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Editorial

In today's technology-conscious world, Dental Science is progressing rapidly due to the society's urgent need for a dental practice that offers an astute and circumspect service as well as a painless and lifetime period of successful treatment. To achieve these goals of continuously improving the different procedures in dental practice, there is a compelling need for much research, the responsibility of which lies with the professionals in various disciplines that belong to this community.

A journal is an appropriate and effective mode for exchange of scientific ideas and innovations. The motive of this journal is to give the readers the best of the quality Original researches, Reviews, Case reports which would help the readers to keep the pace with the updates so as to augment the information and to stimulate interest, debate, discussion and interaction among dentists and specialists of all disciplines within the field of dentistry.

I am extremely grateful to the Authors for considering this Journal for their submissions. The editorial policy of Dental Bites is to disseminate among its readers factual information on research, clinical practice and cases of interests in Dentistry. The board is dynamic; it will offer a platform to the contributors to address the evolution and new areas of interest in the specialty.

Yours ,
Sd/-
Dr. Kunjamma Thomas
Chief Editor

TABLE OF CONTENTS

A NEW SIMPLE APPLIANCE NAMED AS "KMCT APPLIANCE" FOR CORRECTION OF CLASS II DIVISION 1 MALOCCLUSION IN CHILDREN

*Dr. E.Ramakrishnan, **Dr. Akhilesh.R.A, **Dr. Supreeda.S,
***Dr. Nisha Elizabeth John, ***Dr. Aswathi Joseph, ***Dr. Ameera Ahmed Ismail

Abstract

Class II division 1 malocclusions in children are treated best with myofunctional appliances. The complicated and bulky myofunctional appliances receive poor co-operation from children giving poor result. Here a simple single arch removable appliance named as KMCT appliance is being introduced. The design of the appliance, advantages of the appliance and our experience during the last 7 years are communicated here.

Keywords: Class II Div 1 malocclusion, Inclined plane appliance, Myofunctional appliance.

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Introduction

According to a European study by Brirgit Thilander et al, the prevalence of Class II div 1 malocclusion among children is 14.9%.[1] An Indian study at Nalgonda by Reddy E R et al showed 13.9% prevalence of Class II div 1 malocclusion among children.[2] Though different studies show different prevalence at various places, there is an average prevalence of around 15%(Fig 1). This is the most common skeletal malocclusion in children than Class II div 2 and Class III malocclusions.

The different treatment modalities for Class II div 1 malocclusion can be grouped under three headings:

1. Myofunctional appliances used in children
2. Camouflage treatment in young adults and adults, extracting two premolars in upper arch
3. Orthognathic surgery combined with fixed appliance therapy

Fig 1: Characteristics of Class II division 1 malocclusion

The myofunctional appliances are used in children and are very successful if

properly worn by the child. The myofunctional appliance therapy in young children of pre pubertal stage excludes the necessity of further treatment at later ages.

The various removable myofunctional appliances used to treat Class II div 1 malocclusion in children are (1) Twin block appliance, (2) Activator (3) Bionator (4) Frankels appliances (FR II), (5) pre orthodontic aligner, and (6) inclined plane appliances. Fixed myofunctional appliances are (1) Herbst appliances (2) Jasper Jumper (3) Forcs FRD, and (4) MARA (mandibular anterior repositioning appliance). Among all these fixed and removable appliances, twin block appliances gained popularity because of its success rate. All the above mentioned removable functional appliances have the disadvantage of poor patient co operation due to the bulkiness of the appliance, extending to both arches. Fixed functional appliances are more time consuming to fabricate and fix and requires imported components. Hence they become expensive appliances.

Inclined plane appliances are relatively simple involving only the upper arch and are well accepted by the children. Here a new modified inclined place appliance is presented. This appliance has been used successfully during the last 7 years in the Paediatric Dentistry Department of KMCT Dental College, Manaserry, Kozhikode, Kerala. Hence the appliance is given the name "KMCT appliance".

The KMCT Dental College is situated in a rural area of Kerala. The people belonging to the villages around the college are simple and of low and medium socio-economic status. The treatments suitable for them are simple inexpensive appliances which are efficient to give good results. The present appliance is designed to suit the majority of the patient population of this hospital.

