European Journal of Orthodontics 26 (2004) 289–291

European Journal of Orthodontics vol. 26 no. 3

The role of the headgear timer in extraoral co-operation

Cenk Doruk, Uğur Ağar and Hasan Babacan
Department of Orthodontics, Faculty of Dentistry, Cumhuriyet University, Sivas, Turkey

SUMMARY The aim of this research was to study headgear co-operation using an objective measuring instrument, the Compliance Science System (CSS). Forty-six patients were included in the investigation, 32 girls and 14 boys (10–15 years of age; mean 13 years). The patients, who were not informed that they were being monitored, were instructed to wear the headgear, with an electronic module timer attached to the neckstrap, for 16 hours per day. At the end of 2 months (T_1), the time for which the headgear was worn was measured. At this stage the patients were divided into two groups: group 1 (unco-operative patients) who wore the headgear for less than 16 hours per day, and group 2 (co-operative patients) who wore the headgear for at least 16 hours per day. Only the unco-operative patients were informed that they had been monitored, and a subsequent 4 month treatment period was initiated for both groups. The time was also measured at the end of the second (T_2) and third (T_3) 2 month treatment periods.

The unco-operative patients increased their use of the headgear to approximately 4.5 to 6 hours per day ($P < 0.05$). All of the co-operative patients also used their headgear as recommended during the 4 month period.

Introduction

Headgear was first used in the early 1800s (Graber and Swain, 1975) and while modifications have been made, basically the appliance has changed very little (Cureton *et al.*, 1993a). Headgear is an essential part of orthodontic therapy, and a lack of co-operation can reduce the effectiveness of the best treatment plan and the most promising treatment mechanics (Allan and Hodgson, 1968; Weiss and Eiser, 1977). Many clinicians have studied the characteristics that predict and may increase co-operation. Allan and Hodgson (1968) used standardized personality measurements in 30 subjects and found that the younger patients tended to be more co-operative. Similarly, Weiss and Eiser (1977) studied the psychological timing of orthodontic treatment in 274 patients and concluded that those aged 12 years and younger were more co-operative than older patients. Starnbach and Kaplan (1975) investigated the demographic factors associated with co-operative patients and found that females from moderate to lower socio-economic groups were compliant patients. El-Mangoury (1981), in a study using psychological tests on 70 orthodontic patients to monitor orthodontic co-operation, concluded that affiliation motivation seemed to contribute the most in the prediction of headgear wear, elastic wear, appliance maintenance, unbroken appointments, and punctuality in appointments. However, Nanda and Kieri (1992) found that orthodontic co-operation was not predictable using psychological testing, but the doctor–patient relationship had a positive impact on the co-operative behaviour of patients.

Determining headgear compliance with headgear timers has been used by a number of authors. Northcutt (1974) used a headgear timer made from a miniature electronic watch with a memory circuit, and found that the patients increased the number of hours the headgear was worn from 35–50 hours per week to 100 hours per week when they were informed that they had been monitored. Similarly, Güray and Orhan (1997) studied 10 patients using a Selcuk-type headgear timer. The patients were instructed to wear their extraoral appliances for 16 hours per day and after a 2 month period they were introduced to the timing mechanism and a subsequent 2 month treatment period was initiated. At the end of the second period they reported that the patients had increased their use of the headgear by approximately 26 per cent. Clemmer and Hayes (1979) studied headgear co-operation in 20 patients with an Aledyne timer and found that younger patients reported more hours. Cureton *et al.* (1993a) compared the subjective evaluation performed by experienced orthodontists, assistants and graduate students with the evaluation of a headgear timer and found that the patients used their headgear for only half of the prescribed time. In a further study, Cureton *et al.* (1993b) used headgear timers to monitor 28 patients: 14 subjects used a headgear calendar to evaluate the number of hours of daily use and 14 patients were not monitored. The results showed that the subjects monitored daily were more inclined to wear their headgear. Cole (2002) studied the accuracy of patient reporting as an indication of headgear compliance using electronic timing headgear in 20 subjects and found that one-third of the subjects were significantly inaccurate in reporting headgear use.

The aim of this investigation was to study headgear co-operation using an objective measuring instrument, the Compliance Science System (CSS).

Subjects and methods

Forty-six patients (32 girls, 14 boys), 10–15 years of age (mean 13 years) with an Angle Class II division 1 malocclusion comprised the study sample. They were derived from a cohort of 60 subjects from which 14 had to be excluded because of incomplete records. The treatment plan aimed to correct the malocclusion using cervical-pull headgear. An electronic module timer, which is part of the CSS (Ortho Kinetics Corporation, Vista, California, USA), was attached to the neckstrap to evaluate the number of hours the patients wore the headgear.

