Case report

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Device for Assessment of Patient Compliance in Tropical Countries

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Abstract

Patient co-operation is of the utmost importance for successful outcome of removable appliances in Dentistry. Objective measurement of wear time of removable appliances is need of hour. This article highlights the design and application of a low cost electronic timing device suitable for tropical countries like India in application of wear time recording for removable appliances in Dentistry.

Keywords: Wear time; Removable appliances; Sensors in Dentistry; Patient compliance.

INTRODUCTION

Patient compliance is of crucial importance for successful outcomes in orthodontic treatment, especially when removable appliances are used.[1] Different devices have been introduced to measure the objective wear time of removable appliances. More recently developed devices consist of a thermal microsensor that is embedded in the appliances.[2] These microsensors can be embedded into the main construction material of the appliance and identify temperature changes (e.g., from ''room temperature'' to ''mouth temperature''), which are then converted to wear time information.[3] But in the tropical countries where most of the time room temperature is equal or more than mouth temperature, these thermal sensors will give an incorrect result. The increased cost together with reduced reliability and inadequate accuracy in measurements has proved to be a limitation for the use of these thermal microsensors for research or clinical purposes in tropical countries.

We have designed and developed a low cost electronic timing device suitable for tropical countries in application of wear time recording of removable appliances in Dentistry.

Electronic Timing Device Design

Components of design:

- Sensor
- Data Receiver

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SENSOR

This is the part of the device which will sense whether patient is wearing the appliance or not. In order to resolve short coming in the existing thermal sensors as mentioned above, infrared proximity detection is chosen as a method of sensing. It has a footprint of 1 cm x 1.5 cm (Fig. 1a, 1b). This is also equipped with a coin battery of diameter 1.5 cm. Since the set acrylic is hard and translucent we have used the infrared proximity detection sensor embedded inside the acrylic for the sensing purpose. As the patient wears the appliance embedded with the sensor, Infrared (IR) light reflected from the surface of mucosa can be detected and it can thus be used to count the wear time of appliance for the patient.

Fig. 1a: Assembled sensor

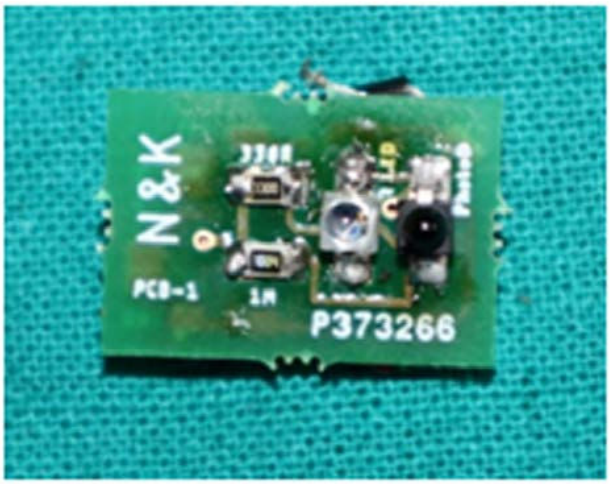

Fig. 1b: Assembled sensor

A minor modification on the working model is made by painting a non-reflective black paint on the palatal surface. The patient is instructed to keep the appliance on the modified working model when not in use. The black paint will absorb the IR radiation from the sensor when it is kept over it, and thus prevents its reflection. Hence the sensor will not count it as wear time.

The sensor is in sleep mode most of the time, and activates every 5 mins and thus this device is accurate in measuring the wear time up to a precision of 5 mins. Compared to the total expected wear time of patient, which is in months; 5 min precision is sufficient to fulfil the device's purpose. Life time of the sensor is around 14 months.

DATA RECEIVER

It is responsible for the detection and display of wear time data obtained from the sensor. It is a one time hardware and can read data from any sensor. The receiver is equipped with a LCD screen along with buzzer which gives an audio cue to the person extracting data from the sensing device. Receiver is also provided with replaceable batteries (Fig. 2a).

Fig. 2a: Receiver with displayed wear time

Procedure

1. Place sensor along with battery on the palatal surface of maxillary cast in appropriate location so that, infrared (IR) LED will come as close as possible to the palatal surface.
2. Add self-curing acrylic on palatal surface along with sensor and battery. Make sure that sensor and battery are completely embedded within the acrylic (Fig. 2b).
3. Once the acrylic is completely set retrieve the plate, and place it near receiver such as IR LED of sensor is in line of sight proximity of receiver. Wait for 5 min after that initial reading will be received.
4. For future appointments after delivery of appliance wear time can be check wirelessly by keeping the appliance with IR LED of sensor in close proximity with receiver (Fig. 2a).

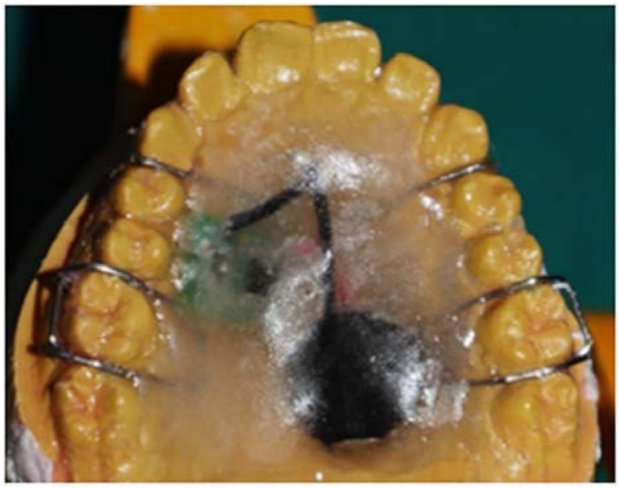

Fig. 2b: Complete acrylisation of maxillary appliance

CASE REPORT

A 13-year-old male presented with a Class II, division 1, sub-division left malocclusion with underlying skeletal Class II base due to mandibular retrognathism. Patient had a 9 mm of overjet, a deep overbite and shift of mandibular midline towards right side by 2 mm (Fig. 3a). Since the patient was in CVMI stage 3, treatment planned for the patient was growth modification using Twin Block appliance.