Review of literature

On searching the literature we found two studies conducted on inclined plane appliances. Emami Meiboidi Shahin et al studied on 25 children in early mixed dentition period (Fig 2), and found that it is effective as an alternative to complicated functional appliances in the treatment of Class II div 1 malocclusion.[3] A modified anterior inclined plane incorporating a double cantilever spring was used by Roa S.A et al to treat a Class II div 2 patient[4](Fig 3). The inclined planes used by these two authors are similar in design.

KMCT appliance

The new inclined plane used by us is different from these inclined planes in that it does not extend laterally towards canine and premolars. It slopes towards canine and premolars also, so that there is least bite interference. It allows sliding of lower jaw forward. The photograph of new inclined plane is given in Fig 4.

Design and construction of the new inclined bite plane - KMCT appliance

The upper and lower Impression for study models and an upper impression for working model are made.

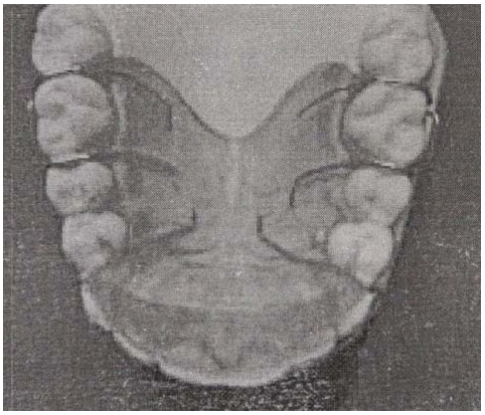

Fig 2:Inclined plane used by Emami Meiboidi Shahin et al[3]

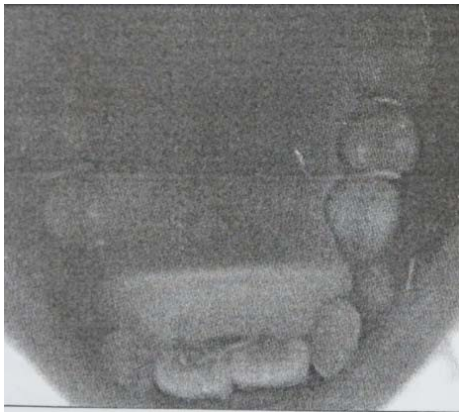

Fig 3: Inclined plane used by Roa S.A et al[4]

Examination of the study model show the extent of deep bite, over bite, over jet and the position of incisal tips on the palatal side. On a working model of the upper arch Adam's clasps are made on the 1st permanent molars and a long labial bow is also made. A Hawley's appliance is first made in self cure acrylic. A small amount of self cure clear acrylic powder is mixed with monomer in a dappen dish and allowed to reach dough stage. At that stage about 1cubic centimetre of the acrylic is taken and added to the palatal side of the appliance and shaped with fingers or a spatula to form an inclined plane and the lower cast is placed on the upper cast and checked if the incisal tip of the lower arch is touching the slope of the inclined plane and can slide forward.

Care is taken to see that the inclined plane slopes laterally also so that there is no bite interference for canines and premolars. Also see that the inclined plane does not touch the gum on lingual surface of the lower incisors. The appliance is immersed in water and is allowed to cure. After curing it is checked on the cast to see that the mandibular incisors could slide forward in to a class I position. There is minimal bite interference and minimal bite opening in the posterior area so that posterior teeth can rapidly erupt and settle in to new position. The child is instructed to wear the appliance 24 hrs except during eating and brushing.

Fig 4: KMCT appliance (modified inclined plane appliance)

Treatment cost

KMCT appliance is an improved and modified inclined plane appliance. It is an inexpensive appliance as compared to all other removable and fixed myofunctional appliances. This college being run by a charitable trust, Kunjitheruvai Memorial Charitable Trust (KMCT) charges only Rs.

500.00 for a removable corrective appliance. One appliance may be enough for completion of treatment in many cases.

Fig 5: Frontal view of a patient with Class II Division 1 malocclusion

Fig 6: Profile view of a patient with Class II Division 1 malocclusion

Sometimes a second appliance may be required if the 1st one becomes distorted or when there is interference due to erupting permanent teeth.

The treatment duration is usually 8 months to 12 months during which good results are obtained. Since it is a non extraction therapy and because of the simplicity and inexpensive nature of appliance it is well accepted by the children and the parents. This has been our experience during the past 7 years. The success of the treatment is well appreciated and satisfied by the parents on seeing the improved aesthetic appearance of the child.

