SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES

OSUDU, AGARAM VILLAGE, KUDAPAKKAM POST, PUDUCHERRY-605502.

Date: 31.3.19

From
DR.BALAJI SUBRAMANIYAN.R,
Professor and Head,
DEPARTMENT OF DENTISTRY,
SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES
Bharath Institute of Higher Education and Research,
Chennai.

To
The Dean,
SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES
Bharath Institute of Higher Education and Research,
Chennai.

Sub: Permission to conduct value-added course: VIRTUAL ARTICULATOR

Dear Sir,

With reference to the subject mentioned above, the department proposes to conduct a valuc-added course titled: **VIRTUAL ARTICULATOR** on 5.4.19. We solicit your kind permission for the same.

Kind Regards

DR.BALAJI SUBRAMANIYAN.R,

FOR THE USE OF DEANS OFFICE

Names of Committee members for evaluating the course:

The Dean: DR.JAYALAKSHMI

The HOD:DR.BALAJI SUBRAMANIYAN

The Expert: DR.AMUTHAVALLI.V

The committee has discussed about the course and is approved.

Dean | Subject Expert | HOD

DEAN
SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES
OSUDU, AGARAM VILLAGE,
KOODAPAKKAM POST,
PUDUCHERRY - 605 502

OFFICE OF THE DEAN
Sri Lakshmi Narayana Institute of Medical Sciences
OSUDU, AGARAM VILLAGE, VILLIANUR COMMUNE, KUDAPAKKAM POST,
PUDUCHERRY - 605 502.
[Recognised by Medical Council of India, Ministry of Health letter No. U/12012/249/2005-ME (P -II) dt. 11/07/2011]
[Affiliated to Bharath University, Chennai - TN]

Circular

1.5.19

Sub: Organising Value-added Course: VIRTUAL ARTICULATOR

With reference to the above mentioned subject, it is to bring to your notice that SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES, **Bharath Institute of Higher Education and Research**, is organising **"VIRTUAL ARTICULATOR ON 5.4.19"**. The course content and registration form is enclosed below."

The application must reach the institution along with all the necessary documents as mentioned. The hard copy of the application should be sent to the institution by registered/ speed post only so as to reach on or before 3.4.19. Applications received after the mentioned date shall not be entertained under any circumstances.

Dean

Encl: Copy of Course content and Registration form.

COURSE PROPOSAL

Course Title: VIRTUAL ARTICULATOR

Course Objective: To enlighten students about significance of VIRTUAL ARTICULATOR

Course Outcome: In depth knowledge regarding virtual articulator

Course Audience: MBBS STUDENTS

Course Coordinator: DR. JAYALAKSHMI

Course Faculties with Qualification and Designation:

1. **DR.AMUTHAVALLI.V M.D.S & ASSISTANT PROFESSOR**

Course Curriculum/Topics with schedule (Min of 30 hours)

SlNo	Date	Topic	Time	Hours
1	5.4.19	articulators	4PM-6PM	3 hrs
2	11.4.19	Uses of semi adjustable articulators	4pm-7 pm	3hrs
3	17.4.19	Difference between mechanical and virtual articulator	5pm-8pm	3 hrs
4	26.4.19	Semi adjustable articulator	4pm-7pm	3hrs
5	2.5.19	Uses of virtual articulator	5pm-8pm	3 hrs
6	11.5.19	Limitations of virtual articulator	5pm-8pm	3 hrs
7	21.5.19	CAD/CAM in teeth replacement	4pm-7pm	3 hrs
8	3.6.19	Different types of articulators	5pm-8pm	3 hrs
9	10.6.19	Recent applications in replacement of tooth	5pm-8pm	3 hrs
10	18.6.19	Treatment modalities in complete denture pts	4pm-7pm	3 hrs
			Total Hours	30

REFERENCE BOOKS: (Minimum 2)

1. **KUMAR.P.KHATTER –TEXTBOOK OF VIRTUAL ARTICULATOR**
2. **SZENTPETERY-TEXT BOOK OF VIRTUAL ARTICULATOR**

Annexure- II

VALUE ADDED COURSE

VIRTUALARTICULATOR

DI-10

List of Students Enrolled Sep 2017 – Jan- 2018

MBBS Student		
Sl. No	**Name of the Student**	**Roll No**
1	SUNITHA .A	U16MB383
2	SURENDAR RAJ .S	U16MB384
3	SUSMITHA .V	U16MB385
4	SWATI GUPTA	U16MB386
5	SWATI KUMARI	U16MB387
6	THAMARAIK KANNAN	U16MB388

