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UTILIZING A COMPUTER MOUSE FOR DIAGNOSIS AND PATIENT EDUCATION IN GNATHOLOGY- A CASE REPORT

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Abstract

A personal computer that utilizes optical mouse could be an effective tool in the study of mandibular movements and effective patient education. Dynamic mandibular movements have been traditionally studied using Gothic arch extra oral or intra oral tracers. However, certain drawbacks of the tracings produced by these methods could be overcome with present day optical mouse. This article describes an innovativeoptical mouse modified Gothic arch tracer which scribes the mandibular movement on the display of a computer laptop. Method of modification has also been described along with detailed discussion of its use.

Introduction

Even as far back as the ancient Egyptians [1] there is evidence of primitive dental practices and "crown and bridge" restorations. Surprising but true, it was attrition and not dental decay that was most prevalent among older civilization. Attrition and wear of natural teeth are basically related to a discrepancy between the position of teeth and the direction of mandibular movement. Many pioneers have focussed to eliminate occlusal discrepancies by utilizing different methods of recording jaw movements like tracers (Gothic arch) and engravings.

Recording of jaw movement is an exclusive method of diagnosing the maxillofacial function in the field of gnathology, and many recording systems are available. Conventional non-contact systems, whether commercially available or self-produced, are able to measure with high accuracy, but these systems, such as magneto metric sensors [2–6] and multiple charge-coupled device (CCD) cameras, [7–13] are generally expensive and difficult to operate for daily use because of their complicated mechanisms. Due to these and other factors, measuring jaw movement has become limited to either few academic institutes or special clinics. Because information obtained from studying jaw movements is essential, development of a simple, inexpensive, easily available and less difficult is highly desired. This article describes a novel use of a computer mouse to analyze patient's mandibular movement for diagnosis and patient education.

Materials And Methods

Mouse modified extra oral tracers: After obtaining the ethical approval from th**e** ethics committee of the University, the design was discussed with the mechanical and computer engineers of the same university. The materials required for the device included a smaller size optical mouse (Dell), Gothic arch extra oral tracer with central bearing plates (Height, Hanau), laptop (Hewlitt Packard, Windows 7) with software (Paint, word or PowerPoint), a soft mouse pad (Portable, 3mm Soft Well), a completely edentulous patient seeking complete denture prosthesis and a printer (Hewlett Packard, Deskjet, 1510). Necessary data for the device included the measurement of the tracing plates and the circuit board of the optical mouse. After evaluation of these dimensions, the maxillary tracer was modified by removing the tracing pin along with its attachmentand replacing it with a rectangular metal frame with upper and lower locking teeth **(Fig. 1A)**. The mandibular tracer which conventionally contains a tracing plate was modified by simply gluing the soft mouse pad on the surface, cut exactly to the dimensions of the plate. The circuit board of the mouse was then isolated from the mouse along with the cord and the USB (Universal serial bus) pin **(Fig. 1B).** Without any modification to the circuit board along with its various components (various switches, light detector chip, X and Y axis wheels, LED generator, plastic prism and potentiometer) was placed inside the maxillary modified tracer **(Fig.1C)**. The modified tracer stabilizes the circuit board both horizontally and vertically. The entire assembly was then locked in a rectangular casing that would allow the mouse to be clicked at any point of time **(Fig.1D)**. For proper alignment, which is

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mandatory, a spirit level indicator was used to make necessary adjustments. Before proceeding with the clinical technique, the controls of the mouse were changed in the laptop control panel under ease of access center so that the keys of the keyboard represent various clicks and scrolling ability of the mouse.

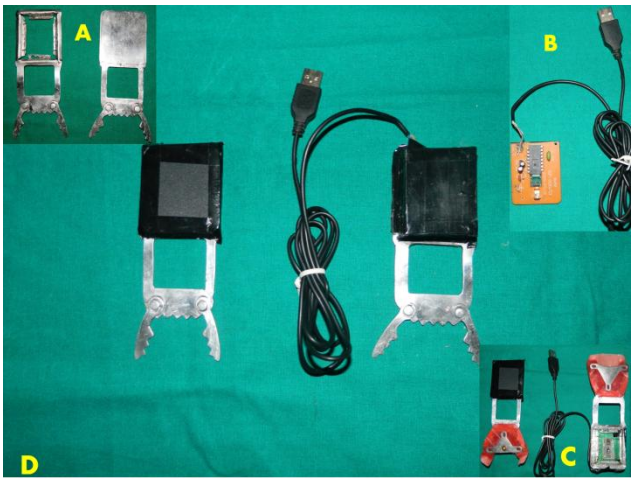

Figure 1:Assembling of the device. Gothic arch tracers with modified maxillary ramp (A) Circuit board of a mouse along with cord (B) Circuit board on the maxillary tracer (C) Sealed mouse modified tracers.

