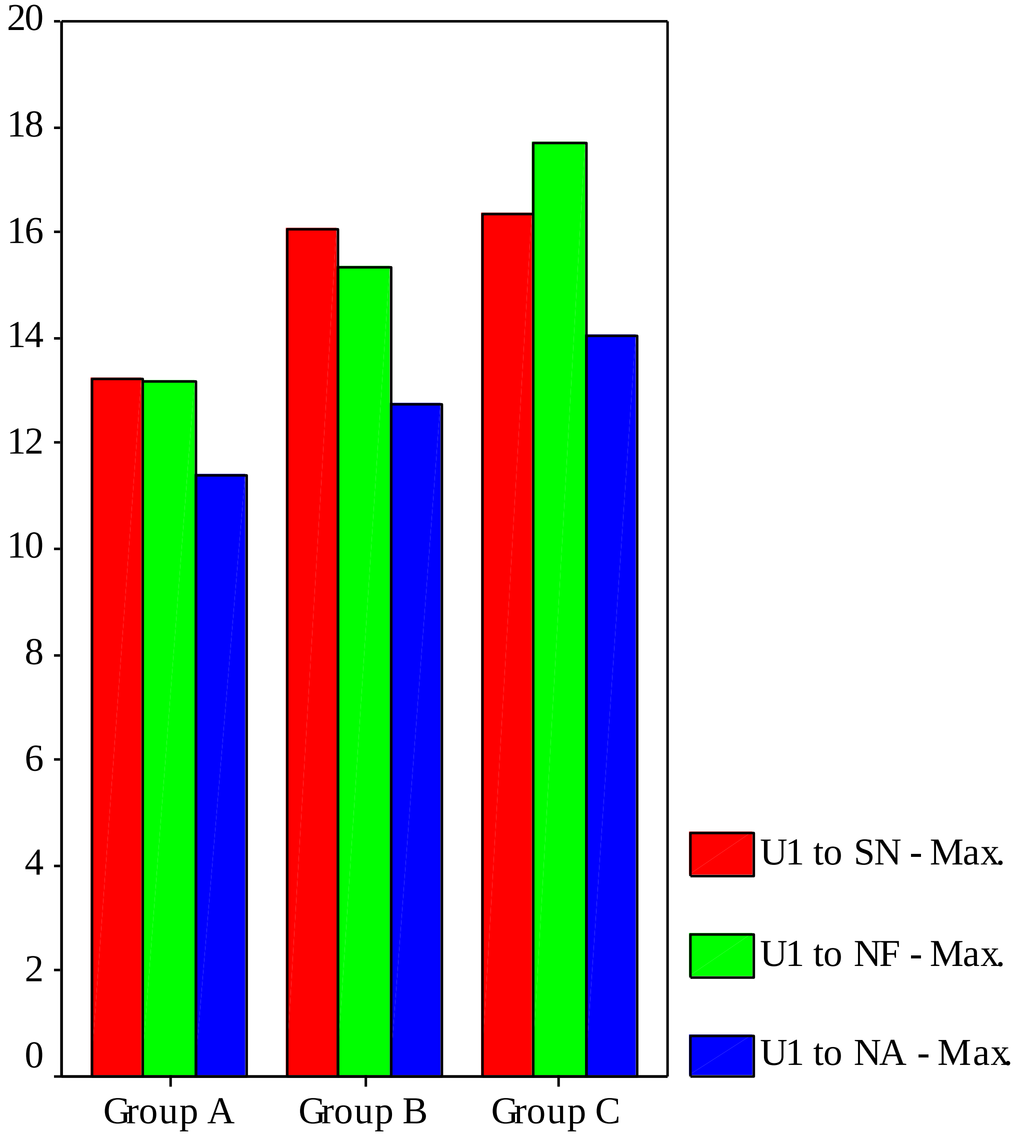
GRAPH 3: SHOWS COMPARISON OF MEAN DIFFERENCE IN INTERMOLAR WIDTH BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



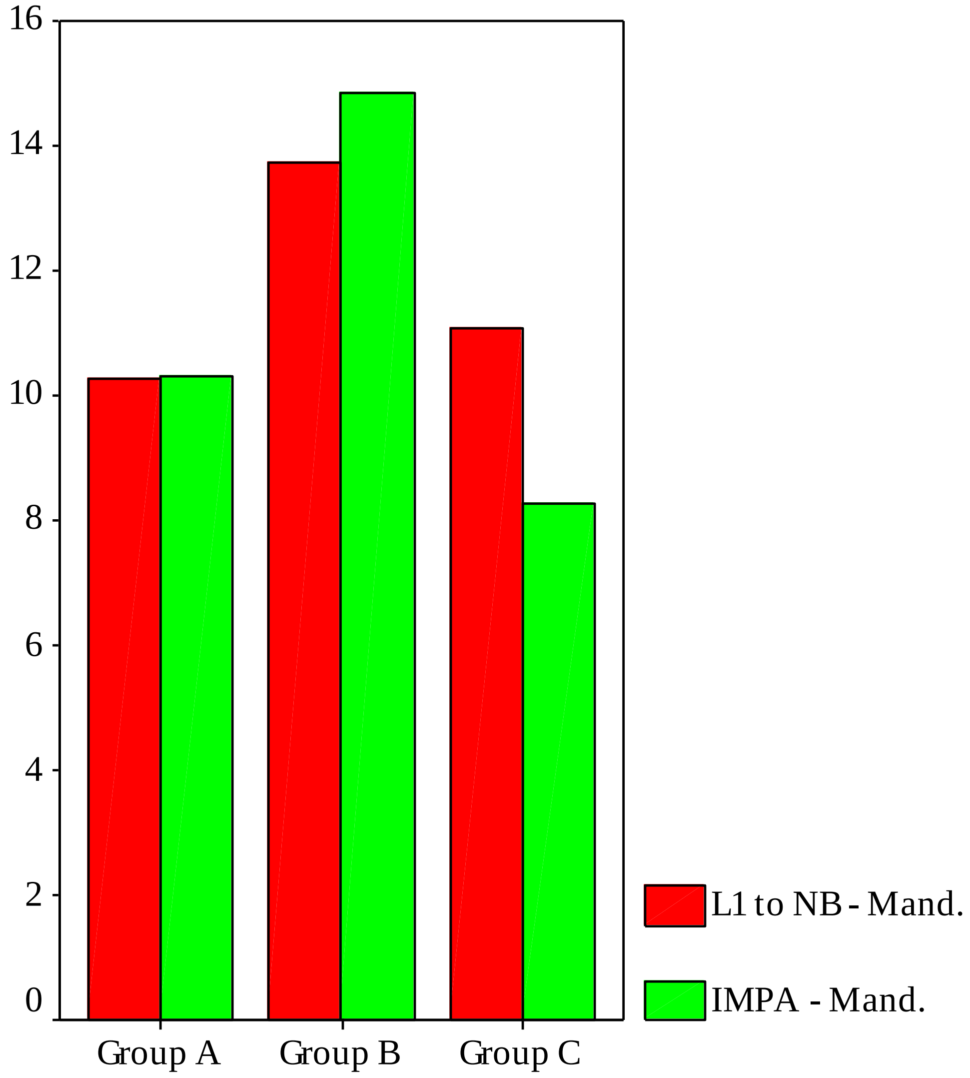
GRAPH 4: SHOWS COMPARISON OF THE MEAN DIFFERENCE IN BUCCAL BONE THICKNESS IN PREMOLAR REGION IN MANDIBLE BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



