

# Quantification of patient compliance with Hawley retainers and removable functional appliances during the retention phase

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**Introduction:** The success of retention with removable retainers is highly dependent on efficient patient compliance. The aim of this study was to quantify patient compliance with removable retainers using microelectronic wear-time documentation during the retention phase. **Methods:** One hundred patients, between 13 and 20 years of age, were retained with removable Hawley retainers and functional appliance retainers after successful multi-bracket treatment at the University Hospital of Tübingen, Germany, and in 4 private practices in Germany. Microsensors were incorporated into the orthodontic retainers by polymerization, and daily wear time was documented in 15-minute intervals during the retention phase for up to 15 months. Patient compliance was quantified with wear-time documentation. Additionally, the influences of age, sex, place of treatment, device type, and health insurance status on compliance were determined and statistically evaluated. **Results:** Most study participants complied with the prescribed wear time of 8 hours or more per day. Combined patient data indicated a median wear time of 7.0 hours per day over the evaluation period. Wear-time documentation showed either regular or irregular patterns of compliance. Initial compliance did not usually alter over the retention phase. Compliance was not influenced by device type, but age, sex, place of treatment, and insurance status produced changes in the median wear time of up to 50%. **Conclusions:** Electronic wear-time documentation of patients' compliance is an easily comprehensible measurement that allows orthodontists to examine the patient's contribution to the success of retention and personalize treatment accordingly. Place of treatment and health insurance status are more closely associated with compliance than are basic patient demographics. (*Am J Orthod Dentofacial Orthop* 2013;144:533-40)

The aim of orthodontic retention is to stabilize the position of the teeth after orthodontic treatment in optimal esthetic and functional positions.<sup>1</sup> In the retention phase, the final alignment of the dentition is maintained because the associated soft tissues

remodel at a rate above the baseline,<sup>2</sup> and the remodeling process varies among different tissue types.<sup>3</sup> Various methods of retention are applied<sup>4,5</sup>; the main types are the removable Hawley, vacuum-formed, and fixed retainers in the United States.<sup>6</sup> In 2010, Hawley retainers were the most commonly used, as reported by active members of the American Association of Orthodontists.<sup>7</sup> However, their success is related to patients' compliance. Lack of compliance can destroy the best treatment planning and the most promising treatment strategy.

The use of removable retainers means the responsibility for retention lies with the patient. Compliance with removable retainer usage is out of the control of the orthodontist. This can lead to frustration for both practitioners and patients.<sup>8</sup> Opinions vary about how many hours the removable retainers should be worn per day.<sup>9</sup> It has been reported that more than 50% of patients admitted that they did not wear their retainers as instructed; the most common reasons were discomfort and forgetfulness.<sup>10</sup> There are wide variations in the retention regimen used by orthodontists, varying from

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immediate night-only wear of retainers to 3 to 6 months of full-time wear followed by night-only wear. Hawley retainers worn only at night were shown to be equally effective at reducing relapse as were the same retainers worn full time for 6 months and only nightly thereafter.<sup>11</sup>

The results of previously published studies about wear time and compliance were based only on self-reporting of compliance with questionnaires and not objective experimentally determined wear times.<sup>12,13</sup> In practice, most orthodontists develop their own retention protocol based on either what they were taught in residency or their clinical experience. With no method of objectively determining whether patients follow the prescribed wear time, orthodontists cannot assess whether unsatisfactory changes in tooth position are caused by poor compliance or by an ineffective retainer.

New technologies for the objective measurement of wear time using microsensors incorporated into removable retainers now make experimental quantification of patient compliance possible.<sup>14,15</sup> Wear-time measurement and documentation can be performed simply and routinely by staff in an orthodontic office.<sup>16,17</sup> The overarching purposes of this study were to quantify removable retainer compliance during the first retention phase and to evaluate the potential association of compliance with several demographic, clinical, and social variables such as age, sex, retainer type, place of treatment, and type of health insurance. A further aim was to determine how much patient compliance can realistically be expected during treatment with removable retainers.

## MATERIAL AND METHODS

One hundred patients (52 male, 48 female) recruited between January 2011 and June 2012 participated in the study, based on the following inclusion criteria: age between 13 and 20 years, no syndromic illnesses, completed active orthodontic treatment with an indication for use of a removable retainer with a microsensor completely incorporated by polymerization, wear time of 3 or more months after the introduction of the device, and checkup appointments at least every 100 days. The mean patient age at the start of treatment was 15.46 years (range, 13-20 years). Wear-time documentation and follow-up were variable, depending on when the patients were recruited to the study; however, all patients had at least 90 days of wear-time documentation. Representative compliance measured by the wearing times of 15 randomly selected patients with different periods of long-duration therapy are documented in

**Table I.** Fifteen randomly selected subjects demonstrate the different monthly wear times during treatment with removable retainers

Patient Subject	Sex	Age (y)	Treatment months			
			1-3	4-6	7-9	10-12
47	F	18.1	9.0	9.2	9.0	9.2
33	F	15.3	5.9	6.9	8.1	
17	F	18.1	7.7	8.3	9.0	9.2
75	M	15.7	2.6	4.4		
80	M	16.1	3.2	4.0		
65	M	15.7	2.1	2.6		
25	M	16.7	11.2	10.8		
43	M	17.5	12.1	11.8		
36	F	14.9	4.0	7.0	5.8	5.1
11	M	14.5	6.7	8.6	7.2	8.1
18	F	18.2	8.5	8.2	6.5	6.7
41	F	15.2	9.0	9.1	9.8	
7	F	13.2	9.0	9.4	10.0	9.1
13	M	13.5	8.7	9.7	9.2	9.1
31	M	13.6	8.7	10.0	10.1	8.4

F, Female; M, male.

**Table I.** Twenty-six patients were treated at the Department of Orthodontics at the University Hospital of Tübingen, and 74 patients were treated in independent specialist practices in Germany. There were no significant differences in age and sex of the patient groups from the different locations. However, the health insurance status was different among the patients. Statutory health insurance in Germany through sickness funds is compulsory for workers whose gross income does not exceed a certain threshold, for unemployed persons, and for certain other population groups. Employees with incomes above the threshold can opt into a voluntary sickness fund (private health insurance), which is more expensive but offers additional benefits. About 88% of the subjects were covered by the statutory health insurance (74% obligatory, 14% voluntarily).<sup>18</sup> No patient was excluded from the study during the treatment period. Written patient consent and that of the parent or legal guardian when necessary was obtained for the incorporation of the wear-time sensor and subsequent data evaluation. The study was approved by the ethics commission of the University of Tübingen (project number 339/2012B01). The influences of the following parameters on wear times were evaluated: age, sex, type of retention device (Hawley retainer or functional appliance retainer), place of treatment (university hospital or private orthodontic practice), and health insurance status (statutory health insurance or private health insurance).

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