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Functional and social discomfort during orthodontic treatment—effects on compliance and prediction of patients' adaptation by personality variables

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SUMMARY During the course of treatment orthodontic patients frequently endure a number of functional complaints and are anxious about their appearance. The aims of this longitudinal study were to follow the progress of patients' adaptation to discomfort, to elucidate the putative relationship between the type of appliance worn and functional and social discomfort experienced, to study potential predictability by their attitude to treatment and to evaluate the effects of discomfort as predictors of patients' compliance.

Eighty-four patients undergoing either removable, functional, or fixed appliance treatment monitored their complaints during the first 7 days of treatment and rated them retrospectively 14 days, and 3 and 6 months after appliance insertion. The most frequent complaints were impaired speech, impaired swallowing, feeling of oral constraint and lack of confidence in public. A significant reduction in the number of complaints was observed between 2 and 7 days after insertion of the appliance. No further differences were revealed after longer periods of appliance wear. The type of appliance had an effect on impaired speech and swallowing. Patients' expectations of favourable treatment performance and appreciation of dental aesthetics were predictive of reported feeling of oral constraint and lack of confidence in public. There was a relationship between the complaints and acceptance of the appliance, as well as between lack of confidence in public and compliance with treatment.

The results of this study highlight the importance of patients' attitudes to treatment and of functional and social discomfort associated with appliance wear for the theory and practice of the management of orthodontic patients, and the necessity for early intervention by clinicians.

Introduction

For more efficient clinical management of orthodontic patients, it is desirable to clarify factors that would predict their behaviour and compliance during subsequent treatment. Such factors include general personality variables and specific attitudes to orthodontics (Herren *et al*., 1965; Lewis and Brown, 1973; Gosney, 1985; Oliver and Knappman, 1985; Woolass *et al*., 1988; Nanda and Kierl, 1992; Sergl *et al*., 1992; Zentner *et al*., 1996). It is also recognized that insertion of a new orthodontic appliance may diminish cooperation by causing considerable discomfort, such as unpleasant tactile sensations, feeling of constraint in the oral cavity, stretching of the soft tissues, pressure on the mucosa, displacement of the tongue, soreness of the teeth, and pain (Oliver and Knappman, 1985; Sergl *et al*., 1987, 1993; Egolf *et al*., 1990; Johnson *et al*., 1998; Sergl and Zentner, 1998). The amount of initial pain and discomfort experienced may predict acceptance of the appliance and treatment in general (Egolf *et al*., 1990; Sergl *et al*., 1998). Patients' self-confidence might be affected by speech impairment and visibility of the appliance, especially during social interactions when attention is focused on the face, eyes and mouth (Lewis and Brown, 1973; Zentner *et al*., 1996). It is noteworthy that those adolescent patients whose motivation for orthodontic treatment is

guided primarily by perception of their own appearance, during treatment feel even more being the centre of attention of peers and acquaintances (Albino and Tedesco, 1991).

It would be desirable to predict the level of compliance for each individual patient at the treatment planning stage, especially as those 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). Currently, however, this is not feasible because reliable predictors are lacking (Woolass *et al*., 1988). It has been shown recently (Mehra *et al*., 1998; Sergl *et al*., 1998) that some personal characteristics, which are recognized as important motivators for seeking orthodontic treatment (Albino *et al*., 1981; Fox *et al*., 1982; Albino and Tedesco, 1991), might also serve as predictors for pain experienced during orthodontics and influence compliance. These include high self-esteem, self-confidence, obedience, expectations of self-efficacy and treatment outcome, appreciation of dental aesthetics, perceived severity of malocclusion, and attitudes characteristic of oral health internal control orientation.

The purpose of this study was to investigate any potential links between patients' attitudes, which might be relevant to health behaviour, and the amount of functional and social discomfort experienced during the wearing of an orthodontic appliance. Predictive variables of relevance to health behaviour tested were perceived severity of malocclusion, value of dental aesthetics, expected ability to wear appliances, and expectations regarding the outcome of oral health behaviour. It was also intended to characterize patients' acceptance of the appliance and of treatment as subjective aspects of patient compliance.