Fig 7: Intraoral view before treatment

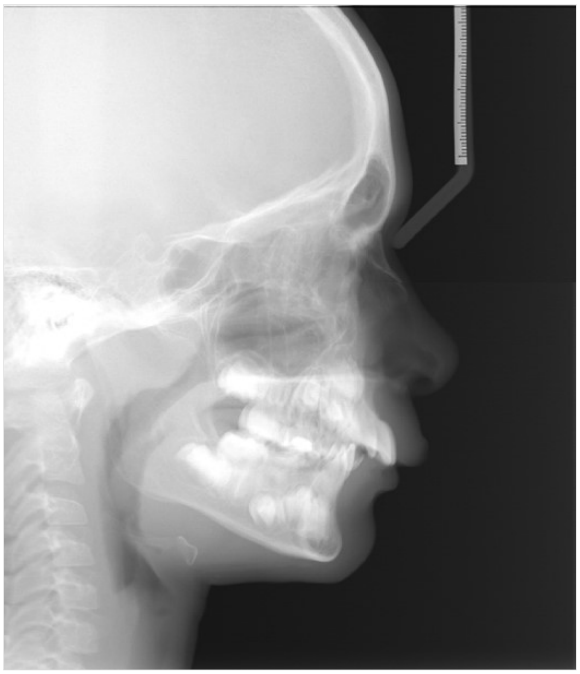

Fig 8: Lateral cephalogram of a Class II div 1 malocclusion before treatment

In a private clinic a dentist may have to charge more than this but it could be much lower than that of the other complicated removable or fixed functional appliances mentioned earlier(Figs. 5 to 10).

Discussion

It has been reported that the most common component in a Class II skeletal malocclusion is mandibular retrusion.[5] Therefore all the functional appliances attempt to reposition mandible into a Class I skeletal relationship by advancement of the mandible.

Fig 9: KMCT Appliance–in the patient's mouth

Fig 10: post treatment profile view of the same patient shown in figures 5, 6, 7 , 8 and 9

Many myofunctional appliances like Twin Block, FR II, Activator, Bionator, removable Jasper Jumper etc were effectively used in various studies. But they failed to become the choice of an Orthodontist or Pedodontist or a General Dentist in his regular dental practice because of the bulkiness of the appliance causing non co-operation from children. Even twin block appliance though found to be effective are not regularly used by the dentists due to the bulkiness of the appliance extending to both arches and the increased chair side time required for trimming and adjusting the appliance.

An ideal appliance should be comfortable for the patient, allow jaw movements, leave room for tongue and provide skeletal rather than dental effects.[6] In these contexts, a removable modified inclined plane appliance that is simple in design, contained in one arch, least bulky becomes practically acceptable for the child and dentist.

Class II div 1 malocclusion is characterised by mandibular dentition 'distal' to the maxillary dentition. The principle of functional therapy is to reposition a retrusive mandible to a forward position by constructing an appliance with a protrusive bite when the appliance is placed in the mouth. Dentofacial orthopaedics represents a positive approach to the treatment of craniofacial imbalance by addressing the underlying cause of malocclusion, in an effort to maximise the natural potential for corrective growth.[7]

Repositioning the mandible in a downward and forward position by the inclined plane appliance stimulates a proprioceptive response in the muscles of mastication. The purpose is to encourage adaptive skeletal growth by maintaining the mandible in a corrected forward position for a sufficient period of time to allow adaptive skeletal changes to occur in response to a functioning stimulus.[8]

The improved and modified inclined plane appliance is simple economical, acceptable by the child and effective in treating Class II div I malocclusion. It allows full time wear of appliance resulting in rapid correction of malocclusion. This inclined plane appliance will not increase vertical dimension considerably. So unlike TBA (twin block appliance), it can be used in children presenting mandibular retrognathia and increased vertical dimension, where a further increase in vertical dimension is unfavourable for the soft tissues.

Though the inclined plane appliance exerts a restrictive force on maxilla through the labial bow, it is generally recommended for a Class II malocclusion with retruded mandible and a normal maxilla. In our experience we have found that mandibular retrusion is the main feature of Class II div 1 malocclusions and maxillary protrusion was uncommon. When the child was asked to bring the mandible forward the facial profile on side view became straight showing that the problem was with the distal position of mandible and not the proclination of maxillary teeth. McNamara also states that mandibular skeletal retrusion is the most common single characteristic of class II malocclusions; whereas maxillary skeletal protrusion was not a common finding.[5] Bishara reported that maxilla is positioned normally in Class II malocclusions.[9] There are some reports which states that maxilla is even in a retrognathic position.