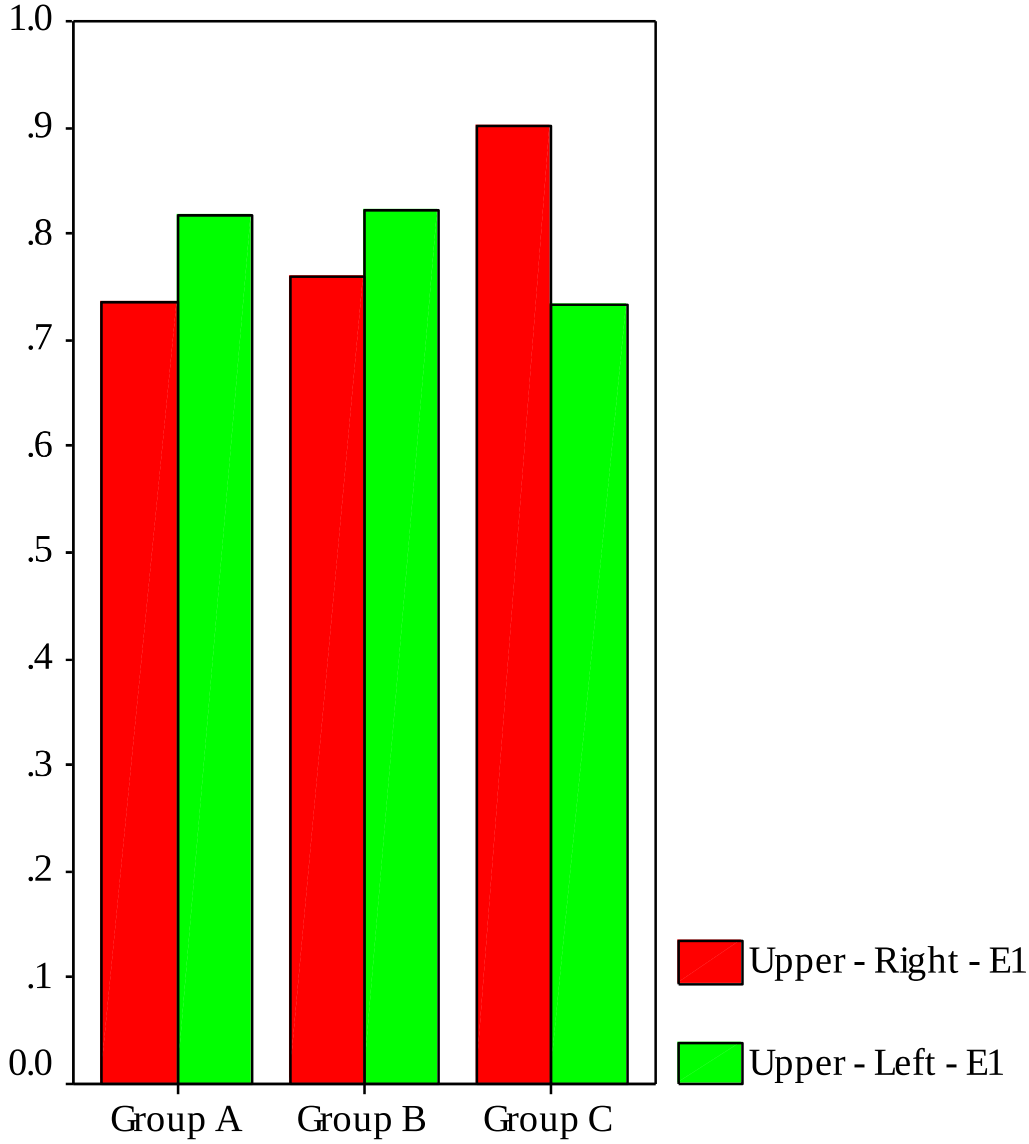
GRAPH 5: SHOWS COMPARISON OF THE MEAN DIFFERENCE IN BUCCAL BONE THICKNESS IN FIRST MOLAR REGION IN MANDIBLE BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