Subjects and methods

Eighty-four patients (39 males, 45 females, mean age 12.8 ± 4.1 years) were recruited for the study. Twenty-five of these patients were provided with one active upper removable appliance, 31 with active upper and lower removable appliances simultaneously, 14 received functional appliances, and the other 14 full bonded fixed appliances. These patients were derived from an original cohort of 99 subjects from whom 15 had to be excluded because of incomplete records. After appliance insertion the subjects were instructed to keep a daily protocol of functional and social discomfort by marking the intensity of 13 complaints. This diary was kept for 7 days, starting on the day of the orthodontic visit. Examples of entries included: 'my brace makes it difficult to speak, … swallow, … breathe; … makes my mouth feel constrained' or 'I don't like wearing my brace in public'. The intensities were marked on a four-grade scale including 'not at all applicable', 'a little applicable', 'strongly applicable' and 'very strongly applicable'. These protocols were collected 14 days later. The same list of complaint-related entries written in the past tense was presented to subjects for a retrospective evaluation of discomfort 14 days, and 3 and 6 months after appliance insertion.

Patients' attitude to orthodontic treatment and their co-operation were evaluated at the appointment before insertion of the appliance using a questionnaire which contained modified rating scales on perceived severity of malocclusion, expectations from treatment, value of dental aesthetics, dental health locus of control, acceptance of the appliance, and acceptance of treatment as described in detail elsewhere (Sergl *et al*., 1998). At the 6-month appointment, patients' co-operation during the entire period was retrospectively rated by their clinicians using the 'Orthodontic Patient Co-operation Scale' (Slakter *et al*., 1980).

Adaptation to orthodontic appliances over the time course of the study was assessed using the scale values obtained from the functional and social discomfort diaries. The influence of appliance type on perceived discomfort was evaluated by comparing discomfort reported in the protocols of patients wearing different types of appliances. Putative relationships between patients' attitude to treatment and the intensity of discomfort perceived was tested by calculating correlations between patients' attitudes before appliance insertion as evaluated by means of the above rating scales, and the intensity of complaints recorded in the protocols. The effects of functional and social discomfort perceived

during treatment on patients' compliance was examined by calculating correlations between the intensity of complaints reported in the protocols and acceptance of the appliance and treatment in general as rated by the test subjects, and compliance as assessed by their clinicians. Statistical tests and calculations of correlations were carried out using the statistical package SAS, release 6.11 (SAS Institute, Cary, NC, USA).

Results

On day 1 after appliance insertion 81.9 per cent of the subjects complained of impaired speech, 54.1 of impaired swallowing, 10.8 reported difficulties with breathing, and 61.4 lack of confidence in public. As the incidence of impaired breathing was very low it was excluded from the further analysis for statistical reasons. Figures 1–4 show the changes in perception of functional (impaired speech and swallowing, feeling of oral constraint) and social (lack of confidence in public) discomfort reported for each type of appliance in the daily protocols over the period of 1–7 days, and from the retrospective assessment carried out 14 days, and 3 and 6 months after appliance insertion. The results depicted in Figures 1–4 indicate an occurrence of a generalized mild decline in the intensity of complaints over the short-term course of 7 days, whilst no clear trend is evident over the longer period.

These changes were subjected to statistical testing using the Wilcoxon test for dependent samples on pooled intensities of each individual complaint on each individual day without referring to the appliance type (Tables 1 and 2). The intensities of each day were tested against the corresponding intensity of the first day, except for the complaint 'feeling of oral constraint', for which the second day was chosen as the reference value because the mean intensity

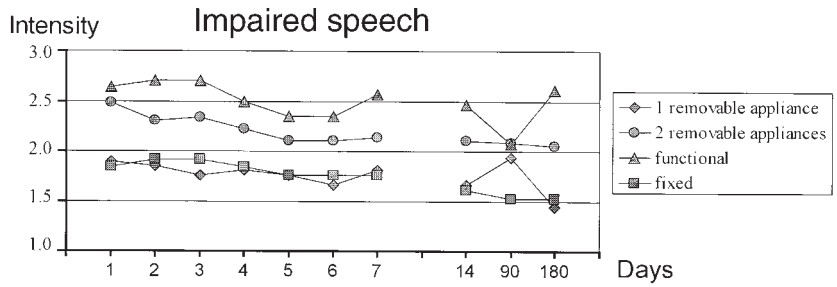

Figure 1 Intensity of the complaint 'impaired speech' reported for individual appliances in self-monitoring daily protocols for the first 7 days, and in retrospective evaluation carried out 14, 90, and 180 days after appliance insertion.

