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Ministry of Higher Education
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University of Baghdad
College of Dentistry

Fixed Class II Corrector

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery.

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سُورَةُ البقرة

الآية ٢٦٩

Supervisor's Declaration

This is to certify that the organization and preparation of this graduation project have been made by the undergraduate student:Shahad Ali under my supervision in the College of Dentistry, University of Baghdad/Department of orthodontics.

Signature

Assist. Prof. Layth Mohammad Kareem

Date:

We, the members of the discussion committee, certify that we have read and examined this graduation project and that in our opinion it meets the standard of a graduation project.

A proved by the head of orthodontics department at the college of dentistry, university of Baghdad.

Dedication

This work is dedicated to my beloved parents
who have been my source of
inspiration and gave me strength when
I thought of giving up, who
continually provide moral, spiritual and
emotional support.
To my sister and my brothers and
my faithful friends
who always gave me the words of advice
and encouragement to finish this work.

Acknowledgment

First, I thank "**Allah**" almighty for granting me the will and strength to accomplish this project and I pray that his blessings upon me may continue throughout my life.

I offer my sincere gratitude to **Prof. Dr. Raghad A. Al-Hashimi**, the Dean of the College of Dentistry, University of Baghdad, for continuously supporting the undergraduate students.

My great thanks to **Prof. Dr. Dheaa H. Al-Groosh**, the Chairman of Orthodontic Department for his help and support during the orthodontic course.

I would like to acknowledge the efforts of my supervisor, **Assist. Prof. Layth Mohammad Kareem,** for his inspiration and continuous valuable scientific suggestions throughout the preparation of this project.

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Introduction

Class II malocclusions are of interest to the practicing orthodontists since they constitute about 25-33% of the cases they treat **(Bishara, 2006).** Angle's Class II malocclusion occurs in 23% of children, 15% of youths, and 13% of adults **(Proffit *et al*., 2018).**

Skeletal class II malocclusions In general, class II cases with anteroposterior skeletal discrepancies are characterized by a large A point, nasion, B point (ANB) angle and Wits Appraisal, reflecting the malrelationship between the maxilla and mandible. The anteroposterior skeletal discrepancies may also be accompanied by a vertical discrepancy, for example, a relatively long or short anterior face. Studies are suggestive that in class II malocclusion mandibular retrognathia is the main cause, rather than maxillary prognathism **(McNamara, 1981;McNamara, Brudon, 2001).** For Class II patients in whom the mandible is retrognathic, the ideal means of correction is to alter the amount or direction of growth of mandible **(Chen *et al*., 2002).** Repositioning the mandible anteriorly can be accomplished with a functional appliance **(Bishara , 1989).**

Various appliances have been developed over the past century, removable and fixed. The main drawback of the removable appliances is that they require very good patient cooperation. Due to noncompliance of the patient, which in general is increasing, alternate treatment strategies of functional appliances had been devised, broadly grouped as fixed functional appliances **(Weiland, Bantleon, 1995)**. In general, correction of the skeletal discrepancy can best be accomplished during periods of active growth. Advocates of the early treatment concept suggest that the correction of skeletal discrepancies is as effective in the preadolescent years as during adolescence. Other orthodontists believe that treatment should be postponed to coincide with the adolescent "growth spurt" regardless of the approach, it needs to remembered that clinically significant mandibular growth spurts do not occur in most individuals **(Bishara, 2000)**.

Class II malocclusion is the condition in which the mandibular first molars occlude distal to the normal relationship with the maxillary first molar. The etiology of class II malocclusion varied between skeletal, soft tissues, dental factors and habits. The treatment modalities of any skeletal problem include Growth modification, Dental camouflage and Orthognathic surgery. The optimal time for treatment of patients with Class II malocclusions therapy should be initiated at the beginning of cervical vertebrae maturation stage CS3 to maximize the treatment effects. The ultimate goal of growth modification depends on treatment timing, length of treatment, working mechanism of appliance, patient's skeletal and dental condition we want to treat and the compliance of the patient **(Rita, Sadat, 2015).**

There is no universal appliance for treatment of all class II malocclusions **(Graber, Rakosi , 1997).**

Class II treatment may be managed in either a one or two phased approach. Apart from the more invasive option of surgery, non_extraction options include the use of headgear, removable functional appliances (e.g. Twin Block, activator) or fixed functional appliances, often prior to comprehensive treatment with brackets in a two phase approach. Alternatively, a single phased approach is becoming increasingly popular in comprehensive treatment with brackets combined with a fixed class II corrector **(Padhraig Fleming and Robert Lee, 2016)**

Non-compliance treatment modalities are not necessarily to be reserved for the 'non-compliant' patient, but may well have useful application with 'compliant' patients also. Placing the treatment outcome under the control of the orthodontist is likely to produce more predictable results **(McSherry and Bradley, 2000).**

AIMS OF THE STUDY

- Evaluate different types of fixed functional appliances used to correct class II malocclusion in non_compliant patient.
- Identify the advatages and disadvatages of the fixed functional appliances.
- Identify the components of the appliances.

Chapter One

Review of Literature

Chapter One

Review of literature

1.1. Class II Growth Modification:

Patients with a class II growth pattern have some combination of deficient forward mandibular growth and excessive maxillary growth that is more likely to be downward than forward. For growing patients, stimulation of forward mandibular growth or restraint of maxillary growth in both directions would be ideal treatment. Alternatively, if the facial appearance is acceptable except for protruding maxillary incisors, mild or moderate class II skeletal relationships can be accepted and the teeth moved with or without extraction to fit together. This is a solution more often chosen in slow or nongrowing adolescent or postadolescent patients **(Proffit *et al*., 2018).**

In the literature, some of the possible therapies for the management of dentoskeletal class II malocclusions in growing age include functional appliances, fixed orthodontic appliances, temporary skeletal anchorage devices, clear aligners, orthognathic surgery, and extra-oral appliances such as the headgear.