The reader of the module timer is connected to a computer and software that reads the information gathered by the module (Figure 1). Communication between the reader and the module is made through an infrared beam. The hardware requirements to install the CSS are: a 486 PC or higher, 8 Mbyte RAM, a hard disk with 10 Mbyte available, one available unassigned serial communication port and a mouse. The headgear module (affirm module) has three principal components: (1) a microprocessor that systematically measures the use of the appliance, (2) a quartz crystal that measures the time, and (3) an optical switch that reads the status of the headgear neckstrap. When the neckstrap is pulled, the optical switch is on and when the neckstrap returns to the original position it is switched off.

The patients were instructed to wear the headgear appliance for 16 hours per day, but were not told that the usage time was being measured. After a 2 month period the wearing time was measured (T_1). At this stage the patients were divided into two groups: group 1 (unco-operative patients) who wore the headgear for less than 16 hours per day, and group 2 (co-operative patients) who wore the headgear for at least 16 hours per day. The unco-operative patients were informed about the CSS, and a subsequent 4 month treatment period was initiated for both groups. The wearing time was re-measured at the end of the second (T_2) and third (T_3) 2 month treatment periods. The co-operative patients were informed at the end of treatment that they had been monitored, the purpose of the study was explained and their informed consent was obtained retrospectively.

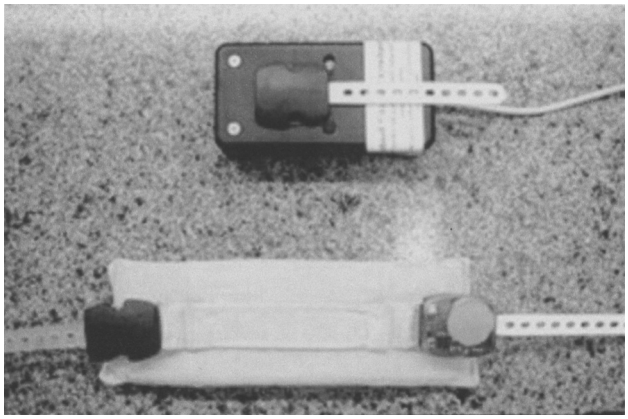

Figure 1 The components of the Compliance Science System.

Statistical analysis

The Statistical Package for the Social Sciences 9.05 (SPSS, Chicago, Illinois, USA) was used to analyse the results.

The mean values of groups 1 and 2 were comparable at baseline (Table 1). Repeated measurements of variance analyses, the Tukey test, and the Mann–Whitney *U*-test were performed. A *P* value of less than 0.05 was used to assign statistical significance for all tests.

Results

The modules were read following 2 months of headgear wear. Twenty-five patients were found not to have worn their headgear as recommended. At the end of the second 2 month period, when the modules were again read, it was found that the unco-operative patients had increased their use of the headgear from 9.53 to 13.97 hours per day ($P < 0.05$), approximately 4.5 hours more per day after they were introduced to the CSS. Eighty per cent of the unco-operative patients had increased their use of the headgear, with 40 per cent achieving the daily goal of 16 hours. At the end of the third 2 month period, the unco-operative patients had increased their use of the headgear to 15.42 hours per day ($P < 0.05$), a total of approximately 6 hours per day. Eighty-eight per cent of the unco-operative patients had increased their use of the headgear, while 52 per cent had achieved the daily goal of 16 hours. There were statistically significant differences between T_1–T_2 and T_1–T_3 values for the unco-operative patients ($P < 0.05$). However, the difference between T_2 and T_3 was not significant ($P > 0.05$). All of the co-operative patients used their headgear as recommended in both the second and the third 2 month periods. When the values for group 2 were compared, no

Table 1 The results of the statistical analysis of co-operative and unco-operative patients (mean ± standard error; hours/day).

	Group 1	Group 2	
T_1	9.53 ± 0.89	18.41 ± 0.36	$P = 0.001$*
T_2	13.97 ± 0.95	18.94 ± 0.48	$P = 0.001$*
T_3	15.42 ± 0.97	18.25 ± 0.44	$P = 0.040$*
	$F = 26.08$*	$F = 0.10$	

*$P < 0.05$.

statistical significance was found ($P > 0.05$). Significant differences were observed in the use of headgear between co-operative and unco-operative patients when the values of the first, second, and third 2 month periods were analysed ($P < 0.05$).