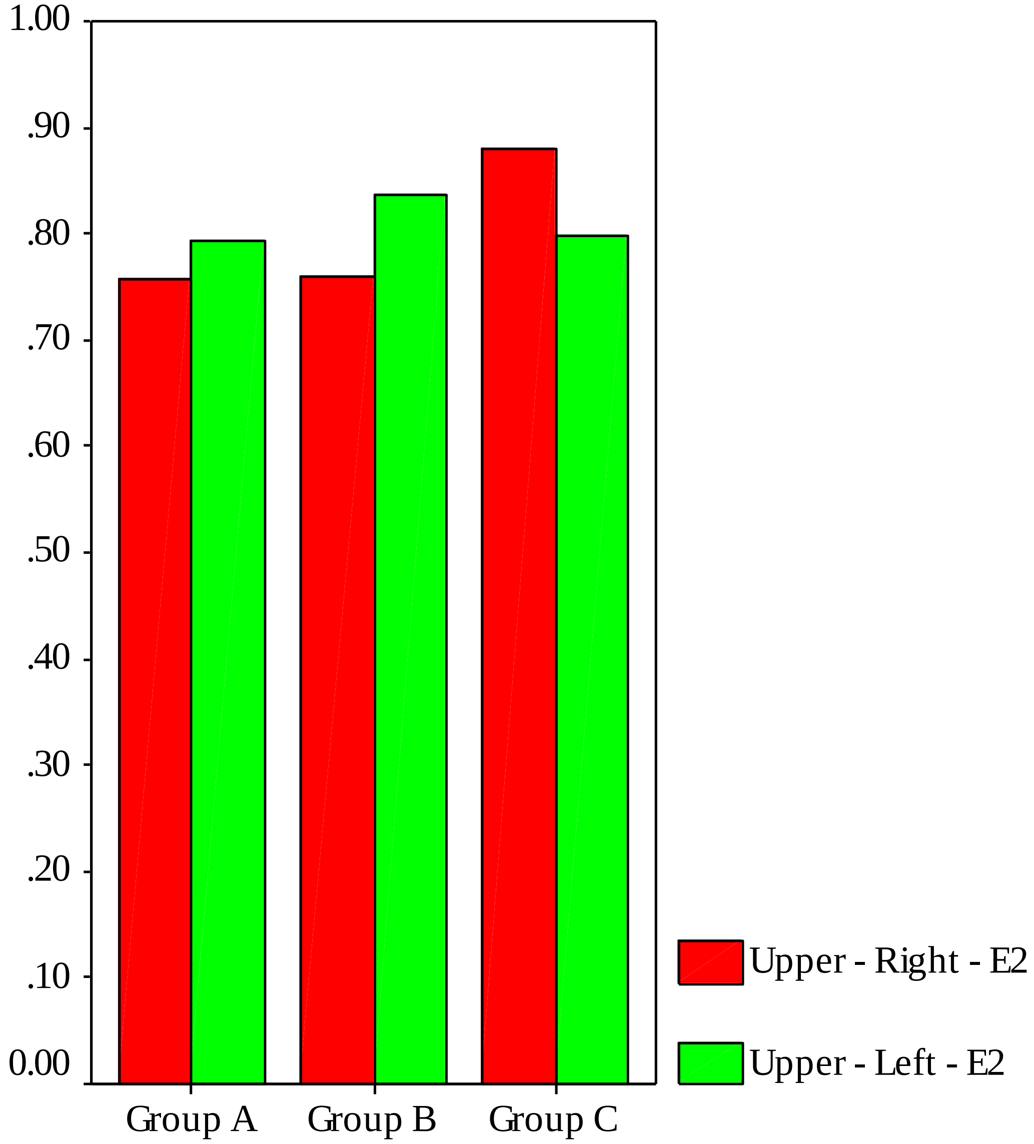
GRAPH 6: SHOWS COMPARISON OF THE MEAN DIFFERENCE IN AXIAL INCLINATION CHANGES IN MAXILLA BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



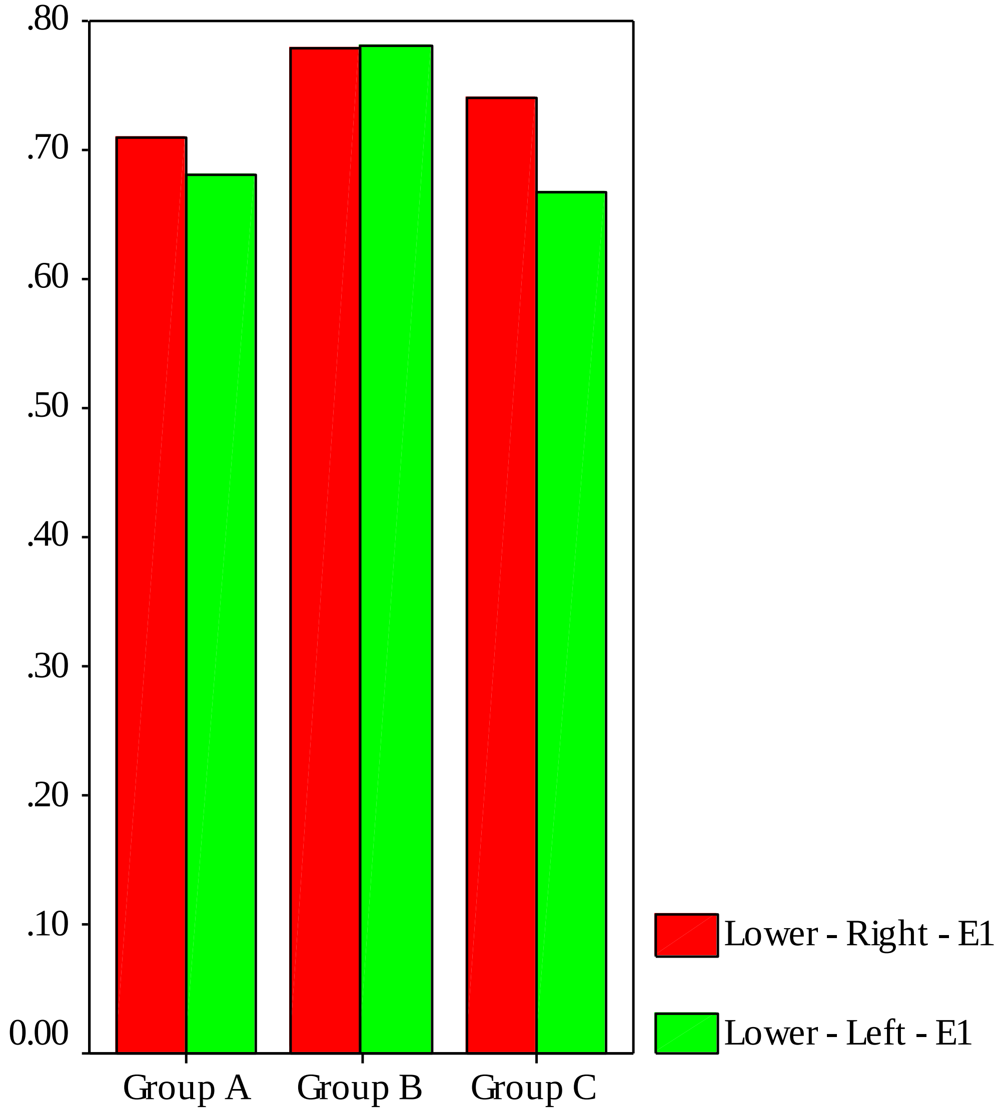
GRAPH 7: SHOWS COMPARISON OF THE MEAN DIFFERENCE IN AXIAL INCLINATION CHANGES IN MANDIBLE BETWEEN PRE (T0) AND POST (T2) IN THREE GROUPS