Dr. Amuthavalli. V
RESOURCE PERSON

Dr. Jayalakshmi
COORDINATOR

Bharath Institute of Higher Education and Research

SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES

Participant list of Value added course: **VIRTUAL ARTICULATOR**

Sl.No	Reg. No	Name of the candidate	Signature
1	U16MB383	SUNITHA .A	
2	U16MB384	SURENDAR RAJ .S	
3	U16MB385	SUSMITHA .V	
4	U16MB386	SWATI GUPTA	
5	U16MB387	SWATI KUMARI	
6	U16MB388	THAMARAIK KANNAN	

VIRTUAL ARTICULATOR

ABSTRACT

Virtual reality is a computer based technology linked with the future of dentistry and dental practice. The virtual articulator is one such application in prosthetic and restorative dentistry based on virtual reality that will significantly reduce the limitations of the mechanical articulator, and by simulation of real patient data, allow analyses with regard to static and dynamic occlusion as well as to jaw relation. It is the purpose of this article to present the concepts and strategies for a future replacement of the mechanical articulator by a virtual one. Also, a brief note on virtual reality haptic system has been highlighted along with newly developed touch enabled virtual articulator.

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 virtual articulator has been designed for the exhaustive analysis of static and dynamic occlusion, with the purpose of substituting mechanical articulators and avoiding their errors. These tools will help both odontologists and dental prosthetists to provide the best individualized treatment for each patient. The review analyzes and the studies published in the literature on the design, functioning and applications of virtual articulators. The virtual articulator can simulate the specific masticatory movement of the patient.

During mandibular animation, the program calculates the sites where the opposing teeth come into contact. The studies made to assess the reliability of the virtual articulator show good correspondence in visualization of the number and position of the dynamic contacts. The virtual articulator is a precise tool for the full analysis of occlusion in a real patient.

VIRTUAL ARTICULATOR

Introduction:

The future of dentistry is linked strongly to the use of computer technology. If dentists and dental technicians succeed in obtaining qualifications in areas of information technology, dentistry will be able to keep up with the highly networked information society. Virtual reality (VR) technologies have a strong impact on research, development, and industrial production. VR technologies in dentistry will be used to provide better education and training by simulating complex contexts and enhancing procedures that are traditionally limited, such as work with the mechanical articulator. The diagnosis of dysfunction and dysmorphology demands advanced skills with regard to optimizing occlusal conditions. Decision support for dentists, orthodontists, and dental technicians supplied by a computer tool such as the ''virtual articulator'' could improve the clinical outcome the further discussion focuses on concepts and developments, the advantages and clinical consequences of using such tools.

Articulator:

Articulator is defined as, a mechanical device that represents the temporomandibular joints and jaw members to which maxillary and mandibular casts may be attached to simulate jaw movement – GPT 8

Mechanical dental articulators

Mechanical dental articulators are tools that simulate the movements of the human lower jaw and the temporo mandibular Joints (TMJ-s). They have been used for more than 100 years for different purposes in dentistry. They have become indispensable instruments for dentists in their diagnostic activity as they simulate

specific patients for dental technicians in their laboratory work. They enable technicians to carry out a study of occlusal relations between dental arches and to detect harmful occlusal interferences on models before more sophisticated occlusal equilibration procedures are performed on the patient. This equilibration of partial and full dentures is also carried out in dental articulators.

Over the last 120 years, hundreds of different articulators have been constructed. Throughout these years there has been no remarkable development on articulators. Today's articulators are handy, functional and more precise in both construction and operation. In order to reproduce the individual parameters of the patient the articulator must be adjustable. The setting data are measured on the patient and, using the face bow, the relative location of the occlusal plane is transferred from the patient to the mechanical dental articulator.[7]

VIRTUAL RELATION:

Virtual technologies in dentistry will be used to provide better education and training by simulating complex contexts and enhancing procedures that are traditionally limited, such as work with mechanical articulator. The virtual articulator is intended to use as a tool for the analysis of the complex static and dynamic occlusal relations.

Limitations of semi-adjustable articulators:

Commonly used semi adjustable articulators, however have major limitations,

- The movements of the mandible cannot be reproduced exactly
- Cannot simulate the mobility ofteeth when using plaster casts in it.
- Cannot simulate the distortion and deformation of the mandible during loading conditions. (the mandible bends in maximal opening position on the inner side, which entails problems when making impression of teeth during wide opening.)

- Cannot simulate the complexity of movement patterns. This is because the movements of the mechanical articulator follow border structures of mechanical joints which never represents the effects of resilience of the soft tissue
- They do not provide time related information on jaw movement. These problems can be solved by replacing the mechanical articulator by a digital simulation i.e., "Virtual Articulator.

Need of Virtual Articulator: The main goal of the virtual articulator is to improve the design of dental prosthesis, adding kinematic analysis to the design process.