Generally, functional appliances are recommended for the correction of class II malocclusions associated with mandibular retrognathism, which is the more prevalent cause whether removable or fixed they tend to be used during pubertal growth in childhood.

1.2. Manner of classification:

1.2.1According to anchorage site:by (Mcsherry *et al*., 2000).

The appliances can be classified into those that derive their anchorage in an inter-maxillary, intra-maxillary, or absolute anchorage manner (table1).

Table 1.1: A classification of the non-compliance appliances

Inter-maxillary	Herbst appliance
	Jasper Jumper
	Adjustable bite corrector
	Eureka Spring
	Saif Springs
	Mandibular anterior repositioning appliance(MARA).
	Klapper SUPERSpring
Intra-maxillary	Pendulum/Pend-X appliance
	Distal jet
	Modified Nance arch with nickel-titanium coils or wire
	Magnetic appliances
	Jones Jig
	Lokar distalizing appliance
	Molar distalizing bow
Absolute anchorage	Palatal implants

1.2.2. According to forces: (Zenter, 2006).

Further classified intermaxillary noncompliance appliances into four categories; depending upon features of force system used to advance the mandible, which include :

A. Rigid fixed functional appliances:

1. The Herbst appliance and its modifications
2. The Mandibular Protraction Appliance (MPA)
3. The Mandibular Anterior Repositioning Appliances (MARA)
4. The Ritto Appliance
5. The IST- Appliance
6. The Biopedic Appliance

B. Flexible fixed functional appliances

1. The Jasper Jumper
2. The Adjustable Bite Corrector
3. The Churro Jumper
4. The Amoric Torsion Coils
5. The Scandee Tubular Jumper
6. The Klapper Super Spring
7. The Bite Fixer

C. Hybrid fixed functional appliances:

1. Eureka Spring.
2. FORSUS- Fatigue Resistant Device
3. The Twin Force Bite Corrector

D. Appliances acting as substitute for elastics:

1. Calibrated Force Module
2. Alpern Class II Closers

1.3. Appliances

Norman W. Kinsley(1879) who first used forward positioning of the mandible in orthodontic treatment. Wilhelm Roux(1883) is credited as the first to study the influences of natural forces and functional stimulation on form (Wolff's law). His work became the foundation of both general orthopedics and functional dental orthopedic principles. Viggo Andresen's Activator was the first functional appliance to gain the widespread clinical use. Fixed functional appliance was introduced by Dr. Emil Herbst of Germany at the 5th International Dental Congress in Berlin in the year 1909 which was later discovered by Pancherz in the late 1970s. Since then various functional appliances have been introduced, removable and fixed, with the basis of correcting class II malocclusion by bringing the mandible in a forward position **(Wahl, 2006).**

The fixed functional class II corrector intermaxillary appliances mainely include:

A. Herbst appliance (HA) :

The Herbst appliance (Dentarum, Pheasant Run, Newtown PA)(fig.1) was first described by Emil Herbst in 1905 at the Berlin Dental Congress,the Herbst appliance is now the most commonly prescribed functional appliance in the united States. Although it has been used in modern orthodontics since 1979 its design has changed over the past two decades **(Pancherz H., 1979).**

Fig 1.1: Herbst appliance (**bronskyorthodontics.com**).

At the department of orthodontics of the university of giessen, we initially used a banded Herbst appliance, but after frequent complications such as band loosening and breakage, we have used a cast-splint Herbst appliance since 1995 **(Sanden E *et al*., 2004).**

Complications of banded Herbst appliance compare to cast-splint Herbst appliances:

1. Breakage of bands or splints (fig.2,3).
2. Breakage of telescoping mechanisms (fig.4).
3. Loosening of bands or splints.

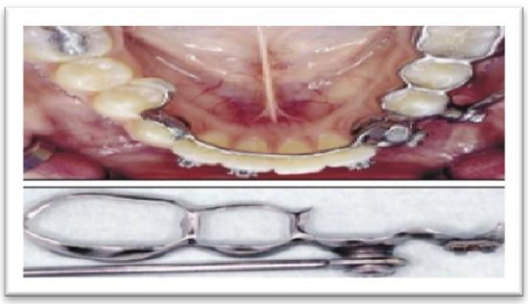

Fig 1.2: Cast-splint breakage at mandibular first premolar **(Sanden *et al*., 2004).**

Fig 1.3: Bent plunger and split tube of telescoping mechanism **(Sanden *et al*., 2004).**

Fig 1.4: Common band breakages. A. Mesiobuccally at maxillary first molar. B. Distobuccally at mandibular first premolar **(Sanden *et al*., 2004).**

Two forms of anchorage were used for the banded Herbst appliance (fig.5). Either the mandibular first premolars only (partial anchorage) or the first premolars and first molars (total anchorage) were banded. The first premolars were connected with a sectional wire contacting the lingual surfaces of the anterior teeth. With both types of mandibular anchorage, the maxillary first premolars and first molars were banded and connected with sectional lingual wires.

Fig 1.5: Banded Herbst appliance. A. Partial anchorage. B. Total anchorage **(Pancherz, 1979**).

In the cast-splint Herbst appliance, the bands were replaced by cobalt chromium(fig.6). In the maxillary arch, the splints covered the premolars and first molars; in the mandibular arch, the canines, premolars, and first molars. the splints in both arches were sectional wires brown copper cement was used to attach the banded appliances, and glass ionomer cement was used for the cast-splint appliances.

