SEGMENTED DENTAL BITE FORCE REGISTRATOR-A Novel Device Which Decry The Change In Bite Force

[1] N. S. Selvarajan1, Dr. D. Vishal Reddy, Dr. R. Venkat

[1] 3rd year BDS, SRM Dental College, Ramapuram, Chennai. India

[2] Guide – Senior Lecturer, Department of Prosthodontics, SRM Dental College, Ramapuram, Chennai. India

[3] Professor, Department of Prosthodontics, SRM Dental College, Ramapuram, Chennai. India

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ABSTRACT

In a typical dental procedure, bite force has been considered as a valuable parameter to assess the efficacy of the outcome. A variety of devices with different design and working principles are used to record the bite force. In literatures the available values for bite force is for full arch and separate sides the oral cavity. Even commercially available products are not available for separated segments and it's cost are extortionate. So we made a device with similar performance at economical cost for each segments of oral cavity.

KEY WORSDS- Force transducers, segments [anterior/posterior],masticatory force..

INTRODUCTION

The craniomandibular function is determined by the complex and interrelated components which includes the morphology and biomechanics of the teeth ,muscle, temporomandibular joint and neuromuscular system1. Chewing/occlusion is a phenomenon of interaction between maxillary and mandibular teeth along with muscles. The force acting during this process is called masticatory force ,which is also termed as bite force. .Bite forces can greatly differ with magnitude and direction resulting from different combinations of action of mastication and cooperative muscle2 .It may be recorded to evaluate the function and efficacy of masticatory system. In dental research and clinical, bite force has been recorded as a variable parameter to assess the efficacy of various dental procedures like prosthesis , orthodontic treatment ; or to study effects of deformities and pathologies on the masticatory system like malocclusion , temporomandibular disorders 3 .Excessive bite force will lead to severe pathology to oral cavity and lead to failure of prosthesis biomechanical . So to overcome it by all dental professionals we are come up with a bite force recording device which records the disparity of bite force.

AIM AND OBJECTIVES

•   To develop a newly modified, simpler bite force recording device when teeth are brought in occlusion.

•   Segmented analysis of occlusal forces.
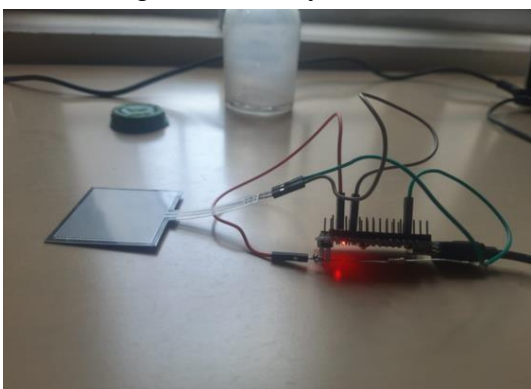
AVAILABLE DEVICES

In earlier days the gnathodynamometer was used to record

the bite force which is purely mechanical.4 Technological advances in signal detection and processing have improved the quality of the information extracted from bite force measurements. Nowadays sensitive electronic devices are used in

bite force devices. Based on the load cell used which converts the force into electrical energy, transducers are classified as

A)   Stain Gauge Transducer

B)   Piezoelectric transducer

C)   Pressure transducer

In strain Gauge transducer, even though it can give accurate readings there is possibility of discomfort, fear of breaking the cusp and edges of teeth and restorations when recording the bite force. However a single strain gauge is not adequate in applications where long-term accuracy is required because of their tendency to drift, especially with change in temperature and humidity.5 Also there may be another disadvantage like unavoidable jaw separation due to thick metal plate or fork. In piezoelectric transducer there was an incorrect reading due to quartz crystals having a minimum active sensing depth of 2 mm . In case of pressure transducer comfortable tubes and elastic deformation of tube density will fluctuate the bite force values.6 Commercially available TEK scanner are not available for separate segments and it's cost are exorbitant. Idea of this article is to develop a new dental bite force recording device that is efficient, accurate and can record in segments economically.

MATERIALS AND METHODS

Segmented Dental bite force registrar is a modified version of strain gauge transducer.

Sensor

The sensor which we use to record is called FSR [Force Resistance Sensor].The length of the sensor pad at each side is 4.4cm . The thickness of the sensor pad is 1mm so that we can able to measure true bite force. The sensor surface is made of conducting and non-conducting cellular matrix which helps in uniform force distribution. The sensor surface is compact and won't cause any disturbance while testing. The sensitive sensor pad can be changed after every 15 patients to get precise values.

Resistor

Resistor is connected to the main circuit and soldered. 10k ohm resistor which was arranged in series connection. Resistor used to provide a specific voltage, gain control, limiting the electric current.

Microcontroller

The microcontroller which is used is based on an Atmel MCU(Microcontroller unit) .

Body

Body of the device is customized in 123D design. It was sliced in such a way that each layer has a thickness of 0.08mm. The body is printed using ENDER 3d printer. The material used for printed is PETG.