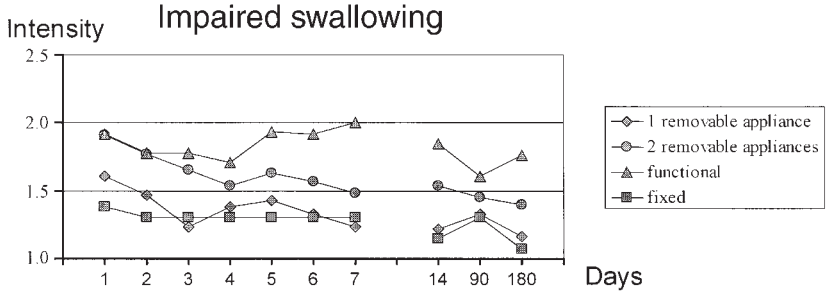

Figure 2 Intensity of the complaint 'impaired swallowing' reported for individual appliances in self-monitoring daily protocols for the first 7 days, and in retrospective evaluation carried out 14, 90, and 180 days after appliance insertion.

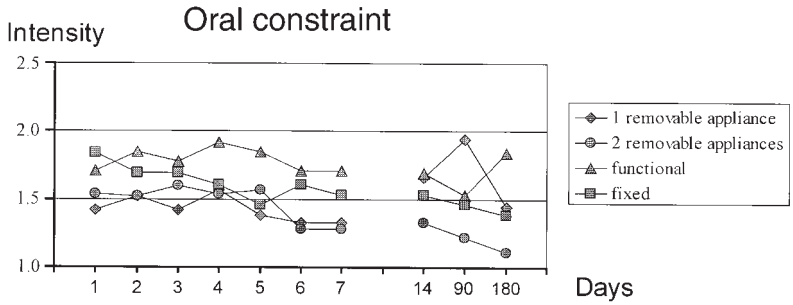

Figure 3 Intensity of the complaint 'feeling of oral constraint' reported for individual appliances in self-monitoring daily protocols for the first 7 days, and in retrospective evaluation carried out 14, 90, and 180 days after appliance insertion.

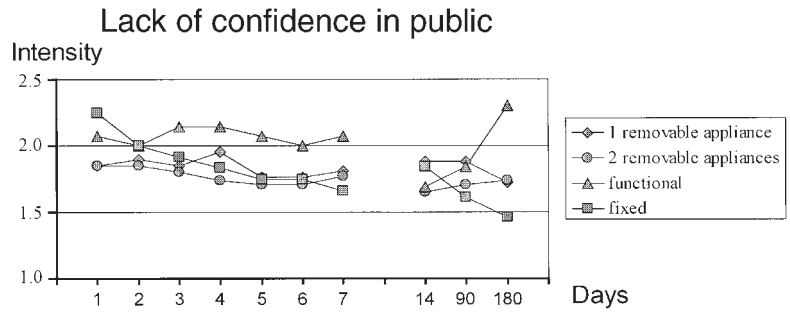

Figure 4 Intensity of the complaint 'lack of confidence in public' reported for individual appliances in self-monitoring daily protocols for the first 7 days, and in retrospective evaluation carried out 14, 90, and 180 days after appliance insertion.

Table 1 Number of subjects reporting higher (↑) or lower (↓) intensities of functional (impaired speech and swallowing, feeling of oral constraint), and social (lack of confidence in public) discomfort within 7 days after appliance insertion.

	Impaired speech			Impaired swallowing			Oral constraint			Lack of confidence		
	↑	↓	*Z*	↑	↓	*Z*	↑	↓	*Z*	↑	↓	*Z*
Day 2	8	12	0.93	5	16	2.10				4	6	0.76
Day 3	8	13	1.09	3	21	3.30***	8	7	0.19	6	10	1.03
Day 4	7	18	2.11*	5	24	3.24**	11	12	0.36	8	13	1.09
Day 5	7	22	2.81**	6	20	2.47*	9	13	0.47*	8	20	2.07*
Day 6	5	23	3.25**	5	22	2.97**	4	14	2.32*	7	19	2.23*
Day 7	10	20	2.10**	3	24	3.60***	6	15	2.24**	8	20	1.68