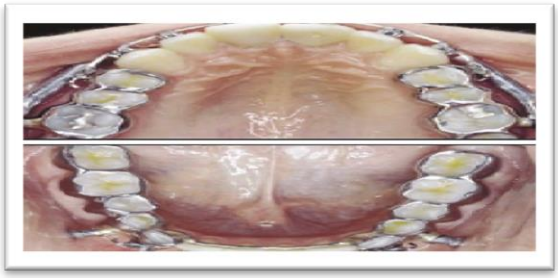

Fig 1.6: Cast-splint Herbst appliance **(Sanden *et al*., 2004).**

Since miniscrews (fig.7) were introduced they have been applied in many treatment planning situations to improve or solve the limits of traditional biomechanics **(Kanomi, 1997; Manni *et al*., 2017).** The combination of Herbest appliance with skeletal anchorage has been described in the literature using miniscrews only in the lower arch to reduce proclination of the mandibular incisors; most of these studies reported improvements in skeletal effects **(Manni *et al*. , 2014;Lima *et al*., 2017).**

Ideally, a skeletally anchored Herbest appliance using miniscrews in the mandibular and maxillary arch could further improve anchorage control and skeletal effects.

Fig 1.7: Herbst appliance with miniscrews

(Manni *et al.*, 2014).

It may be used in association with clear aligners(fig.8) to correct both jaw growth and tooth alignment problems, consequently avoiding a second treatment phase **(Lecornu *et al.*, 2013).**

Fig 1.8: Herbst appliance in conjunction with clear align **(aoaaccess.com).**

Advantages:

1. The Herbst appliance uses a bilateral telescopic system consisting of push rod and tube **(Moro *et al.*, 2018).**
2. short and standardized treatment duration
3. lack of reliance on patient compliance to attain the desired treatment
4. easy acceptance by the patient **(Moschos, 2015).**

Disadvatage:

It is prone to breakage **(O'Brien *et al.*, 2003).**

The Herbst appliance has undergone some changes in its original design but since the seventies has maintained its general shape with only a few modifications taking place with regard to methods of application (Type I, II and IV) **(Pancherz, 1979).**

Herbst I (fig.9) **(DENTAURUM GmbH & Co. KG).**

The classic appliance among Herbst bite jumping hinges.

- Retention hinge for welding to bands.
- Suitable for the banding and casting technique.
- Maximum flexibility for individual designs.
- Effective, non-compliance treatment.
- Visible treatment results after only a short time in situ.

Fig 1.9: Herbst I set on bands **(dentaurum.com).**

Fig 1.10:**A**. Hexagon socket, F-bases **B**. Hex key **(dentaurum.com).**

Herbst II (fig.11)

Modified Herbst bite jumping hinge.

- Modification of classic appliance for fixing onto the archwire of multi-bracket appliances.
- Combined use of Herbst bite jumping hinge and multi-bracket appliance is possible.
- Effective, time-saving treatment.
- Reliable results guaranteed with no need for patient compliance.

Fig 1.11: Herbst II set on remanium® arch, rectangular **(dentaurum.com).**

Fig 1.12: A.Spacer rings, **B**.Hexagon socket screws with long shank and nut **(dentaurum.com).**

Herbst IV(fig.13):

The clever Herbst bite jumping hinge.

- Version with ball and socket joint and C-clips for fixing.
- Greater lateral freedom of movement in the mandible.
- More comfortable for the patient to wear.
- Easier handling thanks to the C-clips.

Fig 1.13: Herbst IV set on bands **(dentaurum.com).**

Fig1.14: A. Telescopic tube with ball,**B**. Lock washers (c-clips),bases **(dentaurum.com).**

Herbst telescopic systems (fig.15):

Herbst bite jumping hinge for the highest demands.

- This Herbst version is fitted with an inner telescope.
- Prevents the hinge from sliding apart when the mouth is opened wide.
- Perfect solution for small jaws due to its compact design.
- With hexagon socket screw for secure fixation.
- Treatment results are guaranteed, even without patient compliance.

Fig 1.15: Herbst TS set on bands **(dentaurum.com).**

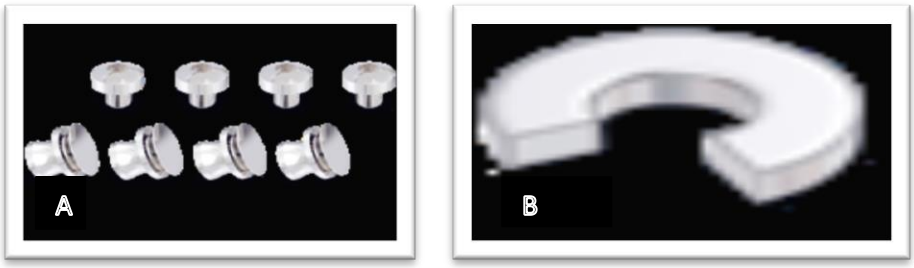

Fig 1.16:A. Hexagon socket screws and bases, **B.** Spacer rings, crimpable **(dentaurum.com).**

The dentoskeletal effects produced by Herbst appliance:

When Class II malocclusion with 6-mm molar relationship is corrected with the aid of Herbst appliance correction may result from several sources, namely restricted maxillary growth; increased mandibular growth; maxillary molars distalization; mandibular molars mesialization. The level of contribution provided by each one of those sources depends not only on appliance design, but also on patient's growth stage, a number of Herbst designs have been developed especially with a view to avoiding mesialization of mandibular teeth; nevertheless, even an increased number of teeth involved with mandibular

appliance anchorage did not prevent it. Fixed appliance assembly in the mandible during use of Herbst appliance further increased proclination of mandibular incisors **(Weschler, Pancherz, 2005).**

The best time to use the Herbst appliance:

Several studies have shown the best time to try stimulating mandibular growth with the aid of the appliance is right before reaching the peak in pubertal growth spurt **(Hagg,Pancherz, 1988).** Nevertheless **(Behrents, 2016)** published an editorial reporting up-to-date safe scientific evidence suggesting the early Class II treatment onset in cases with patients presenting protruding maxillary incisors. Treatment is justified because decreased protrusion protects incisors against trauma, in addition to enhancing patient's self confidence and social adjustme.