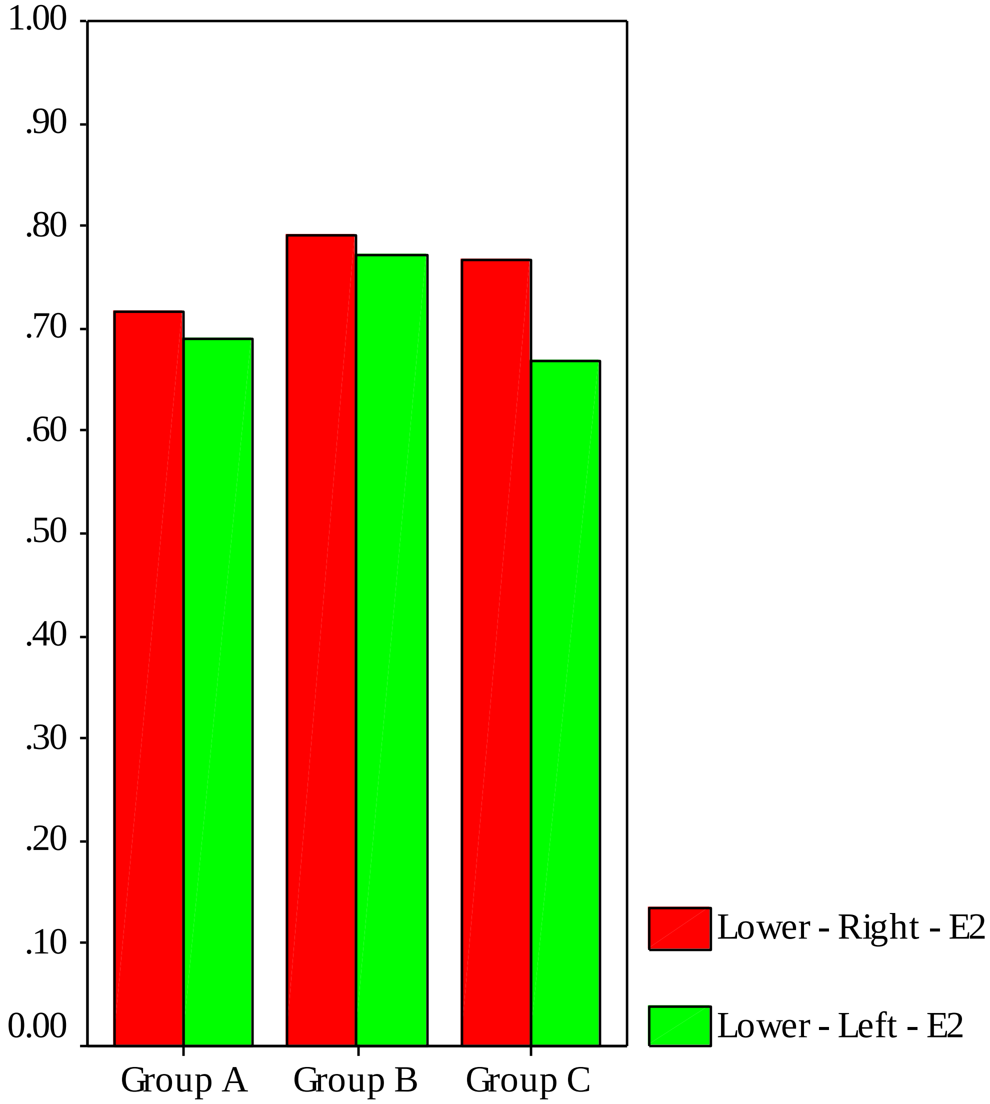
GRAPH 8: SHOWS COMPARISON OF RATE OF RETRACTION PER MONTH INTERVAL IN MAXILLA IN THREE GROUPS BY EXAMINER 1



GRAPH 9: SHOWS COMPARISON OF RATE OF RETRACTION PER MONTH INTERVAL IN MAXILLA IN THREE GROUPS BY EXAMINER 2



GRAPH 10: SHOWS COMPARISON OF RATE OF RETRACTION PER MONTH INTERVAL IN MANDIBLE IN THREE GROUPS BY EXAMINER 1



GRAPH 10: SHOWS COMPARISON OF RATE OF RETRACTION PER MONTH INTERVAL IN MANDIBLE IN THREE GROUPS BY EXAMINER 2

Discussion

DISCUSSION

Self-ligating bracket system has gained immense popularity in the last few years. The proponents of the system claim that the SLBs is more effective and efficient than the conventional bracket system.

The term “self-ligating bracket” (SL bracket) is used for those type of fixed orthodontic brackets that incorporate a locking mechanism (such as a ring, spring, or door mechanism) that holds the arch-wire in the bracket slot[41].

Self-ligating orthodontic brackets have a relatively long history, but their development can best be viewed against the background of an almost universal use of metal and elastomeric ligatures. Elastomeric ligation gives unreliable archwire control, there is force decays therefore, tooth control is not optimal[23], both wire and elastomeric ligatures sometimes may become displaced[29]. The other drawbacks of elastomerics include high friction, increased chair side time and an added oral hygiene challenge[75]. Wire ligation is very time consuming, has inconsistent force application and the wire ends can cause trauma to patient and operator[75].

In contrast to this, the self-ligating brackets are supposed to offer a number of advantages such as[29]:- Secured Robust Ligation, Full Bracket Engagement, Low Friction, Increased efficiency, Maintenance of Optimal Oral Hygiene, Comfortable for the Patient and Longer appointment intervals[13,28]. Wire ligatures provide suitable better ligation, whereas elastomeric ligatures undergo force decay if left for too long without being replaced, which requires frequent patient recalls[28]. A study by Harradine, did quantify the loss of elastomeric ligatures and found that about 15 ligatures were lost in 25 consecutively seen patients in a 12-month treatment period[49].

Full Bracket Engagement is a great advantage if the arch wire can be fully engaged in the bracket slot and maintained there with certainty[25]. Most of the self-ligating brackets have mechanisms to deliver this advantage and would ensure full engagement of all archwires and eliminate the need to regain control of the teeth when full engagement is lost[42].