A Class II division 1 malocclusion is characterised by Class II occlusion of first permanent molars, Proclination of upper anteriors, Increased overjet(up to 10-15mms), Deep bite, Lower incisor tips touching the palate, Lower lip trap between upper and lower incisors, Proclinated upper anterior teeth showing out due to inadequate lip coverage and an appearance of maxillary teeth prognathism. The ANB angle is >4 degrees and it can be up to 8-9 degrees(Fig 1). Reduced vertical facial height is also a characteristic.

In the Inclined plane appliance used by Emami Meibodi Shahin, and that used by Roa.S A et al, the inclined plane is not large enough to guide mandible while closing. The overjet can be up to 10-15mms.The KMCT inclined plane is modified so that the mandibular incisors touches the inclined plane upon closing of the mandible and it guides the mandible to slide on the Inclined plane and reach the desired new anterior positioning of the mandible. In this Inclined plane appliance there is no occlusal interference in canine- premolar area and the bite opening is minimal. This is because the Inclined plane slopes laterally also (Fig 9).

KMCT appliance is an improved and modified inclined plane appliance. In our experience the patient acceptance, co operation and good results are better for this appliance than any other appliance. This has been our experience during the past 7 years. The success of the treatment is well appreciated and satisfied by the parents on seeing the improved aesthetic appearance of the child (Figures 5 to 10).

The correction to class I molar occlusion, the improved facial profile view and the corrected skeletal discrepancy are well appreciated by the doctors as well.

Conclusion

Poor co-operation from children in wearing bulky and complicated myofunctional appliances for correction of Class II division 1 malocclusion gave poor results. Here a new simple, improved inclined plane appliance is described .It has been found to be very effective during the last 7 years in the department of Pediatric dentistry in KMCT Dental college, Manassery ,Mukkam, Kerala. The appliance is named KMCT Appliance.

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ANGIOGRANULOMA –THE ORAL PREGNANCY TUMOUR: LITERATURE REVIEW

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Abstract

Gingival enlargement in pregnancy is called angiogranuloma or pregnancy tumour. It is a conditioned gingival enlargement. It occurs when the systemic condition distorts the usual gingival response. Presence of plaque is not the determining factor of the clinical feature. Pregnancy accentuates the gingival response toward the local irritants. This review provides a discussion regarding the causative factors, histopathology and management of pregnancy tumour.

Keywords: Pregnancy, conditioned enlargement, altered tissue metabolism, hormonal variation, sub gingival micro flora

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Introduction

Gingival enlargement or gingival overgrowth is the accepted current terminology for increase in size of gingival which is a common feature of gingival disease. The term pregnancy tumour(PT) was first coined by Blum in 1912.[1] The first report of PT in English literature was described by Hullihen in 1844, but the term "pyogenic granuloma" or "granuloma pyogenicum" was introduced by Hartzell in 1904.[2] In the past "hypertrophic gingivitis" or "gingival hyperplasia" were the terms used for describing this clinical condition. Other names of pregnancy tumour are pyogenic granuloma, exuberant granulation tissue, granuloma gravidarium, angiogranuloma, pregnancy epuli.[1] Pregnancy associated gingival enlargement is included under the category of conditioned enlargements. Conditioned enlargement occurs when the systemic condition of the patient exaggerates or distorts the usual gingival response to dental plaque.[3] Although there is considerable debate about the incidence and causation of gingival changes during pregnancy, it is generally accepted that increases in gingival inflammation typically begin in the second month and reach a maximal level during the eighth month of pregnancy.[4]

Classifications

1. In 1946, Ziskin and Ness compiled a clinical classification of pregnancy gingivitis as follows:

Class I - Characterized by bleeding gingiva with more or less, no other manifestations.

Class II - Characterized by changes in the interdental papilla-oedema and swelling with subsequent blunting of interdental papilla.

Class III - Characterized by involvement of the free gum margin, which take on the colour and general appearance of a raspberry.

Class IV - Generalized hypertrophic gingivitis of pregnancy

Class V - The pregnancy tumour

2. **Enlargement in Pregnancy**

The changes may be localized or generalized. Another classification is marginal enlargement and tumour like gingival enlargement. The enlargement is usually noted on the marginal, gingival and interdental papilla. [5]

Marginal Enlargement: The incidence has been reported 10% to 70%.The enlargement is generalized in nature and more prominent interproximally than on facial and lingual surfaces. The enlarged gingiva is bright red or magenta in colour, consistency is soft and friable with a smooth shiny surface and a tendency for spontaneous bleeding on slight provocation.