B. Jasper Jumper (JJ)

The Jasper Jumper appliance (American Orthodontic, Sheboygan, Wis) (fig.17) was developed in 1987 by James Jasper. This was the first flexible fixed functional appliance to appear .It is made up of a covered spring. It is also an appliance which is more comfortable for the patient because of its covering **(McNamara *et al.*, 2001).**

Fig 1.17: jasper jumper **(ibdaa., 2013).**

The upper end of the spring is hooked from the first upper molar headgear tube to the lower arch wire in between the canine and first premolar (fig.18). The upper molars receive a distal and intrusive force, while the lower

incisors a mesial and intrusive force **(Buschang *et al*., 2016).**

Fig 1.18: Jasper Jumper device (**ibdaa.com**).

Advantages:

More comfort is provided to the patient as he has autonomy over mandibular movements, lower cost and shorter treatment period thanks to its association with fixed appliances **(Henriques *et al*., 2009).**

Disadvantages:

Its flexible structure permits lateral jaw movements **(Herrera *et al*., 2011).**

In the post-treatment period,study observed considerable anterior movement of the upper incisors, thus, increasing the affinity toward reversion of the anteroposterior correction. To counter-effect this problem the active retention time should be increased in the post-treatment period (**Foncatti *et al*., 2017).**

Authors have concluded that the correction of Class II by the Jasper Jumper device is obtained through 80% of dentoalveolar changes and 20% skeletal changes, and because of this, it can also be used in non-growing patients **(BÜYÜK *et al*., 2018).**

C. The Eureka Spring(ES):

Devincenzo (1997) described the Eureka Spring (Eureka Spring Co, San Luis Obispo, Calif) which is a fixed inter-maxillary force delivery system. Labial root torque to the lower incisors needs to be applied to match the

anchorage requirements and buccal root torque should be applied to the upper first molars because the Eureka spring exerts a push rather than the pull force of Class II elastics, a class II Eureka Spring attaches in the direction of a class III elastic. The effects of this appliance are entirely dentoalveolar and no orthopaedic or bite jumping effects are claimed by the clinicians who have developed the appliance **(DeVincenzo, 1997).**

Eureka Spring (fig.19)holds domestic and foreign patents, no one is able to match its slim and comfortable design **(eurekaortho).**

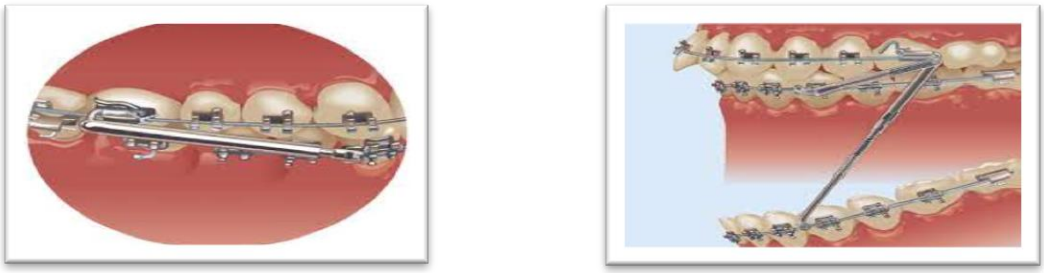

Fig 1.19: Eureka springs **(John P. DeVincenzo).**

The components of the Eureka Spring (fig.20) **(Stromeyer *et al*., 2002).**

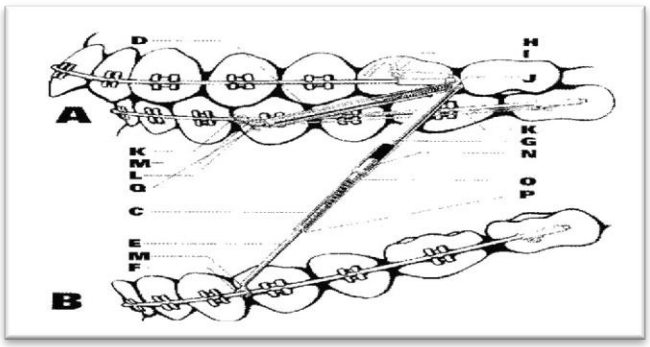

Fig.1.20:A indicates mouth fully closed in a complete Class II relationship; B, Eureka Spring in extended position when the mouth is open 50 mm;C, plunger assembly extended; D, plunger assembly compressed to within 1.5 mm of full compression; E, spring-driven ram portion of plunger assembly; F, ring clamp attachment of plunger; G, molar assembly; H, molar attaching wire; I, ligature wire for stabilizing molar attachment wire; J, ball joint of cylinder assembly; K, tie-down ligature wire; L,ram elbow; M, neck of ram; N, remaining distance plunger assembly can travel before disengagement;
O, plunger assembly cylinder; P,constricted collar of plunger cylinder; and Q, free space.

D. Saif Springs (SS):

These are long nickel-titanium closed coil springs that are used to apply

Class II inter-maxillary traction when fully banded fixed appliances are in place(Pacific,Coast Manufacturing Incorporated ,Ave, NE Woodinville). The springs are tied in place with steel ligatures and are worn in place of inter-maxillary elastics,the springs(fig.21) are available in two lengths 7 and 10mm,the desired force is achieved by activating the spring to the appropriate length. No longitudinal research studies on this auxillary are available in the literature to date **(Starnes, 1998).**

Disadvantage:

1. Breakage
2. Oral hygiene difficulties and problems with patient comfort

Appliances producing pulling forces **(McSherry P, Bradley H., 2000).**

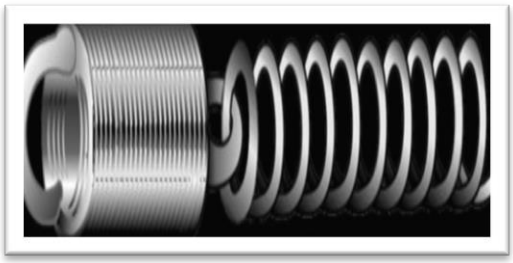

Fig 1.21: Saif springs **(Truforce Orthodontics.com).**

E. The Mandibular Anterior Repositioning Appliance(MARA):

This was created by Douglas Toll of Germany in 1991 as a solution to the dislike expressed by patients in regards to the Herbst. Unlike the Herbst, it is considered an active appliance since it requires the patient to posture forward without the help of a spring **(Toll *et al*., 2011).**

The MARA(fig.22)(Allesee Orthodontics Appliances, Sturtevant, Wis) was designed as recommended **(Bogdan, 2006).**

The MARA is composed of (fig.23) **(Eckhart,White, 2003)**

1. Stainless steel crowns on all first molars:the upper molar has a rectangular archwire tube and a large square tube in which slides an adjustable square elbow (removable attachment) that hangs

vertically.the lower molar has a rectangular tube and a round wire arm on the mesial side projecting buccally.

2. Lingual arch or lower braces.

Fig 1.22: The MARA (**jorgensenorthodontics, dynaflex**).

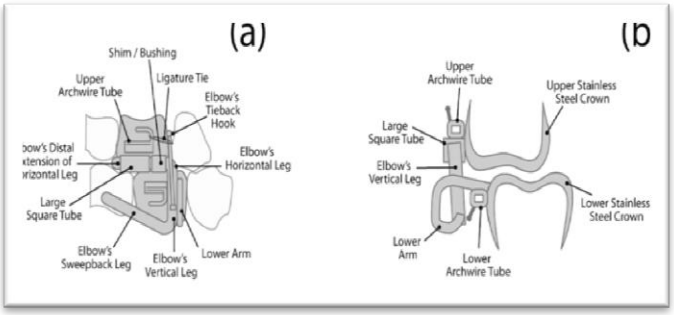

Fig 1.23: The MARA and its elements, (a) sagittal view, (b) frontal view **(Toll et al., 2011).**

Given that the MARA does not feature any systems involving telescopic tubes or springs connecting the jaws permanently, it allows greater freedom of mandibular movement **(Eckhart,White, 2003).**The results of treatment with the MARA are very similar to those produced by the Herbst appliance but with less 'headgear' effect on the maxilla and less mandibular incisor proclination than with the Herbst appliance **(Pangrazio *et al*., 2003).**

Disadvantages (Weber *et al.*, 2019).

1. Mobility of the mandibular first molars caused by contact of the elbow with the posterior surface of the lower arm.
2. Distal tipping and intrusion of the upper first molars due to force exerted by protrusive lower molars.

F. The Klapper SUPERspring: (Mcsherry *et al*., 2000).

This appliance created by Lewis Klapper in 1999 (fig.24). Is an auxiliary which is fitted to fully banded upper and lower fixed appliances (ORTHOdesign, Falls Circle, Lake Forest, Illinois). The appliance consists bilaterally of a length multi-flex nickel-titanium which is bent back on itself attaching to the upper first molar tube and attaching to the lower archwire by means of a helical loop. The springs lie in the buccal vestibule. The effect of the spring is to place a distalizing and intrusive force to the upper first molar. The latest design of the spring requires a special oval tube to be fitted to the upper first molars. This facilitates buccolingual adjustment of the springs in the vestibule and aids patient comfort. The springs can be readily removed for adjustment or activation. There have been no studies to date documenting results achieved with this appliance.

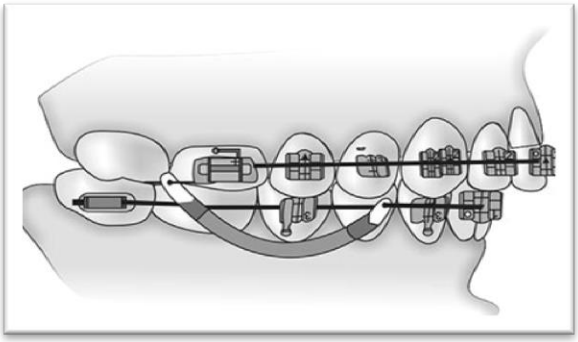

Fig 1.24: Klappper SUPERspring **(Sivaraj Aravind, 2013).**

G. The Ventral Telescope(VT): (Zenter, 2006).

This was the first telescopic rigid fixed functional appliance that appeared as a single unit (fig.25).

Advantages:

This appliance is available in two sizes and fixing is achieved through ball attachments. It is particularly easy to activate. The operation is simple and is carried out by unscrewing the tube thus allowing an activation of around 3 mm.

Disadvantages:

It is quite thick and suffers from fractures to the brake which stabilizes the joint. As with the other appliances where fixing is achieved through ball attachments, great accuracy is necessary with regard to inclination and the welding of components.

Fig 1.25: Ventral telescope **(Wiechmann et al., 2015).**

H. Ritto Appliance(RA): (Zenter, 2006)

The Ritto Appliance created by Korrodi Ritto,1998 (fig.26) can be described as a miniaturized telescopic device with simplified intraoral application and activation. The construction of this appliance is based on the mechanism and function used in the Ventral Telescope adapted for use in conjunction with a fixed appliance.

The main differences when compared to the Ventral Telescope appliance are:

- The appliance does not come apart (no disengagement after achieving maximum extension).
- The smaller size facilitates adaptation and it does not affect aesthetic appearance or speech.
- It comes in a single format which allows it to be used on both sides and is available in only one size.

