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Review Article

Smart Retainers in Orthodontics

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Abstract

Orthodontists often observe discrepancy between what a affected person reports about retainer wear and what a medical examination shows. Retention is the maximum vital issue of treatment frequently omitted through the patients. The orthodontists normally do not have a whole lot of choices but to blindly agree with the patients. For that reason, this takes up a large toss on the treatment consequences. The orthodontic remedy normally takes up 2-three years for the completion. So this 2 years of treatment will move down the drain given that the retention protocols are accompanied rightly. This is how smart retainers have come into picture. The device is intended to permit a dentist to screen the quantity of time a patient wears his retainer by means of using an electronic device that itself fits into retainer.

Keywords: Smart Retainers; Retention; Orthodontist

Introduction

In the controversial book Straighter: The Rules of Orthodontics by Drs. Ben Burris and Marc Ackerman, Ackerman writes, "Orthodontic retention is imperfect and how you deal with relapse is a critical practice management decision." According to Ackerman, showing unhappy patients with relapse their signed consent form and then charging them for re-treatment is practice reputation problem. Without retention, there is a tendency for the teeth to return to their initial position [1]. This unfavorable change from the corrected position is known as relapse. The causes of relapse are not fully understood, but are felt to relate to recoil of the fibres that hold the teeth in the jaw bone; pressures from the lips, cheeks and tongue; further growth and the way the teeth meet together (Melrose 1998) [4]. Reorganization of the periodontal ligament occurs over 3 to 4 months after active appliance removal [5]. Reorganization of the collagenous and elastic fibers in the gingiva occurs more slowly [6]. Though the need for retention is well understood, there is disagreement among orthodontists about the most appropriate and effective retention protocols [1]. In practice, most orthodontists develop their own retention protocol that is based either on what they were taught in residency or on what they have seen clinically after some years of practice [3].

Multistranded bonded retainers have a relatively high failure rate. Approximately 20% of mandibular and 50% of maxillary-bonded retainers fail within five years. Furthermore, a longer-span retainer has a higher incidence of failure. This is particularly true for maxillary retainers that extend to the canines and mandibular retainers that extend to the premolars. If you choose to place bonded retainers, they should be accompanied by removable overlays-the orthodontic equivalent of wearing both a belt and suspenders [1]. Then comes understanding the limitations of bonded retainers. Even if the retainer does not fail, relapse can still occur in the absence of a removable overlay. For example, spacing can appear if the bonded retainer stretches, unwanted torque can be expressed on the teeth that are bonded to the wire, and anterior teeth can extrude en masse, causing the overbite to return. Always remember that bonded retainers serve as backup to removable retainers rather than as their replacement. Along with that the chances of gingival accumulation is also more [1,20].

Although the removable retainers may be broken or lost, the question of patient compliance cannot be ignored.

The wishes and expectations of young patients regarding wear-time prescriptions differ from the requirements of effective treatment on a few points. Wide discrepancies between wear-time instructions and patient wishes reduce compliance, thus making therapeutic success difficult to achieve. Removable appliances with an integrated wear-time sensor certainly may provide an objective measure of wear times, thus probably enhancing the justification for and acceptance of wear-time instructions [2].

The idea of measuring compliance in appliance wear originated approximately 40 years ago [10]. Due to their bulkiness as well as their complexity, the original recorders aimed at measuring the time of appliance wear did not survive for long [9-11].

The Smart Retainer environmental micro sensor allows the clinical orthodontist to collect tangible data about removable appliance usage and eliminates the inconsistencies of patient-reported data [3].

It thus becomes possible to investigate fundamental, long-discussed scientific questions in orthodontics on the basis of precisely measured data, or critically examine prevailing therapeutic opinion [7].

Literature Review/Discussion

How are they available?

Presently, the literature indicates that two new sensors, the SMART14 and the TheraMon15 microsensors, may be able to record aspects of compliance in orthodontic patients.

The manufacturers of both microsensors state that their recorders monitor the oral environment through temperature, store the data in an encrypted form, and then allow a provider to upload the information wirelessly into a computer for further analysis. Only one

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Figure 1:

Figure 2:

clinical study focused on the SMART microsensor9 while three studies reported on findings obtained with the TheraMon Sensor [16-18]. Ackerman and Thornton9 used the SMART microsensor in a short-term randomized clinical trial that compared a group that was aware of the microsensor with one that was blinded to it. They concluded that the aware group wore the retainer on average 2.3 hours per day more than the unaware group [8]. There have been mention about WEEDROP retainers in the literature, which is discussed further.

How does it work?

SMART14: The slightly larger dimensions (diameter 14 mm, height 4 mm) and round shape [7].