The mechanical articulator which is currently used in the fabrication of fixed dental prosthesis has numerous limitations as mentioned. Also many often problems regarding the technical procedures and dental materials decreases the accuracy of reproduction as

- the deformation of registering material (Eg. Wax, which is susceptible to heat),
- repositioning the cast into bite impression without leaving any space.
- the correct orientation of the casts
- the use of rigid and expanded plaster material
- maintenance of the mechanical articulator.
- Stability of the articulator itself

Because of these problems, the reproduction of dynamic, excessive contact seems to lower the reliability. Replacement of the mechanical articulator with the virtual articulator will solve these problems.

Applications of virtual articulators:

- 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.

- The digitizing of tooth surfaces opens possibilities in manipulation procedures to improve the occlusion.
- Computer aided design/computer aided manufacturing (CAD/ CAM) techniques or tools for a virtual set-up of the teeth could be linked.
- Currently, the virtual articulator is concerned with better visualization of details and supports the use of mechanical tools, but it will replace them in the future.
- Can be used to provide better education and training by simulating complex contexts.
- Importantly, it would influence the quality of the networking communication between dental practice and laboratory, helping to produce the best-fitted occlusal restorations possible. The VR articulator will be affordable and economical in private practice, with costs perhaps depending on demands for use.
- One of the most interesting options offered by the virtual tools is the ability to ''move'' and navigate through enlargeable occlusal surfaces to explore the details of functional occlusion that cannot be visualized using casts alone.
- To study the impact of joint determinants (eg, Bennett angle, slope of condylar guidance, side shift) on occlusal movement patterns, the virtual articulator requires virtual tools for joint-constraint adjustment and collision detection, which simulate the stops of static and dynamic occlusion. Such collision detection is implemented in the most recent version of the VR

articulator, which has been developed in cooperation with the Fraunhofer Institute for Computer Graphics.[3]

Need for virtual articulators in CAD/CAM systems:

With the advent of the digital impression and dental CAM/CAM system, today's dentistry has become dentistry of single visit. Patient can receive crown in single appointment. There is no doubt as to these high-tech instruments taking over dentistry in the future. In a few minutes, the dentist is able to obtain the necessary electronic impression with a scanner and then, it will take him/her about 20 minutes to have the tooth designed in a computer and afterwards, He/she will have it milled from one ceramic block in less than an hour.

But even the latest CAD/CAM system has its own limitations. Main disadvantage of the system is limited accuracy of the occlusal surface. This is because it acts as simple mechanical occludators and cannot take into consideration the functional movements of the mandible. So the occlusal surface of new tooth has to be trimmed manually after in patient's mouth, at the cost of valuable chair side time, and if we are not considering the mandibular movements and placing the restoration as it is, we are creating problems for the patient's TMJ. So for accurate occlusal surface construction there is need to use kinematic method i.e. virtual articulator along with CAD/CAM system.

However, considering the limited accuracy of the occlusal surface, this type of restoration can only match the possibilities offered by simple occludators (static design). The system cannot take into consideration functional movements, so the occlusal surface of the new tooth has to be manually trimmed to these movements in the mouth or in an articulator. Even a really high-tech-system such as the Cerec3

[5-7], the latest CAD/CAM development, presents this severe handicap despite being able to make an occlusal surface fit the antagonists in intercuspal position. This shortcoming is common to nearly all laboratory CAD/CAM systems. Unfortunately, in order to take these movements into account, it is not possible to integrate any mechanical dental articulator in such systems.

For accurate occlusal surface construction there were two ways.

a) The use of fully adjustable articulator which simulates mandibular movements with high degree of precision and is time consuming and expensive.

b) Use of virtual articulators with CAD/CAM system. The prosthodontics applications of virtual articulators are to fabricate the best fitted occlusal restoration possible, to help students to understand the function of dental articulator, different excursive movement and their influence on the occlusal surface and to improve the quality of communication between the dentist and dental technician. As a consequence, all dental CAD/CAM systems aim to deliver similarly precise occlusal surfaces analogous to the occlusal surfaces obtained when working with adjustable mechanical dental articulators. These systems should use kinematic methods for occlusal surface construction or correction.

Preliminary and matching procedures for adjusting the VR articulator:

The use of a three-dimensional laser scanner for digitizing data is the prerequisite to visualizing the tooth on the screen. The three-dimensional laser scanner automatically digitizes a single tooth, complete denture models, or centric relations referred to previously. For digitizing dental arches and bite records, the three-dimensional scanner ''Scan 3D'' by Willytec (Munich) is used. The reproducibility is 2 um with the standard objective, and the accuracy after matching is 10 um. Between 8000 and 14,000 points per second are digitized.