Z-values and corresponding significance levels (*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$) obtained from Wilcoxon test are also shown. Significance was tested comparing values for each individual day with the value for day 1, except 'feeling of oral constraint', where day 2 was chosen as the reference value.

reported for this complaint on day 2 was higher than on day 1 (Figure 3). It is evident that the intensities of all complaints related to functional discomfort significantly decreased during the short term (Table 1) after appliance insertion and showed no statistically significant long-term changes (Table 2). A statistically significant decline in the intensity of impaired speech started on day 4 and continued until day 7, as revealed by the number of subjects reporting

higher or lower intensity of speech impairment as compared with day 1. Perception of impaired swallowing also declined significantly between days 3 and 7, as did the intensity of feeling of oral constraint, which, however, took place between days 5 and 7. Social discomfort (lack of confidence in public) decreased significantly between days 5 and 6, and showed no difference on day 7 as compared with the reference value of the first day.

Inspection of Figures 1–4 also suggests differences in the changes of the intensity of complaints with regard to different types of appliances worn. The results of statistical testing of these differences by means of Kruskal–Wallis test for independent samples are shown in Table 3. It is evident that impairment of speech and swallowing reported by subjects undergoing treatment with different appliances varied significantly between appliance types over both short- and long-term periods, whereas feeling of oral constraint and lack of confidence in public were not related to the type of appliance worn.

The results of Spearman correlation analysis between patients' attitude to orthodontic treatment before appliance insertion and the intensity of complaints are presented in Tables 4 and 5. Positive expectations from treatment, that is how easy or difficult it would be to wear orthodontic appliances, showed a significant negative correlation to perceived intensity of feeling of oral constraint and lack of confidence in public over both the short- (Table 4) and long-term (Table 5) periods, and to impaired speech during the short term. Significant negative correlations were also revealed over both time courses between the value of dental aesthetic appearance and the feeling of oral constraint

Table 2 Number of subjects reporting higher (↑) or lower (↓) intensities of functional (impaired speech and swallowing, feeling of oral constraint) and social (lack of confidence in public) discomfort over the longer periods.

	Impaired speech			Impaired swallowing			Oral constraint			Lack of confidence		
	↑	↓	*Z*	↑	↓	*Z*	↑	↓	*Z*	↑	↓	*Z*
Day 90	13	14	0.48	11	15	0.43	9	12	0.31	16	13	0.25
Day 180	16	20	0.53	10	15	1.14	10	15	0.26	18	14	0.47

Z-values obtained from Wilcoxon test are also shown. Significance was tested comparing values for days 90 and 180 with the values for day 14. No statistically significant differences were found.

Table 3 Influence of appliance type on intensities of complaints over short (1–7 days) and long (14, 90, 180 days) periods. Mean ranks, χ^2-values and corresponding significance levels obtained from Kruskal–Wallis test ($^*P < 0.05$, $^{**}P < 0.01$) are shown.

	One removable appliance	Two removable appliances	Functional appliance	Fixed	χ^2-value
Short period					
Impaired speech	29	47	52	35	11.14**
Impaired swallowing	35	47	50	28	9.53*
Oral constraint	37	39	48	48	3.28
Lack of confidence	37	40	48	44	2.01
Long period					
Impaired speech	32	45	50	26	11.59**
Impaired swallowing	31	42	54	29	12.25**
Oral constraint	33	37	51	44	6.49
Lack of confidence	39	39	44	38	0.55

Table 4 Spearman correlations between intensities of complaints perceived within 7 days after appliance insertion and attitudes to orthodontic treatment such as perceived severity of malocclusion, expectations from treatment, value of dental aesthetics, and internal dental health locus of control.

	Impaired speech	Impaired swallowing	Oral constraint	Lack of confidence
Severity	–0.12	–0.11	–0.16	–0.15
Expectations	–0.24*	–0.15	–0.33**	–0.40***
Aesthetics	–0.18	–0.01	–0.28**	–0.25*
Locus of control	–0.05	–0.16	–0.12	–0.14

Significance levels, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

Table 5 Spearman correlations between intensities of complaints perceived over the longer periods (14, 90, 180 days) after appliance insertion and attitudes to orthodontic treatment such as perceived severity of malocclusion, expectations from treatment, value of dental aesthetics, and internal dental health locus of control.