Tumour like Gingival Enlargement: This is a non neoplastic condition. The presence of bacterial plaque and the inflammatory response toward the bacterial plaque is the cause for the enlargement. The incidence rate is 1.8% to 5%.[6] The lesion appears as discrete, mushroom like, flattened spherical mass which protrudes form the gingival margin or from the interproximal space. It has either sessile or a pedunculated base. The colour usually appears as dusky red or magenta and numerous deep red pinpoint markings could be noticed. The consistency usually is semi firm. The condition is usually painless until it is accentuated by local factors or occlusal interference which may lead to painful ulcers.

Histopathology

It is a non-specific, vascularising and proliferating inflammation.[7] Connective tissue has newly formed and engorged capillaries lined by cubical epithelial cells. The stratified squamous epithelium is thickened, with prominent rete pegs and prominent intercellular bridges and leukocytic infiltration. It is histologically similar to a pyogenic granuloma but it is a distinct lesion on the basis of etiology, biologic behaviour, and treatment protocol.[8]

Management

The need for surgical intervention during pregnancy should be carefully examined and there is possibility of regression after childbirth, due to the normalization of hormonal levels.[9] Surgical excision and removal of the local irritants are the usual treatment indicated. In certain cases the excision might need to extend beyond the periosteum in order to prevent recurrence. Presently soft tissue LASER can be used for the excision of the gingival tumour because of the lower risk of bleeding when compared to scalpel method.

Surgical excision of the lesion after delivery seems the best treatment option. The majority of cases are symptomatic and

show bleeding; nodules (71.9%) with soft consistency (62.3%) and a red surface (73.2%). Simple excision is enough to prevent recurrence but the aetiology and pathogenesis must be known to understand its nature. The Nd:YAG LASER is used nowadays because of the lower risk of bleeding compared to other surgical techniques.[10]

Discussion

In general, accepted cause for pregnancy tumour is that the hormonal level that increases in gingival inflammation typically begins in the second month and reach a maximal level during the eighth month of pregnancy. This may lead to oedematous, erythematous and hyperplastic gingiva. Capillary dialation is said to be one cause for the increase in gingival inflammation.

The classic work of Kornman & Loesch in 1980 have reported that the subgingival flora changes to a more anaerobic flora as pregnancy progresses.[11] The increase in Prevotella intermedia in the subgingival microflora is one of the significant finding. O'Neil in 1979 suggested that the altered tissue response to plaque is due to depression of the maternal T lymphocyte.[5]

Matthiesen et al. reported systemic suppression of maternal immune systems, specifically an altered T cell response, and impaired lymphocyte proliferation.[12] An in vitro study conducted by Ehring et al suggested that the progesterone concentration found in placenta blocks the K channel and this in turn contributes to maternal immunosuppression.[13] It has been proposed that, in the absence of VEGF, Angiopoietin-2 (Ang-2) causes blood vessels to regress. The protein level of Ang-2 was highest in the pregnancy tumours, followed by those after parturition and normal gingiva. The amount of VEGF was high in the granulomas in pregnancy and almost undetectable after parturition.

Summary and Conclusion

Angiogranuloma is a type of conditioned gingival enlargement. The three types of conditioned gingival enlargement is hormonal, nutritional and allergic. The increase in Prevotella intermedia in the subgingival microflora is one of the significant finding. Hormonal variation is another important factor in the occurrence of pregnancy tumour.

The presence plaque deposits and the factors that favour in the occurrence and recurrence of the condition should be eliminated.

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VIRTUAL ARTICULATORS: A SMART TOOL FOR SMART WORKING

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Dr. Sheejith. M,* Dr.Ranjith. M

Abstract

The future of dental practice is closely linked to the utilization of computer-based technology, specifically virtual reality, which allows the dental surgeon to simulate true life situations in patients. The transition from numerous mechanical articulator designs to recently developed virtual articulators is a breakthrough in the development of the articulator design. It is used to simulate temporomandibular joint which helps in fabrication of accurate prosthesis in prosthodontics. This paper reviews the need of virtual articulators, its advantages, and the analysis of the dynamic contact of occlusal surface of the maxilla and mandible.