Afterward, the data are available for any computerized presentation, manipulation, or navigation. The ultrasonic measurement system Jaw Motion Analyzer is used to record and implement the movement pattern. This system is based on measuring the velocity of ultrasonic impulses emitted from three transmitters attached to the lower sensor. Four receivers are attached to a face bow opposite them. This positioning enables the detection of all rotative and translative components in all degrees of freedom. Asp ecial digitizing sensor is used to determine the reference plane, which is composed of the hinge axis infraorbital plane and special points of interest (eg, on the occlusal surface).

Subsequently, the movement data finally can be calculated in relation to the digitized points. Silicon-based jaw relation registrations are used to reproduce the best occlusion in the position of intercuspidation. It is important
that the registration remain attached to the upper teeth during opening. The registration then should be stabilized with impression plaster on a metal carrier plate. The digitizing sensor is attached to detect three main reference points on the rear of this metal plate. These three points are used to combine movement data and the digitized dental arches.

SRI LAKSHMI NARAYANA INSTITUE OF HIGHER EDUCATON AND RESEARCH

VIRTUAL ARTICULATOR

QUESTIONS

Course Code: DI-10

I. ANSWER ALL THE QUESTIONS

1.Uses of virtual articulator?

2. Difference between mechanical articulator and virtual articulator?

3. Limitations of semi- adjustable articulator?

4.need for virtual articulator in CAD/CAM system?

5. Disadvantages of semi-adjustable articulator?

NAME: SONJITHA N
Roll No: 016MB338

Virtual articulator.

Articulator: virtual refers to a simulated, interactive, multisensory view-centered and three dimensional (3D) generation environment.

- Mean value articulator
- Hanau articulator.
- Whip-Mix articulator
- Denar articulator
- TMJ articulator.

Incisal guidepin
- anterior reference point
- The incisal edge of the maxillary incisor at the midline of the occlusal rim should touch the tip of pin guide during articulation

Four different factors.
- Sagittal factors
- Earpiece factors
- Twin-factors
- Adjustable axis factors.

Adjustable.

Semi-adjustable articulator.

Virtual articulator

Virtual articulators are also called Software articulators. Here clipping is a handy way to collect important slides you

Fully adjustable type arcon Stuart Instrument.

Gnathator, Denar- D5A H1.0 Dech.

Virtual articulator provides Virtual reality application to the world of dental procedures used for occlusal relation.

Sri Lakshmi Narayana Institute of Medical Sciences

Affiliated to Bharath Institute of Higher Education & Research
Deemed to be University under section 3 of the UGC Act, 1956

CERTIFICATE OF MERIT

This is to certify that SUNITHA.A has actively participated in the Value Added Course on *VIRTUAL ARTICULATOR* held during APR 2019 – JUNE 2019 Organized by Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry- 605 502, India.

Dr. Amuthavalli.V
RESOURCE PERSON

Dr. BALAJI
COORDINATOR

Student Feedback Form

Course Name: VIRTUAL ARTICULATORS

Subject Code: PI - 10

Name of Student: SUSHMITHA. V Roll No.: U16MB385

We are constantly looking to improve our classes and deliver the best training to you. Your evaluations, comments and suggestions will help us to improve our performance

Sl. NO	Particulars	1	2	3	4	5
1	Objective of the course is clear		✓			
2	Course contents met with your expectations		✓			
3	Lecturer sequence was well planned			✓		
4	Lectures were clear and easy to understand		✓			
5	Teaching aids were effective		✓			
6	Instructors encourage interaction and were helpful			✓		
7	The level of the course			✓		
8	Overall rating of the course	1	2	3	4	5

** Rating: 5 – Outstanding; 4 - Excellent; 3 – Good; 2– Satisfactory; 1 - Not-Satisfactory*

Suggestions if any:

Date: 31.3.15

Signature

COURSE COMPLETION

Date 20.6.19

From
DR.BALAJI SUBRAMANIYAN.R
DEPARTMENT OF DENTISTRY,
SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES
Bharath Institute of Higher Education and Research,
Chennai.

Through Proper Channel

To
The Dean,
SRI LAKSHMI NARAYANA INSTITUTE OF MEDICAL SCIENCES
Bharath Institute of Higher Education and Research,
Chennai.

Sub: Completion of value-added course: VIRTUAL ARTICLUATOR

Dear Sir,

With reference to the subject mentioned above, the department has conducted the value-added course titled: **VIRTUAL ARTICULATOR** on 18.6.19. We solicit your kind action to send certificates for the participants, that is attached with this letter. Also, I am attaching the photographs captured during the conduct of the course.

Kind Regards

DR. BALAJI SUBRAMANIYAN.R

Encl: Certificates

Photographs