Advantages:

Simple to use, comfortable, cost effective, breakage resistant and requires no patient cooperation. The fact that the appliance does not disengage creates enormous advantages. It eliminates the time lost in measuring length before fitting, as in other appliances. This feature makes it possible to fit the appliance in approximately 5 minutes and remove it in about half that time. Fixation accessories consist of a steel ball pin and a lock. Upper fixation is carried out by placing a steel ball pin from the distal into the .045 headgear tube on the upper molar band, through the appliance eyelet and then bending it back. The appliance is fixed onto a prepared the lower arch. The thickness and type of arch is chosen, its length is adjusted, locks are fitted and the Ritto appliance is then inserted. Activation is achieved by sliding the lock along the lower arch in the distal direction and then fixing it against the Ritto Appliance.

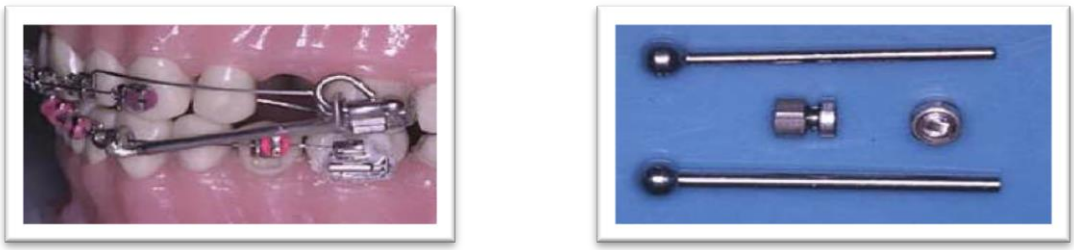

Fig 1.26: Ritto Appliance **(Ritto.com)**

I. FORSUS Fatigue Resistant Device(FRD) (fig.27) :

Is a hybrid appliance meaning it is a combination of flexible and rigid ones.it is a modification of the original “Forsus” device developed by Vogt in 2001. It is a semi-rigid appliance with a telescoping system that integrates a super elastic nickel-titanium coil spring. It serves to replace conventional Class II elastics and applies continuous force 24 hours a day. it is a newer type of appliance that has the benefit of being easily assembled in the chair side and thus, requires no lab work and saves time **(Shahid *et al.*, 2017).**

Components of the FRD:

1.Spring Modules: EZ2 Module(fig.28A) the EZ2 module allows for

more consistent installation and automatically prevents the spring from pivoting toward the cheek. L-pin Spring Module(fig.28B) the L-pin module allows for more flexible installation options and movement in the mouth.

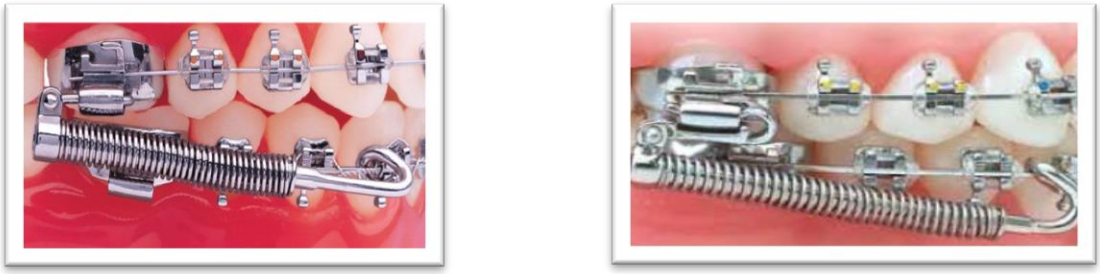

Fig.27: FORSUS Fatigue Resistant Device **(3M Manufacturing.com).**

Fig.28:A. EZ2 Module,**B**. L-pin module **(3M Manufacturing.com)**

2. Push Rods, Headgear Tube on Band, Rectangular Archwires.

In contrast, Class II elastics load upon jaw opening, producing extrusive forces at their terminal ends and potentially undesirable side effects as the occlusal plane is rotated clockwise the Forsus FRD exerts a continuous force with more elasticity and flexibility than the Herbst, permitting a greater range of mandibular opening and lateral movements during speech,chewing and swallowing. Because muscular forces are distributed over a larger periodontal area, there is less inhibition of the jaw elevator muscles by the periodontal mechanoreceptors,allowing better stabilization of the mandible **(Sood *et al.*, 2011).**

J. FORSUSTM NITINOL FLAT SPRING (FNFS):

The FNFS (3M Unitek, St Paul, Minn) developed by Bill Vogt in 2001. It

comprises spring bars (nickel-titanium) coated with a transparent plastic to prevent the cheek from bulging. attached to headgear tubes of maxillary first molars through ball pins and to the mandibular archwire by an auxiliary arch. The distal end of the auxiliary arch was attached to the second tube of the first molar band and cinched back. The mesial end was hooked over the mandibular archwire between the canine and the first premolar brackets **(Heinig, Go¨z, 2001).**

The appliance's(fig.29) flat surface is more esthetically acceptable and it offers more comfort. It is available in various sizes for different patients or to get more activation **(Vogt, 2003).**

Fig 1.29: FORSUSTM NITINOL FLAT **(photograph © 2002 3M Unitek).**

K. Sabbagh Advanced Repositioning Appliance(SARA): (OrthoDepot.)

The SARA (Fig 1.30) (OrthoDepot orthodontics) is a stationary telescopic appliance with exchangeable outer spring (3N/ 4N), which allows an effective therapy, independent of the patient's cooperation, of class II cases without the need for extraction or surgery. The technology, developed in collaboration with Dr. Aladin Sabbagh, is based on combining the Herbst appliance and the Jasper jumper with the objective of pooling the advantages of these two technologies. The result is a force system with an external spring which is compatible with all fixed bracket systems. It is attached to the upper jaw mesially in the headgear tube. This not only makes handling much easier, but also reduces mucous membrane irritations.