By noting temperature changes, it determines the wear time of removable orthodontic appliances and is now on the market under the name Smart Retainer® [7]. It comes with a tongue pressure sensor and a temperature sensor inbuilt, which helps monitoring the trend of usage of the retainer. The data can be read by placing it over a wireless reader [19] (Figure 1).

The Smart Retainer environmental microsensor automatically and at preset intervals monitors the oral environment around it, and either stores the data or a heuristic decision about the data in an encrypted form. This information is later used by software in the orthodontist's office to determine retainer wear frequency and duration. When an orthodontist or a staff member places a retainer with an integrated Smart Retainer environmental microsensor onto the proprietary USB-powered Smart Reader, within a few seconds, a wireless communication link is established, and all information recorded since the last read session is automatically downloaded, decrypted, further analyzed by using proprietary algorithms for trends and use patterns, and presented to the user in easy-to understand charts. The orthodontist can in turn discuss actual retainer usage *vs*

Figure 3:

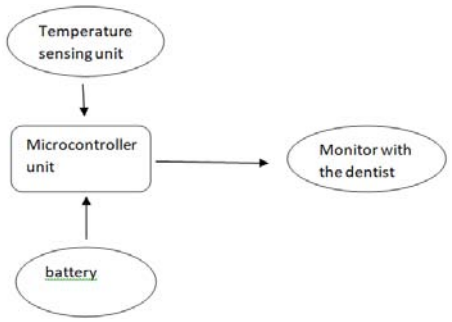

Figure 4:

prescribed retainer usage with the patient and the parent and make data-driven recommendations about future retention [3].

THORNTON9: This analog wear-time sensor was developed around the same time in Austria and is due for release on the market at the end of 2010 under the brand name TheraMon® [7].

They are rectangular TheraMon® sensor (12 mm × 8 mm × 2 mm) [7]. The TheraMon® sensor thus demonstrates markedly better concordance between the programmed water temperature and registered "wear time". Unlike the Smart Retainer®, the TheraMon® program also dates the daily wear times. This would make documenting patient records easier. Incorporation of the smaller TheraMon® sensors should not cause any loss of wearing comfort with the most frequently used orthodontic appliances, such as expansion plates, activators, and retention appliances unlike the smart retainers [8] (Figure 2).

The entry price for a supply of five Smart Retainer® sensors, including the readout device, is currently approx. $1000. The TheraMon® sensor will be supplied at a unit price of €20 to €30, while the readout device can only be leased for an annual fee of €250 [7]. The TheraMon® sensor's temperature measuring program takes the small fluctuations in temperature into account that may be expected to occur in a patient's oral cavity [7]. The TheraMon has greater versatility and more accurate recordings of wear time down to the minute than the SMART microsensor [8]. However, that both micro sensors could be used as objective wear-time sensors in orthodontic appliances [8].

WEEDROP: Weedrop is one of the most popular commercial miniature temperature data logger. This ultra-miniature temperature data logger weighs in just under 1.15 grams. It is encased in a high grade Transparent FDA approved silicone housing that won't harm

the animal. It comes with an EEPROM memory where the data is kept safe even after the battery has provided all its energy for the mission. For better precision, the Wee Drop can be calibrated for Cold blooded applications (0 to 40˚C), or for warm blooded applications (30-50˚C) [19] (Figure 3).

Basic Design of a Retainer

Aadarsh et al in his study have come up with a block diagram for the sensors in patient mouth and the monitor used by the dentist.

The LM35 sensor was chosen for the experimentation of proof of concept [19].

The Attiny85 is a microcontroller unit with small form factor and less power consumption during sleep cycles [19].

The battery to be used could be a thin film battery which could be flexible or high efficiency button cells [19] (Figure 4).

Pros and Cons

Several concepts of varying practicality for determining the wear times of a wide variety of orthodontic appliances have been proposed, based on electrical [9,12-14] or microelectronic measuring systems [15-20]. Initial wear-time measurements with these devices showed that even when they functioned perfectly from a technical perspective, they had to meet additional requirements in order to be used in routine orthodontic practice: they must be safe (a prerequisite of the highest priority), affordable and easy to use (the amount of work involved in integrating, read-outs and monitoring must be reasonable, as must the sensors' unit price) [7].

It becomes possible to investigate fundamental, long-discussed scientific questions in orthodontics on the basis of precisely measured data, or critically examine prevailing therapeutic opinion. However, the possibility of objectively documenting patient compliance could cause negative and positive changes in the patient-doctor relationship [7].

Conclusion

SMART retainer will revolutionize compliance in orthodontic retention. Although the smart retainers provide an effective way to track patient compliance, more research has to be undertaken in the technological aspect making it more cost effective for the patients. Measures taken in the right aspect would make it a state of art technology addressing one of our profession's biggest problems.

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