Friction is the only source of resistance to sliding when drawing arch wires through well-aligned brackets. Frictional resistance to wire sliding has consistently been measured and said to be lower in the self- ligating brackets than in the conventionally ligated brackets[2,30,36,3,40,67,68,69,76]. Studies typically report value of minimal frictional resistance with self-ligating brackets and values from 43 to 98 g per bracket for various elastomeric-arch wire combinations[37].

The original motive of developing self-ligating brackets was to speed up the process of arch wire ligation[30]. Maijer R, Harradine et al have shown self- ligating brackets to save up to 9 minutes per visit compared with wire ligation and approximately 2 minutes when compared with elastomeric ligation[28,67].

Several consecutive case series studies have found that treatment with self-ligating brackets was quicker, required fewer visits, and resulted in better final alignment and occlusion than treatment with conventional appliances[9,78]. Two recent systematic reviews have concluded that there is insufficient evidence to support the view that treatment with self-ligating brackets results in fewer visits or shorter treatment time[51,73]. The studies, which are predominantly retrospective, have provided conflicting evidence: on one hand self-ligating brackets result in improved treatment efficiency and on the other that they offer no such advantage. For example, Harradine reported a significant 4 month reduction in the duration of treatment when Damon SL brackets were compared with an unspecified conventional, pre-adjusted twin bracket. More recently, Miles et. al. found no advantage in treatment efficiency when either SmartClip or Damon 2 SL brackets were compared with conventional brackets. There is, however, one consistent finding from these studies which may impact on the efficiency and cost of treatment with self-ligating brackets: they have a higher rate of bond failure than conventional brackets.

Bracket manufactures promote patient comfort as an advantage of self-ligating brackets inspite of the lack of concurrence in scientific literature; more constant pain for conventional ligation and claim that treatment with self-ligating brackets is less painful and it has put forth two explanations: forces applied on teeth are lower because lighter arch wires can be used with equal effectiveness, and the teeth move more readily in response to the applied forces because of decreased resistance to sliding[30].

Yamaguchi M et al[82], conducted a split-mouth study to examine the measure of pain by assessing level of neuropeptidase substance P in gingival crevicular fluid, which is a marker of inflammation and associated pain resulting from orthodontic forces and, found that treatment with self- ligating brackets significantly lowered the levels of Substance P and inflammation when compared with the conventional ligation for 24 hours period after the arch wire placement.

Repeated claims of more efficient treatment with SLB have been made and which have also been contradicted by the findings from few randomized trials[11,18,35].

Similarly, there appears to be little basis for the claim that self-ligating brackets induce distinctive arch dimensional changes. Padhraig S. Fleming conducted a randomized controlled trial, and found no differences in maxillary arch dimensional changes[50] or molar and incisor inclination changes after alignment with passive self-ligating brackets, active self-ligation, or conventional brackets[50]. A meta-analysis investigating arch dimensions showed no significant differences between self-ligating and conventional brackets for intercanine and intermolar widths. Nevertheless, a few studies have suggested greater increases in intermolar widths with self-ligating brackets.

Pandis et al found no significant differences between the 2 systems[45]. However, other studies have shown more emergencies associated with self-ligating brackets. The meta-analysis mentioned above found no significant differences[45].

During orthodontic treatment, in cases with premolar extraction, the orthodontist has various options for space closure. A popular method is en-masse space closure with sliding mechanics using Ni-Ti coil springs. Some self- ligating brackets are labelled as passive and promoted on the premise that elimination of ligatures reduces friction and allows for faster sliding mechanics. If true, self-ligating brackets could reduce overall treatment time. Studies investigating the rate of space closure have also reported no difference between self-ligating and conventional brackets. However, they have only compared passive SLB with conventional brackets and either have used a split-mouth design or have measured space closure for only a limited time[55].

Interest in self-ligating brackets has grown in the recent years. There are essentially two main types of self-ligating brackets, based on the designing of the locking mechanism and the dimensions of the slot: active brackets and passive brackets.

In passive systems (such as the Damon System. ORMCO, A Company, Orange, CA), the slot is locked with a rigid locking mechanism. Once it is engaged, the bracket is effectively turned into a tube, ideally allowing arch wires to slide freely within the tube[41]. In active systems (such as Quick, Forestadent Ltd., Germany; and SPEED, Cambridge), the locking mechanism generally consists of a flexible but resilient clip that can actively engage the wire into the bracket slot once the arch wire reaches a certain size of deflection[67].

Active self-ligating brackets such as, SPEED (Strite Industries, Cambridge, Ontario, Canada), and Quick brackets (Forestadent Ltd., Germany) have a sliding spring clip, (type of clip search) which encroaches on the slot from the labial aspect, potentially placing an active force on the arch wire. These brackets are all correctly described as having potentially active clips. In contrast, the passive self-ligating brackets such as the Damon brackets (ORMCO, A Company, Orange, CA) have a slide which opens and closes vertically and creates a passive labial surface with the slot having no intention to encroach and store force by deflection of a metal clip[75].

A third type of bracket system has been added called the Interactive self-ligating brackets such as the InOvation R bracket (GAC, International, Bohemia, NY, USA) which can exhibit either passive or active properties during any stage of treatment at the discretion and direction of the clinician[79]. They exhibit minimal force and friction (passive) in the early stage of treatment. Torque and rotational control (active) in the middle and finishing stages of treatment[80].

The aim and objective of our study, was to compare the retraction efficiency, transverse arch dimensional changes and the torque expression between interactive, passive self-ligating bracket system and Conventional bracket system using CBCT and dental casts. To the best of our knowledge, no previous in vivo studies have compared the retraction efficiency and the arch dimensional changes with use the of interactive, passive self-ligating bracket with conventional bracket in a CBCT and in a dental cast concept. In our study we used AO Empower interactive Self-Ligating Brackets, passive Gemini SL and AO conventional brackets. (all 0.022 X 0.028 slots)

Thus, this study was done to compare the retraction evaluation of rate of space closure, arch dimensional and axial inclination changes between two self – ligating systems (Empower Dual Activation, American Orthodontics, Sheboygan, WI, USA and Passive - 3M Gemini SL) and conventional brackets (Mini/Master Series, American Orthodontics, Sheboygan, WI,USA) along with changes in transverse dimensions and the torque expression between both the bracket systems.

There is a relative lack of evidence comparing the retraction efficiency of SL and CL brackets in extraction patients because most studies have investigated mixed samples. Only 2 clinical trials have compared SL and CL brackets solely in extraction patients[55,54].

