

RECENT ADVANCES IN CRANIOMANDIBULAR REPLICATORS

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ABSTRACT

Digital dentistry is gaining momentum in day to day practice. The introduction of virtual articulators to record the jaw relation has eased the conventional procedure. Virtual articulators offer more convenient way of recording and transferring jaw relation. This article gives details about the types and method of recording jaw movements using virtual articulator.

KEYWORDS: Virtual articulator, recent advances in articulators, software articulators.

INTRODUCTION AND RATIONALE

Simulation of temporomandibular joint (TMJ) movements is a prerequisite in the development of occlusion. Dental articulators perform this task almost accurately, however negligible errors occur. Recording jaw relations clinically has evolved from recording the bite with pumice and carborundum to use of silicone bite registration pastes. Transferring the orientation relation to an articulator is possible with face bows. The technology of using a fully adjustable articulator has gained popularity in recent years. Digital dentistry has led to the practice of cad cam technology. Another milestone in the digital dentistry is the development of virtual articulator.^[1] The success of the virtual articulators are yet to be hypothetically proved, but these articulators have been used to record jaw relations both in static and dynamic positions. This article gives an insight into the types, mechanism, advantages, disadvantages and accuracy of virtual articulators.^[2]

Common Errors in Mechanical Articulators

- An articulator may be made of metal or plastic. Errors in tooling or errors resulting from metal fatigue are common errors in metal articulators.
- It may not exactly simulate intraborder and functional movements of mandible.
- Errors in jaw relation procedures are reproduced as error in dental occlusion. Mechanical Articulators do not have any provision to indicate or correct these errors.

The transitions from mechanical articulator to its recent advances were due to the following drawbacks:^[3]

- Mechanical articulators cannot stimulate all the movements of the mandible.
- Proper orientation of cast may not be obtained.
- Occlusal corrections are not accurate.
- Stability and rigidity of the dental material is lost during technical procedures hence malocclusion occurs.

Virtual Articulator

Virtual articulators are developed to avoid the errors caused by mechanical articulators.

Virtual articulator's computer aided software programmes, also called as Software Articulators. This visualizes the jaw in dynamic and kinematic movements it shows the teeth in different windows namely rendering window, occlusal window and small window.^[4] Virtual articulators are further classified into (a) completely adjustable virtual articulator and (b) mathematically stimulated virtual articulator.^[5] Virtual articulators are computerized articulators that run using software programmes. They have preselected condylar and incisal guide planes. The preselected guide planes may be user defined or based on mathematical values.

Types of Virtual Articulator

The virtual articulators are of two types^[6] namely

- (1) Completely Adjustable virtual articulators.
- (2) Mathematically stimulated virtual articulator.

Completely Adjustable Virtual Articulator

This was invented by Kordass and Gartner of Greifswald University Germany (Zebris).

The incisal and condylar guide planes are preselected according to each patient^[7] The scanned jaw motions are transferred to the computer system and checked for occlusal collision.

Components of a Completely Adjustable Virtual Articulator

It is composed of:^[8]

- **Jaw motion analyzer:** This records the exact movement pathway of mandible.
- **A face bow with receiver:** It is an instrument that records the spatial relationship of the maxillary arch to some anatomic reference points in the mandible and transfers this relationship to the articulator. In case of virtual articulators the receivers attached to them transfer the data to the computer screen.
- **Lower jaw sensor:** This is fastened to the paraocclusal bite attached to the lower jaw. This transfers the mandibular movements.
- **Software package:** This is composed of orthodontic modules with virtual setup.^[9]
- **Sensor pen:** This is used to define a plane by measuring the two condylar and infraorbital points.
- **Basic unit:** This consists of the computer system.

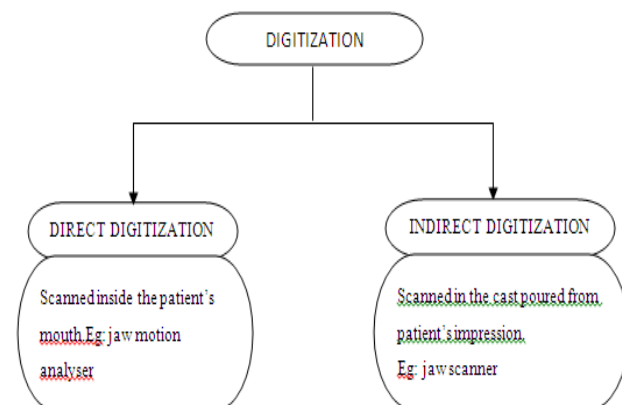
Mathematically Stimulated Virtual Articulators

This works on arbitrary values or mathematical values hence it resembles the Average value articulators. This can bring about all the movements of the temporomandibular joint but in a constrained position. It cannot give an individualized record as in case of completely adjustable virtual articulators.^[10] Eg: Szentpetery's virtual articulators.

Technique

Digitization of Virtual Articulator

In order to view the tooth surface in all the aspects 3D digitization techniques are followed. This is further classified into direct and indirect digitization.^[11]



Virtual Reality Dencam

This is a virtual tool used to demonstrate the tooth surfaces in different aspects called windows namely:^[12]

- **Rendering window:** shows the jaws in dynamic occlusion position.
- **Occlusal window:** shows the jaws during occlusal movement.
- **Small window:** shows the movement of TMJ in horizontal and vertical positions^[13].

DISCUSSIONS

The advantages of virtual articulators are Comfort and convenience

Virtual articulator's offers chair side convenience for the dentist. The clinical and laboratory procedures are more simplified. The virtual articulators are capable of simulating all the mandibular movements.^[14] Hence collision free and smooth movements are made.

Time saving

Digitalized work is more time saving because occlusal corrections are done then and there.^[15]

Accuracy

Since it records the exact jaw motion it is accurate to a greater level than other mechanical articulators. This more simple and precise.

Disadvantages

- Virtual articulators are expensive to practice in a clinic.
- Software packages require frequent update to a revised version.
- A clinician has to maintain a separate record for each patient which will not be possible in all the time

CONCLUSION

Virtual articulators offer high precision of recording jaw relations. However clinical trials are required to prove the accuracy of these records.

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