Advantages:

1. Universally applicable(one version for all jaw sizes Minimum inventory).
2. Easy handling
3. Cost-effectiveness
4. High patient acceptance(Extraction or surgery as well as the use of a headgear are not necessary).
5. Time-efficient(Time-consuming and costly laboratory processes are not necessary)
6. Compliance independent(The cooperation of the patient e.g. with elastics is not required).
7. Effective
8. Fewer side effects like e.g. lateral open bite or intrusion of the upper jaw molars due to the horizontal force effect of SARA.

Disadvantages:

1. Patient cannot close mouth completely, SARA seems to be too long.
2. Fastening screw on the mandibular connection loosens.

Fig 1.30: Sabbagh Advanced Repositioning Appliance **(OrthoDepot.com).**

L. Power Scope:

Is the latest innovation in Class II correction which is a direct derivative of the Herbst Type II appliance. Dr. Andy Hayes worked in conjunction with American Orthodontics to develop PowerScope **(Antony *etal.*, 2016).**

Components of power scope: (fig.31)

Telescopic push rods (right and left), hexagonal screw drive and crimpable shims

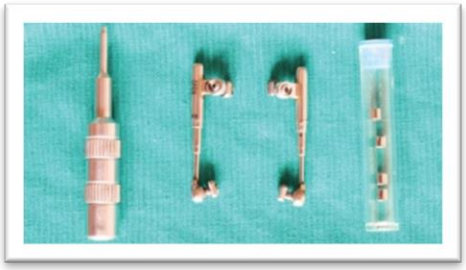

Fig 1.31: Components of power scope **(Antony, 2016)**

Appliance insertion: (fig.32)

Unlike other Class II correctors, there was no need for assembly, taking measurements or appliance manipulation. The appliance allows wire-to-wire installation with attachments placed mesial to the first molar in the maxillary arch and distal to the canine of the mandibular arch generating a horizontal directed force. This could also yield a slight intrusive force component to maxillary molars.

Fig 1.32: PowerScope insertion **(Antony, 2016).**

Advantages:

1. Fixed one-piece appliance available in one size suiting all Class II patients.
2. Require no laboratory setup.
3. Quick and easy wire-to-wire installation.
4. Compliance free.

5. Internal NiTi spring delivers 260 g of force for continuous activation during treatment.
6. No headgear tube or special band assemblies required.
7. Can be used with banded or bonded molar tube.
8. No bond failure of canine bracket or buccal tube.
9. Low profile and less bulky for more esthetic facial appearance.
10. Smooth, rounded patient-friendly design for better patient comfort.
11. Easy to clean – better oral hygiene.
12. Ball and socket joint allowing maximum lateral movement.
13. Telescopic device that does not displace or disengage during treatment.

M. VektorPRO Class II Corrector : (TP ORTHODONTICS., 2019)

TP Orthodontics Incorporated, La Porte, Induction, announced the introduction of the VektorPRO Class II Corrector (fig.33). The VektorPRO is an orthodontic appliance that aims to simplify Class II correction using low forces. According to the company, it is "the only appliance that utilizes gentle, intrusive forces vectors that do not tip the maxilla—just what is needed for efficient Class II Correction."

Featuring a patented design, the VektorPRO appliance reportedly introduces gentle intrusive vectors forces resulting in rapid, yet gentle changes. Class II correction can be achieved in 6 months or less, according to the company.

Designed by Dr James Jasper, the VektorPRO does not require any lab submission, which can help reduce costs and turnaround time.

Advantages:

Because the vector control module (VCM) is made from nickel titanium, the appliance is reportedly break-resistant and force values of only 3.5 ounces are produced. The appliance is designed to allow for easy installation and to be

free from the "food zone." The fixed intraoral device features a silicone sleeve intended for patient comfort and an improved mechanical assembly for enhanced durability. The company points out that VektorPRO is compliance-independent, making it an efficient solution for Class II correction.

"After inventing a whole new category of orthodontic appliances—the flexible push category—I realized that there were still major problems and side effects that were very undesirable with linear forces," said Jasper. "Namely, they all rotated the maxilla clockwise and caused extrusion of the already over erupted upper incisors. It took me 20 years to figure out that the curved vectors of edgewise could be applied to the maxilla to avoid any tipping moments."

Fig 1.33: VektorPRO **(tportho.com).**

N. CS®5 – Class II Corrector: (DynaFlex.com)

The CS® nickel_titanium (NiTi) springs are a DynaFlex® exclusive, utilizing a patented, instant force (350 grams), closed coil spring and a specially built "key-hole" end which fits over our traditional and Twist-Lock pivot.

CS® System Components:

1. CS®5 Spring: (fig.34)

The widely known CS® spring is made from an exclusive nickel titanium material with specially built key-hole ends that improve the strength and durability by 40%. This spring load force instantly and remain extremely consistent throughout treatment with confidence of longer usage. The benefit is a smoother, more constant force that performs better and lasts longer.

Fig 1.34: CS®5Spring **(dynaflex.com).**

2. Twist-Lock Pivot:

The Twist-Lock Pivot was skillfully designed as a one-piece component with no moving parts. This will guarantee a no-hassle installation and improved performance.

TWIST-LOCK™ PIVOT ADDITIONAL INSTRUCTIONS:

A. Insert Pivot onto the archwire by making sure the pivot slot is horizontal along the wire (fig.35)

Fig 1.35: Horizontal **(dynaflex.com)**

B. The sides of the pivot are flat for figure placement and to quickly and easily identify that the mounting archwire slot is in the horizontal or vertical position (fig.36).

Fig 1.36: Flat **(dynaflex.com)**

C. Pre-assemble the nickel_titanium (NiTi) spring, Twist-Lock™ Pivot, & Hybrid Screw. Ensuring hybrid screw is threaded ¾% (fig.37).