Keywords: Virtual articulators, CAD-CAM, mechanical articulators.
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Introduction

"An articulator is a mechanical instrument that represents the temporomandibular joints and jaws, to which maxillary and mandibular casts may be attached to simulate some or all mandibular movements".[1] Articulators are an inseparable tool in designing and fabrication of any prosthesis in dentistry. Since ages, they are being used in dentistry and dental technology to simulate the human temporomandibular joint, thereby helps in accurate diagnosis and treatment planning, and appropriate treatment of the patient.[2]

The history of articulators dates back to 18th century. First mechanical articulator "The plaster articulator" came into existence in the year 1756 by Philip Pfaff.[2] Numerous articulators are available today, some are very complex and some are very simple in their use and adjustments. The articulator to be used depends on dentist's preference. Carl O. Boucher stated, "It must be recognized that the person operating the instrument is more important than the instrument itself. If dentists understand articulators and their deficiencies, they can compensate for their inherent inadequacies".[3]

Need for a Virtual Reality (VR) Articulator

In daily practice, mechanical articulators are used to diagnose and simulate the functional effects of malocclusions and morphological alterations upon dental occlusion.[4] A mechanical device is limited in its ability to simulate the variability of biologic systems (i.e, the dynamic conditions of jaw movements and dependent aspects). For instance, mechanical articulators cannot simulate:

- The mobility of teeth when using plaster casts in it.
- The distortion and deformation of mandible during loading conditions (mandible bends in maximal opening position to the inner side, which entails problems when making impressions of teeth during wide opening).
- The complexity of movement patterns because the movements of the mechanical articulator follow border structures of the mechanical joint, which never represent the effects of resilience of the soft tissue or the time-dependent, muscle-guided movement pattern of chewing.[5,6]

Casts cannot represent the real dynamic conditions of the occlusion in the mouth. Many other problems regarding the technical procedures and dental materials decrease the accuracy of reproduction such as:

- The stability of the articulator itself.
- The precise orientation of the cast onto the articulator.
- The expansion and contraction of the plaster used for articulation.
- The deformation of the bite registration material (eg., wax, which is susceptible to heat).
- Repositioning the mandibular cast into maxillary cast using the bite impressions without leaving any space.[6,7]

Therefore the future of dental practice is closely linked to the utilization of computer-based technology, specifically virtual reality(VR), which allows the dental surgeon to simulate true life situations in patients.[4] The dilemmas associated with the use of semi-adjustable articulators can be resolved by replacing the mechanical articulator by its digital replication- the virtual articulator. In contrast to the conventional mechanical procedure, the VR tools enable three-dimensional navigation through the occlusion based on every point of view while the mandible moves along predefined pathways (as the mechanical articulator would do), or reproduce movement patterns of mastication that never can be simulated in mechanical systems. It essentially improves the designing of dental prosthesis by adding kinematic analysis to the design process. Virtual articulator can signify and quantify the effects of resilience of the soft tissue on the time-dependent basis during muscular movements of chewing. [6]

Virtual articulators are also called as "Software articulators". They are not concrete, but exist only as a computer program. They comprise of virtual condylar and incisal guide planes. Guide planes can be measured precisely using jaw motion analyser. Virtual articulators are able to design prostheses kinematically. They are capable of simulating human mandibular movements, by moving digitalized occlusal surfaces against each other and enabling correction of digitalized occlusal surfaces to produce smooth and collision free movements.[2]

Advantages

- Full analysis can be made of static and dynamic occlusion, of the inter-maxillary relationships, and of the joint conditions, due to dynamic visualization in three dimensions (3D) of the mandible, the maxilla, or both.
- The possibility of selecting section planes allowing detailed observation of regions of interest such as temporomandibular joint.
- Combined with CAD/CAM technology, this tool offers great potential in planning dental prostheses, since it affords greater precision and a lesser duration of treatment.[4]

Types of Virtual Articulators

a. Completely adjustable virtual articulator

b. Mathematically simulated virtual articulator

Completely adjustable virtual articulator

The virtual articulator of Kordass and Gartner from the Greifswald University in Germany was designed to record the exact movement paths of the mandible with an electronic jaw movement registration system called `Jaw Motion Analyser`(Fig 1). The ultrasonic measurement system, Jaw Motion Analyzer (Zebris, Germany) is used to record and implement the movement pattern of the mandible.