	Impaired speech	Impaired swallowing	Oral constraint	Lack of confidence
Severity	–0.02	–0.10	–0.14	–0.02
Expectations	–0.14	–0.09	–0.20*	–0.33**
Aesthetics	–0.04	–0.02	–0.34**	–0.11
Locus of control	–0.02	–0.17	–0.01	–0.24*

Significance levels, *$P < 0.05$, **$P < 0.01$.

Table 6 Spearman correlations between intensities of complaints reported over short and long time courses, and acceptance of appliance and treatment as rated by the patients themselves and patients' compliance as rated by their clinicians.

	Appliance acceptance	Treatment acceptance	Compliance
Impaired speech	–0.35**	–0.09	–0.05
Impaired swallowing	–0.24*	–0.11	–0.14
Oral constraint	–0.35**	–0.03	–0.11
Lack of confidence	–0.63**	–0.10	–0.27*

Significance levels, *$P < 0.05$, **$P < 0.01$.

and lack of confidence in public. Personality characteristics of internal dental health locus of control were only related to the long-term intensity of social discomfort, whilst perceived severity of own malocclusion by the subjects showed no statistically significant correlation with the recorded intensity of complaints.

Table 6 shows the results of correlations between the intensity of complaints and acceptance of the appliance, acceptance of treatment, and compliance with treatment (as rated by the clinicians). All complaints related to functional and social discomfort correlated significantly with acceptance of the appliance, whilst showing no correlation with acceptance of treatment. Only lack of confidence in public was significantly related to subjects' compliance as rated by the clinician.

Discussion

The aims of this study were to characterize any potential links between patients' attitudes that might be relevant to health behaviour, and the amount of functional and social discomfort experienced during wearing of an orthodontic

appliance, as well as to investigate their influence on patients' acceptance of the appliance and compliance with treatment. To meet these aims, hypotheses regarding four issues were tested:

(1) functional and social discomfort might change during both short- and long-term periods after appliance insertion;
(2) functional and social discomfort might depend on the type of appliance worn;
(3) attitudes to orthodontic treatment might help predict the discomfort over both the short and the long time courses;
(4) functional and social discomfort experienced initially might help predict long-term compliance with treatment.

As far as the first hypothesis was concerned, evaluation of both the self-monitoring daily protocols and the long-term retrospective reports revealed a significant reduction in functional discomfort during the first week following appliance insertion (Tables 1 and 2). Together with the rapid reduction of pain, sensitivity and pressure observed after appliance insertion in another study (Sergl *et al*., 1998), these results indicate that physiological adaptation to new appliances tends to occur as a short-term event. Changes in the intensity of social discomfort were, however, less consistent suggesting that this aspect of adaptation is more likely to depend on personality characteristics of the patient, such as his/her general social anxiety. The speed of adaptation to new appliances underlines the significance of a patients' initial reaction to an appliance and necessitates early consideration by the treating clinician. Conceivably, it is even more important in the case of adverse initial reactions when early intervention might help prevent the long-lasting establishment of a stereotype denial of orthodontic appliances.

With regard to the second hypothesis, the complaints influenced by appliance type were impaired speech and swallowing, with functional and bimaxillary removable appliances causing the higher intensities of complaints. These findings parallel the results of other studies reporting effects of appliance type on oral complaints, such as higher degree of pain or speech impairment during wearing of Bionator and headgear (Johnson *et al*., 1998), increased incidence of perceived pain, tension, and sensitivity and pressure under treatment with functional and fixed appliances (Sergl *et al*., 1998), or differences in initial acceptance of various designs of functional appliances (Sergl and Zentner, 1998). It seems likely, therefore, that because of different experiences encountered, the type of appliance may have a substantial effect on initial adaptation. There was no relationship between the appliance type, and the feeling of oral constraint or lack of confidence in public. This indicates that these problems are caused by the presence of a foreign body/appliance in the oral cavity or its visibility regardless of particular shape or size. These observations may be used in clinical situations by informing the patient in advance of a specific complaint associated with a particular appliance type which may help reduce adverse experiences (Klages *et al*., 1992; Tedesco *et al*., 1992).