In our prospective clinical study totally 18 patients, who were undergoing orthodontic treatment in our department, were selected according to selection criteria and divided into three different groups of 6 each as Group A, B and C in which 1 patient from each group was eliminated due to multiple breakage of brackets and irregular visits, so the final group comprised of 5 patients in each.

Once the leveling and alignment is completed, 19x25 inch stainless steel archwire with soldered hooks were left in place for 5 weeks and then the retraction was commenced using Ni-Ti closed coil springs in all quadrants at the same time. Post treatment CBCT images were taken after the completion of the retraction, to assess the buccal bone thickness, arch- dimensional changes that includes inter-canine, inter second premolar and inter-molar widths. Lateral Cephalograms were generated from CBCT images using Dolphin 3D imaging software (version 11.8) to assess axial inclination changes of the anterior teeth. All these measurements were done by one primary investigator using Dolphin 3D software program and a set of study models were taken at the beginning (T_1) and after completion of the retraction (T_2)

The treatment efficiency of this study are discussed in the following topics:-

- Evaluation of rate of space closure,
- Arch dimensional and
- Axial inclination changes

Assessment of the mean difference in buccal bone thickness, arch dimensional changes and axial inclinational changes were assessed using one way ANOVA analysis for finding the significance differences between the three groups and rate of retraction of retraction per month for different groups were also assessed using ANOVA test.

Evaluation of rate of space closure:

In our study the rate of retraction was defined as the distance travelled, divided by the time taken to complete retraction, which was recorded in millimeters per interval. An interval was defined as a 4week period. The widths of the extraction spaces and time of retraction were recorded. Measurements were performed by direct - technique from casts with the help of Vernier Caliper with sharpened tips that were accurate to 0.01mm. Models were measured by the primary investigator and secondary assessor who were blinded about the study and there is no significant differences were found between measurements made by two operators at two different time points.

In our study no statistical significant difference was found between the three groups on the rate of retraction for both SLB and conventional bracket groups

In a study by Miles et al[55] where it has been observed that the rate of en masse retraction with sliding mechanics between passive self-ligating (Smart-Clip) brackets and conventional brackets ligated with stainless steel ligatures had no difference in the rate of space closure.

The results of our study demonstrate that the rates of space closure were almost identical with the interactive, passive bracket and the conventional brackets tied with SS ligatures distal to the extraction site. Clinicians can therefore use their preferred bracket type (conventional or interactive or passive self-ligating) without affecting the rate of space closure in extraction patients. SS ligatures were tied normally with no intention to keep them loose, which does not offer any advantage during en-masse space closure when the teeth are already leveled and aligned.

However, if a different method such as use of elastomeric modules or a elastomeric chains tied around the bracket, there might have been a higher resistance to sliding that might impact the rate of space closure.

A previous split-mouth study comparing the effectiveness of Ni-Ti coil springs and a stretched elastomeric module showed that springs were superior to the module for en-masse space closure[64]. The same authors, compared the effectiveness of 150-gms of Ni-Ti coil springs (as used in this study) along with 200-g springs, found no clinical difference in the rate of space closure[65]. A randomized clinical trial of a 0.022-in slot pre-adjusted bracket with 0.019 X 0.025-in SS wires compared active ligatures, power chain, and Ni-Ti coil springs during space closure[12]. They found that Ni-Ti coil springs were found to achieve the most rapid rate of space closure at 0.81 mm per month. These authors concluded that inter-maxillary elastics were not a factor in the rate of space closure. In a split-mouth study on a comparison of elastomeric chain and Ni-Ti closed coil springs with a 22-in slot system and 0.019 x 0.025-in SS wires, no statistically significant difference was found in another study[48]. The elastomeric chain achieved movement of 0.21 mm per week (about 0.9 mm per month), whereas the 9-mm Ni-Ti closed coil springs achieved 0.26 mm per week (about 1.1 mm per month); which is similar to the rate of space closure (1.1-1.2 mm per month) in the study done by Peter G. Miles[55]. Although these previous studies used a 22-inch slot system, the rates of retraction and space closure were less than or identical to the 18-in slot system used in that study[55]. It would therefore appear that the slot size in conjunction with the appropriate wire size makes minimal clinical difference in the rate of space closure.

This is the reason for using Ni-Ti closed coil springs in our study with 19x25 inch stainless steel archwire in a 0.022 inch slot in our study

In addition, the use of the passive SmartClip bracket made no difference to the rate of space closure when compared with the conventional twin bracket ligated with SS ligature. It appears that, once the initial static friction in either system is overcome, the residual force with the 150-g spring is sufficient to produce similar rates of movement. Therefore, choice of slot size and bracket ligation (self-ligating Vs SS ligature) for sliding mechanics can be based on clinician's preference. Although when comparing self-ligating brackets with conventional brackets they save time used for untying and ligating, once a Stainless Steel ligature wire is tied at the initial placement of the SS archwire for space closure, it can be left for the entire duration of space closure without retying[1,28]. The time saved for ligation would be greater at wire changes during initial alignment and in the final detailing stages of treatment.

The archwires used in the study done by Miles et at[55] extended only till the first molars during space closure, and, if extended to the second molars, this might affect the rate of closure.

Arch dimensional changes:

Inter canine widths and Inter second premolar widths were measured from the cusp tips of the canines and second premolars and Inter molar widths were measured from mesio - buccal cusp tips for the first molars in maxilla and mandible with CBCT images using 3D software program by the primary investigator at two time points T_0 and T_2.

A disadvantage of the CBCT method is its greater radiation dose in comparison to conventional radiographs. However, CBCT is an invaluable tool in orthodontic research. Good to excellent reliability of CBCT scans used for detection of bone defects was demonstrated by Misch et al. Furthermore, when compared to bi-dimensional radiographs, CBCT showed great reliability and offered advantages when detecting and quantifying bone fissures and fenestrations, as well as periodontal defects in the buccal bone.

Mandibular arch bone expansion studies with CBCT scans comparing SLB and CLB are rare in the literature and few studies have assessed the maxillary arch response to SLB and CLB systems[59]. Nonetheless, some studies compared arch expansion on dental casts and on digitized models, which may offer greater accuracy[64]. Claims have been made that SLB can result in broader arch forms in comparison to CLB. Our study aimed at testing the null hypothesis that there are no significant differences in the arch dimensional changes in maxilla and mandible between pre and post orthodontic treatment with either SLB or CLB systems and as demonstrated by analysis on CBCT using Dolphin 3D imaging software.