Clinical technique

A completely edentulous patient was selected who was completely edentulous for more than a year, but had not worn any complete denture prosthesis. Another criterion for this particular study was the patient's mandibular movements were not coordinated and had no underlying temperomandibular joint pathology. Conventional steps for complete denture fabrication were undertaken following regular academic protocol. After tentative jaw relations were recorded, the occlusal rims were mounted on a semi adjustable articulator (Hanau, Waterpik, Ft Collins, USA). At this stage the modified Gothic arch tracers were attached to the occlusal rims in the usual way **(Fig.2 A)**. The difference though is that the tracing in conventional method is done on a plate which needs to be frequently carbonized with flame or a coloured ink whereas in this case the tracing would be done on a computer screen.

In the next clinical appointment, the modified occlusal rims carrying the digital mouse were placed in the patient's mouth **(Fig. 2B)** and the patient was instructed to perform various mandibular movements. After placing the device in the patient's mouth the tracer was attached to the laptop (Hewlett Packard) and the tracing was done on the paint application. Movements of the patient were carried in three directions as usual and every time he completed a particular movement the keyboard control would end that exercise. After final approval of the tracing, the tracing was saved in a file **(Fig. 2C)**. The tracers were then placed back on the articulator and connected following which another tracing was scribed by the articulator and saved in a file. The two files were then printed on a paper and coincidence was verified.

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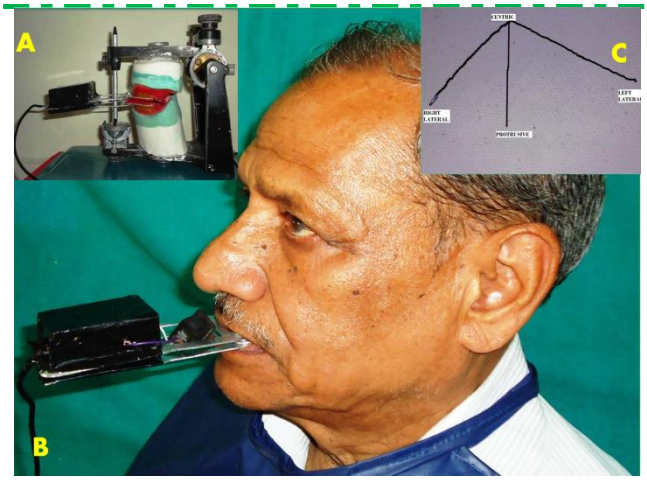

Figure 2: Clinical use of mouse modified Gothic arch tracers (A) Maxillary and mandibular tracers with mouse and mouse pad attached on an articulator (B) Device placed on the patient for evaluation of mandibular movements and (C) Recorded tracing

Results and discussion

Compared to the conventional method of mandibular tracing with gothic arch tracer, the opportunity of the visible tracing to the patient adds benefits and thus reduces clinical time. Patient education was comprehensive and effective. Minor obstructions to the movements in the temperomandibular joint can be easily made out on the tracing. Any abnormality in the movement of the mandible within the confines of the condylar fossa is magnified.

The information obtained from jaw movements is essential to all fields of dentistry, especially in cases where occlusion is modified or restored. The device mentioned in this article has been clinically applied to a complete denture patient, but after minor modification in the methodology, one can apply it in dentate patients also. In gnathological procedures, minor differences between the centric relation and maximum intercuspation adversely affect the stomatognathic system in both dentulous and edentulous jaws, therefore a centric relation and maximum intercuspation should coincide. [14-18] most of the problems that are associated with intraoral and extraoral gothic arch tracing are overcome once the path of mandibular movement is allowed to be viewed on a display. [19]

Gothic arch is a reflection of anatomic factor of the temperomandibular joint and is calculated by the positional relationship of the condyle with respect to articular fossa. Although the gothic arch apex is treated as the centric relation, [3] it is difficult to determine the gothic arch apex unless the gothic arch bilateral tracing path is drawn in a straight line and the apex is clearly traced in arrowhead fashion. Visibility of the apex and its formation on a screen to a patient allows him to quantify the amount of errors that he is doing while translating the mandible.

Accuracy of optical mouse, especially its sensitiveness in relation to minor movements of the mandible and head position are a subject of study and needs to be further verified. However, among different types of available mouse (mechanical, optical, laser, inertial and gyroscopic, 3-dimensional, tactile, ergonomic and gaming), [20] application in gnathology is a subject of research. Basically a mouse is something you push along your desktop to make a cursor (pointing device) move on your screen. So what the mouse has to do is to figure out how much you are moving your hand and in which direction. [21-23] The mouse used in this study does so by bouncing a light of the platform on which it is placed. The combination of optical mouse and a soft mouse pad used in this study allows the light coming from LED (light emitting diode mounted on the base of the mouse) to bounce straight up into the lens of a photocell (present near to LED) where it is magnified so that mouse can respond more precisely to hand movement. [24], [25] When the mouse is pushed horizontally the pattern of reflected light changes and the chip inside the mouse uses this to figure out how the hand is moved. These above mentioned features of the mouse are essentially important in proper alignment of the mouse within the tracer. Any error in inclination of the circuit board of the mouse would lead to errors.

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Conclusion

At first glance, the use of the mouse modified Gothic arch tracer may seem technique sensitive and difficult. But with a small learning and practicing curve and adherence to the principles described herein, consistent, repeatable, and accurate relation can be achieved. Further studies need to be done to validate the reliability of such customized devices and their use in making interocclusal records.

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