With respect to the third hypothesis the results obtained provide novel predictive evidence of patients' attitudes to orthodontics at the start of treatment to the intensity of discomfort perceived during appliance wear. Positive expectations from orthodontic treatment which are closely linked with the concept of self-efficacy (Bandura, 1977) showed a significant negative correlation to the intensity of some of the complaints over both the short (Table 4) and long time courses (Table 5). Self-efficacy is an individuals' belief in his/her ability to function competently (Albino and Tedesco, 1991). In agreement with the results of psychological research on self-efficacy and personal health-related behaviour (Bandura, 1977) it appears that patients with a higher expression of self-efficacy with regard to orthodontic treatment are less concerned with the discomfort associated with it. Another predictor of the discomfort during orthodontic treatment revealed in the present work was the value of dental aesthetics. The more appreciative the subjects were of a pleasing dental aesthetic appearance, the lower was the complaint intensity of 'feeling

of oral constraint' and 'lack of confidence in public'. For an orthodontic patient, expectation of a pleasing dental aesthetic appearance from treatment is usually one of his/her priorities (Albino *et al*., 1981). Together with self-efficacy, the latter are recognized key components of health preventive behaviour and compliance with treatment (Bandura, 1977; Tedesco *et al*., 1991). The remaining two facets of attitudes to orthodontic treatment evaluated in the present study, namely the perceived severity of own malocclusion and the characteristics of dental health internal control orientation, did not have any predictive relevance to the intensity of functional and social discomfort. Internal locus of control implies that patients attribute treatment outcome to their personal efforts without relying primarily on chance or endeavours of others (Rotter, 1966). However, it has been shown in other studies that these traits may serve as reliable predictors of pain associated with orthodontic treatment (Sergl *et al*., 1998), and possibly even compliance at large (Sergl *et al*., 1993; Mehra *et al*., 1998).

Concerning the fourth hypothesis, it was tested whether there was a relationship between the intensity of functional and social discomfort and compliance. In this instance, the item 'compliance' was separated into two facets, namely the objective facet consisting of compliance rating by the treating clinicians and the subjective one comprising acceptance of the orthodontic appliance and treatment in general, such as satisfaction with having started treatment, willingness to recommend orthodontics to others or liking the orthodontist. All complaints evaluated in the present work were significantly correlated with appliance acceptance. On the other hand no relationship was found between the intensity of the complaints and acceptance of the treatment in general, which is contrary to the previously reported strong correlation between the amount of pain and general acceptance of orthodontic treatment (Sergl *et al*., 1998). It appears that in contrast to functional and social discomfort, perception of pain during orthodontics has a more profound effect on the acceptance of treatment, possibly because infliction of pain is more likely to be personally associated with the orthodontist and orthodontics, whilst impaired function can be more easily blamed on the appliance. Compliance with treatment as rated by the clinicians was, with the exception of social discomfort, not associated with the intensity of complaints. This finding is also in disagreement with previous reports of the effects of pain on co-operation (Oliver and Knappman, 1985; Egolf *et al*., 1990; Sergl *et al*., 1998), indicating that impairment of oral function is less likely to affect compliance than perception of pain. It is noteworthy that subjects with the least concern with their appearance (no 'lack of confidence in public') showed the highest correlation with appliance acceptance (Table 6, $r = -0.63$, $P < 0.01$) and a statistically significant, albeit relatively low, correlation with dentist-rated compliance ($r = -0.27$, $P < 0.05$), designating social discomfort as one of the major contributors to compliance.

Conclusions

In general, the results of this study highlight a strong interrelationship between a patient's attitude at the beginning of orthodontic treatment, his/her capability to accommodate to discomfort associated with the orthodontic appliance, the type and intensity of discomfort encountered, and the resulting overall compliance with the treatment. On these grounds it may be recommended that the patient's initial attitudes to orthodontic treatment are thoroughly considered and discussed carefully with the patient. This approach of *rational restructuring* (Tedesco *et al*., 1992) should also include explanation of the severity of malocclusion and treatment need as motivating stimulus, and discussion of the effects of non-compliance on the existing condition. The patient should be helped in establishing a sense of personal control over treatment progress and prepared for encountering discomfort during treatment, which is known to occur in association with the particular type of appliances to be employed. As adaptation to treatment or its denial occur as short-term events it is necessary for the clinician to react early in order to be able to influence these events.

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