In our study, no statistical significant difference was found between the three groups for inter canine, inter second premolar and inter molar widths which showed that no statistically significant differences in arch expansion has taken place in three groups.

Unlike in our study, Cattaneo et al[59] noted that the transversal dimensions at the second premolar and the first molar region were greater in the passive self-ligating group than in the active self-ligating group. The greater expansion could be due to the broad wires with the passive self-ligating brackets and the narrow wires with the active self-ligating brackets.

Similar to our study, the authors of another study used the same broad Damon archwires and found no difference in the arch dimensional changes between the conventional and either the active or passive self-ligating brackets. The authors concluded that bracket type had no significant effect on any transverse dimensional changes. However, unlike in our study, the factors included such as wide variations of ethnicity and malocclusions with an especially high proportion of Class III patients should be considered. In our study, we eliminated the differences in malocclusion between the groups to negate the confounding effects.

Cattaneo et al[59] compared active and passive self-ligating brackets using cone-beam computed tomography images and showed that there is an increased buccal tipping of the premolars and molars in both systems. They concluded that the claims regarding expansion without tipping using active or passive self-ligating brackets could not be confirmed.

Changes in buccal bone thickness:

According to Birnie,[68,69,76] Damon divulged his theory that by using SLB with low friction and light forces more stable biological results could be produced. Damon, based on clinical evidences, attributed advantages to self-ligating brackets, among which is the passive expansion of the arches. The Damon[8] SLB system claims that post-treatment computed tomography images show transverse arch development and normal alveolar bone on buccal surface. Low friction and low force are purported to be good to physiologically rebuild the alveolar bone.

The three-dimensional capability of CBCT makes it possible to non-invasively assess alveolar bone changes for mandibular posterior teeth. We found that

BBT measurements decreased from T_0 to T_2 for both groups. A significant difference occurred for the majority of measurements regarding Buccal Bone Thickness from T_0 to T_2 for both groups. There was no statistically significant differences between the groups.

The results of our present study confirm findings in the literature showing similar behaviors for both brackets, particularly with regard to dental expansion assessed by means of CBCT. Inter second premolar distances, measured on CBCT with dolphin 3D software in both groups, increased between T_0 to T_2.

This result is similar to those found by Fleming et al[51], with an increase of 0.85 mm and 1.17 mm for SLB and CLB, respectively. However, the change was not significantly different between the two bracket systems. Further corroborating these findings, Vajaria et al also found expansion in inter second premolar distances. When the inter-second premolar distances is assessed pre and post treatment between the groups, there was an increase of 2.10 mm for Self ligating Brackets and 1.75 mm for Conventional Brackets; however, this increase was similar for both groups. Once again, the results yielded by the present study are similar to those obtained by Fleming et al[49] (SLB= 1.43 mm, and CLB= 1.72 mm).Nevertheless, contrary to our findings, Vajaria et al found a larger increase for the self-ligating group (4.35 mm in comparison to 2.6 mm for the conventional group). Regarding inter-molar distances, there was an increase ranging from 1.4 to 2.4 mm for SLB, and from 0.43 to 1.85 mm for CLB. On the other hand, a decrease in inter-molar distance was observed in only one study in which cases were treated by means of premolar extractions[54]. We found no - significant increase in mandibular first inter-molar width for both SLB and CLB groups, and there was no significant difference between the two bracket groups. The present study showed molar expansion of 0.92 mm and 0.46 mm for SLB and CLB, respectively. This result is in accordance with the study by Vajaria et al. Nonetheless, Pandis et al and Fleming et al[49] found that SLB expanded more than CLB in the molars region, and this difference was considered statistically significant.

In our study when the values of buccal bone measurements was assessed, we found that the alveolar buccal bone did not follow dental expansion. Therefore, the statements that "Self-ligating brackets produce physiological and passive movements of the dental arches" were not confirmed in this study. Regarding buccal bone changes, our study shows that self-ligating brackets do not offer any significant advantages over the conventional system. The same has to be confirmed with larger sample size.

Padhraig S. Fleming[50] observed that significant changes occurred in the premolar region with upto 4.51 mm of expansion with Damon Q in the premolar region. The changes were slightly greater than those reported by Franchi et al[21] in a prospective follow-up of 20 patients treated with fixed appliances with low-friction ligatures over the initial six months of treatment. Franchi et al[21] reported that expansion ranging from 1.71 to 3.65 mm for maxillary transverse dimensions with increases peaking in the premolar region. The reasons for relatively large dimensional increases in Fleming's[50] study can be related to the use of Damon archwires, whereas Tru-arch medium form wires were used by Franchi et al. Its a known fact, that Damon arch wires have a broad arch form shape, particularly in the buccal segments, and that could have contributed to the amount of expansion reported[43]. Moreover, a previous randomized study by Cattaneo et al[59] had combined the use of Damon wires and brackets, but the narrower wires with active self-ligating brackets, and it shows that there is no significant difference in first premolar expansion measurements with mean values of 4.5 and 4.3 mm in the active and passive groups, respectively. Slight increase in transversal dimension of inter molar (0.9 mm) and inter second premolar expansion (0.7 mm) were seen with Damon system, however, suggesting that any effect with broadened archwire might be exerted farther posteriorly.

Axial inclination changes:

Passive self-ligating brackets have been claimed to lead to posterior expansion without prominent labial movement of the incisors. Based on this idea, in several studies the conventional and passive self-ligating brackets were compared in terms of transverse arch dimensional changes. However, the “posterior expansion” claim has not been made for active self-ligating brackets, in which the clip has a constant pressure on the archwire, unlike the other one. (i.e) passive self-ligating brackets. Because only a few studies have evaluated active and passive self-ligating and conventional brackets in terms of arch dimensional changes, so we aimed at comparing these changes in 3 bracket types

Angular changes in axial inclination of the long axis of the maxillary incisors in relation to S-N plane and N-A line and the mandibular incisor relative to the mandibular plane and N-B were measured by assessing the CBCT generated lateral cephalograms. Radiographs were traced and measured which revealed no statistically significant difference in the amount of axial inclination changes in the expression of maxillary and mandibular incisor in angular measurements.