DISCUSSION

Technology advancement in signal detection and processing has improved the quality of the information extracted from the bite force measurement. Bite force measurement varies with numbers of factors such as pain, craniofacial morphology, occlusal factors, gender, age, physiological factors, psychological factors. Theoretically, jaw muscle are able to generate a unilateral bite force equal to the bite force obtained during bilateral clenching. But force per side is larger when measured unilaterally compared with half of force measured bilaterally7. With this device we are planning to read up on disparity of masticatory forces for individual tooth and prosthesis. It aids in occlusal force analysis and in comparison, between natural tooth and prosthesis; between segments in same individual; and between individuals for academic, clinical and research purposes.

USER GUIDELINES FOR THE DEVICE

Ensure the zero before starting the study with device. The practitioner asks the patient to sit erect, straight, comfortable position. Following which the patient is asked to bite the sensor with the appropriate tooth. Slowly the amount of force in newton starts increasing and reaches its peak value in 3 to 5 seconds. Meanwhile we should ensure that patient is not facing any fear or discomfort while testing. Once the peak value obtained the patient is asked to slowly open their mouth and the sensor is removed. To prevent the spread of infection plastic sleeves like the once used in RVG sensors can also be used. This segmented analysis of bite force helps us to understand the variation in force deliverance of tooth.

CALIBRATION

Calibration of the segmented dental bite force registrar is done at SRM University, Ramapuram. Calibration was done by standardizing the unknown mass using WENSAR balancer. Now we kept the same mass over our bite force registrar. Amount of force acts on the sensor will measure in newton. The obtained weight of unknown mass is converted into Force by the formula $F=Mg$ [g=9.8]. By comparing the formulated force with the force shown by the sensor we can check the accuracy of the device. It has an accuracy of 95% and value ranges in grams from 300g/0.01g. Hence our device has an accuracy of 95%

WEIGHT OF UNKNOWN MASS [g]	ACTUAL VALUE [F=Mg]	FORCE ON SENSOR
106.97	1.04 N	1N
214.14	2.1 N	2N
285.52	2.8 N	3N

PATIENT TRIAL

Fig 1:Testing bite force in anterior of 4th quadrant FPD

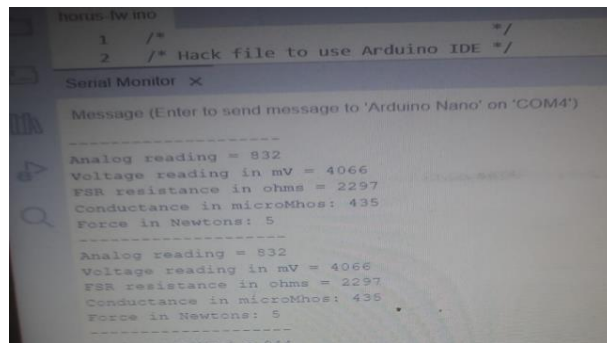Fig 2 :Testing bite force in maxillary anterior

Fig 1:Testing bite force for long term edentulous patient and its results

REPORT

Fig 1:Testing bite force for long term edentulous patient and its results

Report of the patient trial:

Bite force over 46,47 : 82.61 N

Bite force over mobile maxillary anterior with long term mandibular edentulous : 6.8N Bite force of FPD on 11,21,22,23 : 56.3N

Bite force of RPD on 33,34 : 47.8N

ADVANTAGES

• Bite force act as an indicator and functional state of masticatory system. This segmented analysis of bite force helps us to understand the variations in force deliverance over oral cavity.

• Accurate and precise device to record the bite force in each segment of the quadrant economically

• Reduced dimensions of device helps in mobilization to dental camps/clinics/labs

• Improves the therapeutic effect of prosthesis by checking the premature contact areas.
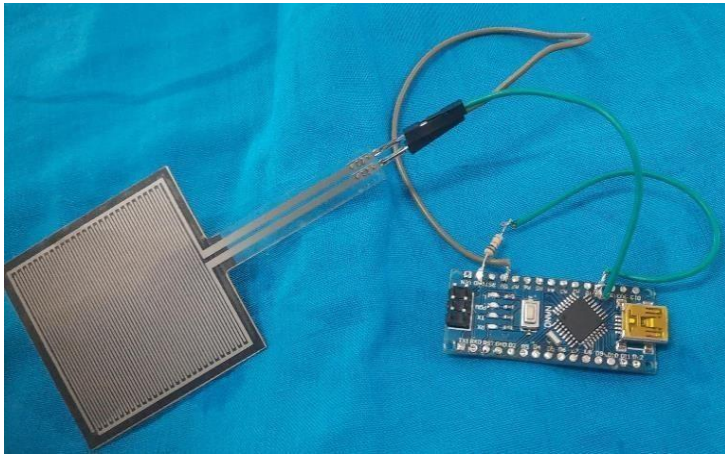
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CONCLUSION

Measuring bite force in clinical scenario will be a reliable method of assessing the force liberated during mastication. With this device we are going to make a study with disparity of bite force with oral rehabilitated individuals on different type of prosthesis and compared it with the natural dentition.

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