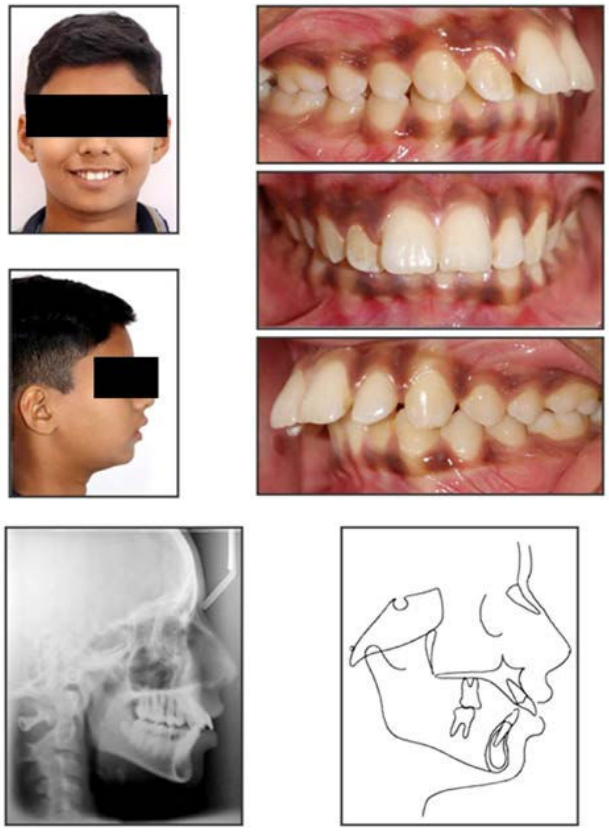

Fig. 3a: 13-year-old male patient with Class II, division 1, subdivision left malocclusion before treatment

Informed consent of the parents was obtained for electronic assessment of wear time. Twin Block appliance was constructed with electronic timing device (sensor) embedded within the acrylic of upper plate to assess the wear time of appliance (Fig. 3b).

Fig. 3b: Patient wearing twin block appliance with electronic timing device embedded within acrylic of upper plate.

First follow-up appointment was approximately one month after the appliance fitting. Patient compliance was evaluated as appliance electronic wear time documentation. Patient wore appliance for a median of 12 hours per day, compared with the 20 to 22 hours per day prescribed. On that appointment, patient was made aware and demonstrated the electronic assessment of his wear time. Following that, the planned visit frequency was every 1 month and at each visit, changes in the occlusion and wear time recording by the sensor were checked. Patient compliance had improved as the median wear time increased to 18 hours per day and thus, awareness of wear time monitoring appeared to boost compliance.

During, eight months of active Twin Block treatment, a class I molar and canine relationship was accomplished, overjet reduced to 4 mm along with deep overbite and midline corrections achieved (Fig. 3c).

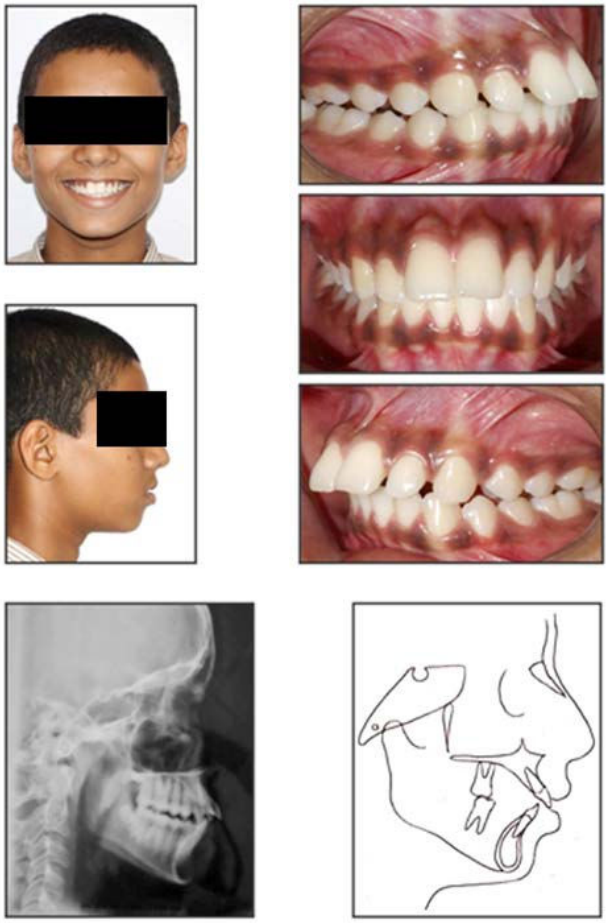

Fig. 3c: Patient after eight months of treatment with twin block, prior to treatment with fixed appliance

CONCLUSION

Assessment of wear time with electronic timing device has following advantages:

1. Wear time documentation of removable acrylic appliances in all regions irrespective of surrounding temperature.
2. Ease of fabrication.
3. Low cost.
4. Evidence in case of relapse of fixed orthodontic treatment by embedding sensor within removable retainers.

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