N. Pandis, S Strigou, T Eliades[52] tested the hypothesis that the engagement mode of wire to bracket affects the buccolingual inclination of maxillary incisors in extraction and non extraction treatment with self-ligating and conventional brackets and they concluded that self-ligating brackets seem to be equally efficient in delivering torque to maxillary incisors relative to conventional brackets in extraction and non extraction cases.

Studies have depicted that mandibular incisor proclination in both self-ligation and conventional groups had no statistical significant difference [Jiang and Fu[34], ; Scott et al[54]., ; Fleming et al. [49] ; Pandis et al[52]], indicating that the mechanism for relieving crowding involves incisor proclination and transverse expansion through tipping of posterior teeth, which is similar for both conventional and self-ligating brackets. A study by Cattaneo et al[59]. , using CBCT was done to compare the labio - lingual inclination of mandibular incisors relative to the occlusal plane between active and passive self-ligating brackets and confirmed a significant proclination of mandibular anterior teeth, thereby rejecting the claim of torque control by self-ligating systems The meta-analysis including three of these studies showed that self-ligating brackets had 1.5 degrees less proclination that was statistically significant, although it may not be a clinically significant change.

Our finding agrees with that of Pandis et al[52], who found no significant difference between the self- ligating and conventional groups in terms of axial inclination changes of the incisors.

LIMITATIONS OF THE STUDY:

However there were certain limitations in the study,

1. The study duration for the present study was 8 months, however, efforts should be taken to follow up for a period of 2 or 3 years for assessing stability and treatment outcomes.
2. With a small sample size, it is possible that a type II error could have been made and the null hypothesis was accepted when it might have been rejected (no difference was found when it would have been found with a larger sample with higher power), so a larger sample would be preferable.
3. Pre-cautional measurements for the type of malocclusion, arch wire standardization and influence of muscle on malocclusion were not designed in this study.

Thus, the null hypothesis of the present study was accepted; in other words, no significant differences were found between self-ligating and conventional brackets systems regarding the rate of retraction, arch dimensional changes and mandibular buccal cortical bone thickness.

Summary and Conclusion

SUMMARY AND CONCLUSION

The purpose of this study was to evaluate the rate of retraction, arch dimensional and axial inclination changes in patients treated with two different Self-ligating bracket systems and compared to those patients treated with conventional bracket system.

15 consecutive patients who met the selection criteria were included in the study from a pool of patients. The patients were divided into three groups of six each- Group A - SLB interactive (Empower Dual Activation, American Orthodontics, Sheboygan, WI, USA), Group B – SLB passive (3M Gemini) and Group C - Conventional group (Mini Master Series, American Orthodontics, Sheboygan, WI,USA), with 0.022 –in slots. The rate of retraction was estimated in weeks. The time points of the protocol were set as T0-start of the treatment; T1- at the time of start of retraction and T2- after the extraction space have been completely closed. Study models were taken at T1 and T2. Post treatment CBCT images were taken and CBCT generated Lateral cephalometric radiographs were assessed using Dolphin 3D imaging software and the changes in the axial inclination of the incisors were assesed. Measurements of inter canine, inter second premolar and inter molar widths were also made on the CBCT images with Dolphin program to evaluate the transverse arch dimensional changes associated with the bracket systems. One way ANOVA test were used to compare the changes in the mean difference in

changes in arch dimension, axial inclination and buccal bone thickness between pre and post treatment between the three groups. The tests suggested that there are changes between pre and post treatment in all the three groups but the changes were not statistically significant. Thus our null hypothesis is accepted that there are no changes in rate of retraction, buccal bone thickness, arch dimensional and axial inclination changes between the self ligation and conventional bracket system

The following conclusions can be made from the present study:

The results of this prospective study indicates that

1. There is no difference in the quantum of expansion and buccal bone thickness between pre and post treatment in patients treated with self ligating and conventional brackets .
2. There is no differences found in terms of maxillary arch dimensional changes nor axial inclination changes of the anteriors between interactive, passive self-ligating, and conventional brackets used.
3. There is no significant difference in the time taken for space closure between interactive, passive, or conventional groups.

Both bracket types treated malocclusions to the same standard.

So our study suggests that the bracket system, may not have a major effect on arch dimensions, mandibular incisor inclinations, occlusal outcomes and treatment efficiency. It is possible that the variations in these parameters may depend more on patient characteristics, or on treatment choices made by the clinician, such as mechanics, or technology.

The limitations of the study are the fact that the sample size needs to be further enhanced to assess the amount of arch expansion brought about by the self ligation system.

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Annexures

ANNEXURE -I

RAGAS DENTAL COLLEGE & HOSPITAL

(Unit of Ragas Educational Society)
Recognized by the Dental Council of India, New Delhi
Affiliated to The Tamilnadu Dr. M.G.R. Medical University, Chennai
2/102, East Coast Road, Uthandi, Chennai - 600 119. INDIA.
Tele : (044) 24530002, 24530003 - 06. Principal (Dir) 24530001 Fax : (044) 24530009

TO WHOMSOEVER IT MAY CONCERN

Date: 5/1/2017

From

The Institutional Ethics Board,

Ragas Dental College and Hospital,

Uthandi,

Chennai- 600119

The dissertation topic titled **"EVALUATION OF RATE OF SPACE CLOSURE, ARCH DIMENSIONAL AND AXIAL INCLINATION CHANGES BETWEEN SELF – LIGATING AND CONVENTIONAL BRACKETS – A PROSPECTIVE CLINICAL TRIAL"** submitted by **Dr.Veera Sankar.S**, has been approved by the Institutional Ethics Board of Ragas Dental College and Hospital.

Dr. N.S. Azhagarasan, MDS.,

Member secretary, Institutional Ethics Board,

Head of the Institution,

Ragas Dental College and Hospital,

Uthandi,

Chennai-600119

PRINCIPAL
RAGAS DENTAL COLLEGE AND HOSPITAL
UTHANDI, CHENNAI-600 119.

RAGAS DENTAL COLLEGE Chennai

ANNEXURE- II

DECLARATION OF PLAGIARISM CHECK

From

Veera Sankar S

Department of orthodontics

Ragas dental college & hospital

Chennai

To

The Head of the Department

Department of orthodontics

Ragas dental college & hospital

Chennai

SUB: Declaration of plagiarism check of my dissertation to be submitted to the "The TamilNadu Dr.M.G.R Medical University"

I hereby declare that I have checked my dissertation for plagiarism using Small Seo tools software– plagiarism checker software.

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