Fig.37: Pre-assemble **(dynaflex.com).**

D. 1.) Use a Hemostat for easy installation, place the hemostat along the flat sides of the pivot (fig.38).

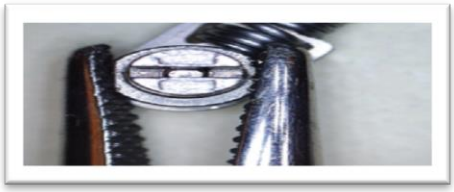

Fig1.38: Hemostat On Flat Sides**(dynaflex.com).**

2) Ensure hemostat is not interfering with the NiTi spring eyelet.

E. Mount pivot on the archwire with hemostat. Notice the hemostat in down position. The slot should be in horizontal for sliding on the archwire

F. Rotate 90 degrees using hemostat.

G. 1.) Tighten hybrid screw to secure/lock Twist-Lock™ Pivot and engage the archwire.

2) Check to make sure the eyelet is not caught between the Hybrid Screw and Pivot and the eyelet is floating up and down (fig.39).

Fig 1.39: Check Eyelet Isn't Caught **(dynaflex.com).**

3) Self-Ligating Pivot: (fig.40)

The self-ligating pivot was years in the making and has been highly tested for strength and reliability. With the self-ligating pivot, placing the CS®5 system is faster than ever and will not require the removal of the archwire which

greatly reduces patient chair time.

Fig 1.40: Self-Ligating Pivot **(dynaflex.com).**

O. Twin force bite corrector TFBC:

Ortho Organizers, Incorporated., Rancho Santa Fe Road, San Marcos, CA. is a fixed, push-type intermaxillary functional appliance with ball-and-socket joint fasteners that allow a wide range of motion and lateral jaw movement (fig1.41,42). The two plunger/tube telescopic assemblies on each side contain nickel titanium coil springs that deliver a constant force. Measuring several appliances with a force gauge demonstrated an average full compression force of approximately 210g. The appliance is attached to the maxillary and mandibular archwires by hex nuts fastened mesial to the maxillary first molars and distal to the mandibular canines. At full compression, the TFBC postures the patient's mandible forward into an edge-to-edge occlusion **(JEFF ROTHENBERG *et al*., 2004).**

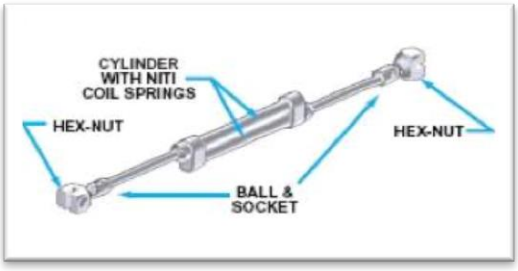

Fig 1.41: Twin Force Bite Corrector (TFBC) in open position **(JEFF ROTHENBERG *et al*., 2004).**

Fig 1.42: Twin Force Bite Corrector **(Five Star Ortho, 2023).**

Chapter Two

Discussion

Chapter Two

Discussion

2.1 Discussion

Generally, treatment approaches of class II malocclusion are categorized according to the growing and non-growing status of patients. Authors have noted that the ideal time to alter a skeletal class II is during the optimal maturation stage, at 12 years of age. The growth spurt commonly occurs in girls of 10 to 13 years of age, and in boys of 11 to 14 years of age.Their mode of action is based on the theory that an imbalance of the neuromuscular component of the orofacial complex results in malocclusions. Hence, when orthodontists treat their Skeletal Class II patients with these appliances, they aspire to obtain a correction in the muscular imbalance, an improvement in soft tissue tone and in the oro-nasopharyngeal complex function. Myofunctional appliances work by force application and force elimination of the abnormal and restrictive forces, thus allowing the proper growth and development of the area. The lower jaw is repositioned in a forward position with the help of protrusive bite registration, this leads to the remodelling of the glenoid fossa and displacement of the condyles in a forward and downward position. Furthermore, these devices act on the maxilla by restraining its growth **(Pachori *et al*., 2012).**

Several studies have expressed the benefits of early treatment with functional appliances, with the main perk being the possibility of preventing or minimizing the need for a complex intervention involving extractions or surgery thanks to the lengthening of the mandible. However, a lot of controversy surrounds this idea as not all authors agree on this statement, with some pointing out that the mandibular lengthening achieved through these appliances is clinically irrelevant. Another debate in the literature would be whether an

early dual-phase treatment truly has important advantages over single-phased ones at a later age. Fixed functional appliances could reduce the two stages of treatment into one stage at late adolescent period to benefit from both skeletal and dental correction **(Sofitha, 2019).**

During the initial phase of treatment, the sagittal jaw relationship is regularised commonly through the use of functional appliances, and in the later phase of treatment the teeth's position is adjusted normally with fixed appliances **(Santiago. , Henriques., 2013)**For optimum results and detailing of the occlusion functional therapy tends to be followed by a full fixed appliance treatment. The second phase of treatment is normally commenced once the permanent dentition has fully erupted.

Depending on the complexity of the case, the practitioner will measure the benefits and risks of each possible treatment option and choose the most adequate one.

Chapter Three

Conclusion

Chapter Three

Conclusion

3.1 Conclusion:

- In general,the fixed functional appliances are more recommended to treat class II malocclusion.the indications and contraindications depend on the patient's skeletal age, phase of growth, compliance and preference, the severity of the case, length of therapy, cost, geographical zone, and orthodontist's knowledge and skills.
- The optimal treatment time is during or around the growth spurt.
- Mandibular incisor proclination is the most common dentoalveolar side effect seen with fixed functional appliance treatment.
- This is of concern because it increases relapse tendency and also limits skeletal and soft tissue correction.one appliance is able to overcome this problem that was developed by Dr.Aladin Sabbagh this appliance is Sabbagh Advanced Repositioning Appliance(SARA).

3.2 Suggestion:

- A survey among Iraqi orthodontists to view the favorite functional appliance for treatment of class II uncooperative patient.
- To investigate the patients and parents perception about the type of functional appliances to be used.

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