Discussion

Co-operation has been studied by a number of authors. Some have used conventional measuring instruments to indicate headgear co-operation, such as (1) molar mobility, (2) cleanliness of headgear tubes and headgear strap, (3) ease of placement by patient, (4) space creation between teeth, (5) molar positioning comparing pre-treatment models and/or cephalograms, and (6) anchorage maintenance. However, the subjectivity in the design of the measuring instruments makes it difficult to predict patient co-operation (Allan and Hodgson, 1968; Starnbach and Kaplan, 1975; Weiss and Eiser, 1977; El-Mangoury, 1981; Nanda and Kieri, 1992). Although headgear timers have been used by some authors, Banks and Reid (1987) reported that only four of the 13 timing devices produced mean timing accuracy values exceeding 90 per cent. Nowadays, with the use of microelectronics, objective methods are available to measure the level of patient co-operation in wearing headgear appliances. The CSS, which was used in the present study, has been tested under laboratory conditions, compared with real time, and accuracy found to be absolute (100 per cent).

The co-operative patients used their headgear as recommended throughout the 6 month treatment period, indicating that subjects who are co-operative at the beginning of treatment tend to be consistently co-operative throughout (Slakter *et al.*, 1980; Woolass *et al.*, 1988).

Eighty per cent of the unco-operative patients improved their use of the headgear after they were informed of the monitoring process. This is in agreement with previous reports (Northcutt, 1974; Cureton *et al.*, 1993b; Güray and Orhan, 1997). Forty per cent of the unco-operative patients achieved the daily goal in the second 2 month period and maintained this in the third 2 month period. Co-operation could only be monitored for a period of 6 months due to limited battery life. A longer evaluation period may have produced different results.

Conclusion

Monitoring of unco-operative patients with a headgear timer is an effective procedure to increase wearing time. Co-operative patients tend to use their headgear as recommended throughout the treatment period.

Address for correspondence

Dr Cenk Doruk
Cumhuriyet Üniversitesi
Dişhekimliği Fakültesi
Ortodonti AD
Sivas 58140
Turkey

Acknowledgements

We would like to thank to Ziynet Çınar, Department of Biostatistics, Faculty of Medicine, for assistance in analysing the data.

References

Allan T K, Hodgson E W 1968 The use of personality measurements as a determinant of patient co-operation in an orthodontic practice. American Journal of Orthodontics 54: 433–440

Banks P A, Reid M J F 1987 An investigation into the reliability of the timing headgear. British Journal of Orthodontics 14: 263–267

Clemmer E J, Hayes E W 1979 Patient co-operation in wearing orthodontic headgear. American Journal of Orthodontics 75: 517–524

Cole W A 2002 Accuracy of patient reporting as an indication of headgear compliance. American Journal of Orthodontics and Dentofacial Orthopedics 121: 419–423

Cureton S L, Regenitter F J, Yancey J M 1993a Clinical versus quantitative assessment of headgear compliance. American Journal of Orthodontics and Dentofacial Orthopedics 104: 277–284

Cureton S L, Regenitter F J, Yancey J M 1993b The role of the headgear calendar in headgear compliance. American Journal of Orthodontics and Dentofacial Orthopedics 104: 387–394

El-Mangoury N H 1981 Orthodontic cooperation. American Journal of Orthodontics 80: 604–622

Graber T M, Swain B F 1975 Current orthodontic concepts and techniques, 2nd edn. C V Mosby, St. Louis, pp. 365–452

Güray E, Orhan M 1997 Selçuk type headgear timer (STHT). American Journal of Orthodontics and Dentofacial Orthopedics 111: 87–92

Nanda R S, Kieri M J 1992 Prediction of co-operation in orthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics 102: 15–21

Northcutt M E 1974 The timing headgear. Journal of Clinical Orthodontics 8: 321–324

Slakter M J, Albino J E, Fox R N, Lewis E A 1980 Reliability and stability of the orthodontic patient co-operation scale. American Journal of Orthodontics 78: 559–563

Starnbach H K, Kaplan A 1975 Profile of an excellent orthodontic patient. Angle Orthodontist 45: 141–145

Weiss J, Eiser H M 1977 Psychological timing of orthodontic treatment. American Journal of Orthodontics 72: 198–204

Woolass K F, Shaw W C, Viader P H, Lewis A S 1988 The prediction of patient co-operation in orthodontic treatment. European Journal of Orthodontics 10: 235–243