It is an ultrasonic motion capture device that is comprised of an ultrasound emitter array that is bonded to the labial surfaces of the mandibular teeth using a jig customized with cold cure acrylic, and a sensor array located on a head frame secured to the patient's head.[2,4]

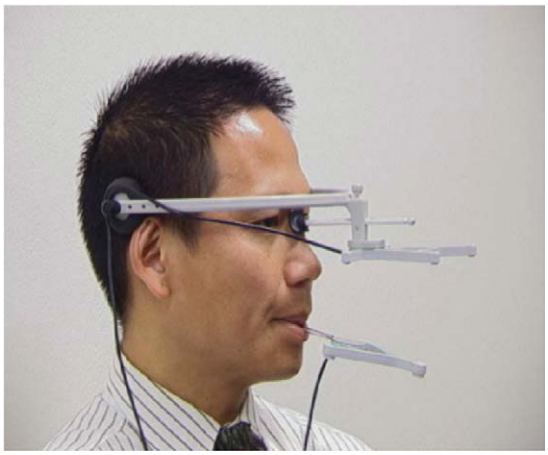

Fig1: Jaw motion Analyzer

Mathematically Simulated Virtual Articulator

Szentpetery's virtual dental articulator from the Martin-Luther University of Halle is based on a mathematical simulation of the articulator movements. It is a fully adjustable three dimensional virtual articulator capable of reproducing the movements of a mechanical articulator. In addition, mathematical simulation contributes to offer possibilities not offered by some mechanical dental articulators, such as curved Bennett movement or different movements in identical settings .This makes it more versatile than a mechanical dental articulator.[2,4]

Programming of Virtual Articulators to analyse occlusal collisions in dental prosthesis

The programming and adjustment methods of the virtual articulator were described by Kordass and Gartner in

1999.[5]First a digital image is obtained of the surfaces of each tooth, of the global dental arches, and of the bite registries using 3D scanners. The scanner projects a vertical laser beam onto the surface of the object. A digital camera equipped with a charge coupled device (CCD) registers the beam reflected from the object and transmits the digital signals to an electronic processing system. The processed image data are stored as digital matrix brightness values, ready for use by the scanner software and for on-screen visualization and computerized manipulation. There are two types of digitization.

a. Direct digitizing, in which tooth surfaces are scanned inside patients mouth.
b. Indirect digitizing, in which tooth surfaces are scanned in the cast obtained from pouring the impression of the patient.[8,9]

The digitized casts are transfered on to the virtual articulator using digital facebow, which was developed to locate the maxillary cast of the patient in a cranial coordinate system. The position of a pointer in 6 positions with reference to the head and transverse horizontal axis are scanned and the exact position of the maxillary cast is transferred on to the virtual articulator (Fig 2). Mandibular cast is positioned exactly to the maxillary cast with the use on the scanned centric occlusion record.[10,11]

Exact movement paths of the mandible was recorded with an electronic jaw movement registration system called `Jaw Motion Analyser`. This ultrasonic measurement system is used to record and implement the movement pattern of the mandible in the virtual articulator.[11,12]

The reference data sets coming from the 3D scanner, and jaw movement records, are matched and presented in the virtual articulator Dent-CAM. The Dent-CAM software consists of three main windows which show the same movement of the teeth from different aspects.

The rendering window shows both jaws during dynamic occlusion and can visualize unusual views throughout dynamic patterns of occlusion (ie, the view from the occlusal cups while watching the antagonistic teeth coming close to the intercuspidation position during chewing movements). It also allows the creation and export of animations.

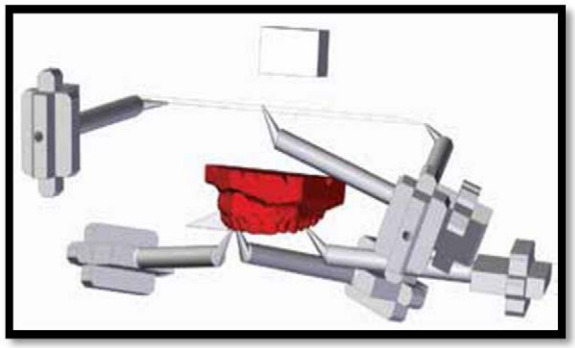

Fig 2: Location of maxillary cast on cranial coordinate system with all 6 pointers

The occlusion window shows the static and dynamic occlusal contacts sliding over the surfaces of the upper and lower jaw as a function of time. The speed of this movement can be controlled with sliders; a colored differentiation of the contact force is also implemented. In a smaller window, the movements of the temporomandibular joint