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PATIENT COMPLIANCE IN ORTHODONTIC TREATMENT: THE ROLE OF BEHAVIORAL, SOCIAL, AND DIGITAL FACTORS – A NARRATIVE REVIEW

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ABSTRACT

Objectives: This narrative review aimed to summarize current evidence on factors influencing patient compliance in orthodontic treatment, with particular focus on behavioral, psychological, social, treatment-related and digital technology-related determinants.

Methods: A narrative literature review was conducted using full-text scientific publications available in PubMed, Scopus and Google Scholar. The search included studies published between 1990 and 2026 and used keywords related to patient compliance, adherence, orthodontic treatment, behavioral and psychological factors, social support, health literacy, teleorthodontics, digital technologies and remote monitoring. Original studies, systematic reviews, meta-analyses and narrative reviews were included. The collected data were analyzed qualitatively and synthesized into thematic categories.

Key Findings: The available evidence indicates that orthodontic compliance is a multidimensional and dynamic process rather than a single patient behavior. Patient motivation, attitudes toward treatment, understanding of recommendations, pain, discomfort, family involvement, communication with the orthodontist and the complexity of treatment protocols all contribute to adherence. Digital technologies, including mobile applications, SMS reminders and remote monitoring systems, may improve oral hygiene, reinforce recommendations and facilitate communication, although their long-term effectiveness remains inconclusive.

Conclusions: Improving compliance in orthodontic treatment requires an individualized and patient-centered approach. Clear communication, regular feedback, pain management, family involvement and appropriately selected digital tools may help strengthen patient cooperation and improve treatment predictability.

KEYWORDS

Patient Compliance, Patient Adherence, Orthodontic Treatment, Behavioral Factors, Psychological Factors, Social Support, Health Literacy, Digital Technologies, Teleorthodontics, Artificial Intelligence, Social Media, Remote Monitoring

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Introduction

Orthodontic treatment is often a long and complex therapeutic process. Its success depends not only on the clinician's knowledge, experience and appropriate treatment planning, but also on the patient's active involvement throughout therapy. Unlike many other dental procedures, orthodontic treatment requires sustained patient cooperation over an extended period of time. Therefore, compliance is considered one of the key factors influencing the achievement of a successful treatment outcome [1]. At the same time, patient cooperation is multifactorial and can be associated with motivation, the patient's perception of their own role in treatment, expectations regarding therapy, and self-assessment of dentofacial appearance [1,2].

According to the World Health Organization, adherence refers to the extent to which a patient's behavior corresponds with recommendations agreed upon with a healthcare professional [3]. In orthodontics, this concept includes a broad range of behaviors, such as wearing removable appliances, extraoral appliances and intermaxillary elastics for the prescribed amount of time [4], maintaining adequate oral hygiene, attending regular follow-up appointments [1], and following retention protocols [5]. Although the terms compliance and adherence are often used in similar contexts, adherence more clearly emphasizes the active role of the patient and the mutually agreed nature of therapeutic recommendations [3].

The importance of adherence in orthodontics results from the direct influence of patients' daily behaviors on the course and outcomes of treatment [4]. In adolescent patients, the level of cooperation often changes over time and depends both on parental attitudes and on the patient's own beliefs [6]. Insufficient adherence can reduce treatment effectiveness, prolong therapy, require modifications to the treatment plan, and lead to less predictable outcomes [4]. Poor oral hygiene during orthodontic treatment increases the risk of enamel demineralization, white spot lesions and periodontal complications [7,8]. Retention after the active phase of treatment is also essential, as it helps stabilize the achieved tooth positions; failure to follow retention instructions, or incorrect use of retainers, increases the risk of relapse [9].

Studies have shown that many patients do not follow orthodontic recommendations consistently. In a systematic review, Al-Moghrabi et al. demonstrated that the actual wearing time of removable appliances and auxiliary components is often shorter than recommended, and that patients tend to overreport their wearing time when compared with objective measurements [4]. Similar findings were reported by Tsomos et al., who used objective compliance assessment and showed a discrepancy between the prescribed and actual wearing time of removable appliances [10]. These findings highlight the need for a better understanding of the factors that influence patients' behavior and cooperation during orthodontic treatment.

The determinants of adherence to orthodontic recommendations are complex and multifactorial. Patient cooperation depends not only on individual patient characteristics, but also on communication with the orthodontist, the therapeutic relationship, and treatment-related experiences such as pain, discomfort and acceptance of the appliance [1]. Previous studies have suggested a possible association between compliance and patient satisfaction; however, cooperation as assessed by the orthodontist does not always serve as a clear predictor of long-term satisfaction after treatment completion [11]. Behavioral, psychological and psychosocial factors are also relevant, including motivation for treatment, attitudes toward therapy, expectations regarding treatment outcomes, a sense of responsibility for the course of treatment, and the patient's belief in the importance of their own contribution to the therapeutic process [12,13].

The role of social factors is particularly evident in children and adolescents. Parental expectations, caregiver support, the need for social acceptance and peer reactions influence the patient's motivation, self-esteem and attitude toward treatment [14,15,16]. Dentofacial appearance may affect self-confidence, body image and social functioning, indicating that patients' motivation and expectations regarding treatment should not be analyzed solely from a clinical perspective [15,16]. Socioeconomic status has also been evaluated as a potential predictor of treatment completion and cooperation; however, Mandall et al. found no significant association between socioeconomic status and completion of therapy, the number of missed appointments or the number of appliance breakages [17]. The effectiveness of health education can also be of practical importance, as oral health promotion programs for patients treated with fixed appliances improve plaque control and gingival health in the short term [18].

Patient cooperation is also influenced by factors directly related to the nature of orthodontic treatment. The complexity of therapeutic recommendations and the way in which patients perceive treatment are also relevant. In the case of retention, adherence additionally depends on the type of retainer, the prescribed wearing protocol, comfort, aesthetics and the patient's individual acceptance of the appliance [19,20]. Pain and discomfort after appliance placement or activation are particularly important factors, as they may interfere with everyday functioning, eating and treatment acceptance, thereby affecting patient cooperation [21,22].

Communication between the orthodontist, the patient and the patient's parents should also be considered, including discussion of adherence requirements, possible discomfort, methods of pain relief, and the roles of both the patient and parents during orthodontic treatment [20,22].

In recent years, digital technologies have become promising tools for supporting patient engagement and improving adherence in orthodontic treatment. Mobile applications, internet-based communication tools, teleorthodontic platforms and remote treatment monitoring systems have created new opportunities for educating, motivating and monitoring selected aspects of therapy outside traditional follow-up visits [23–25]. Studies highlight that app-based and internet-supported interventions improve oral hygiene in patients treated with fixed appliances, reduce plaque and gingival inflammation indices, and limit the development of new white spot lesions [23]. Remote monitoring systems, such as Dental Monitoring, can reduce the number of in-office visits, increase patient convenience and facilitate communication with the orthodontist, while still allowing treatment progress to be monitored [24]. In addition, studies on smartphone-based monitoring suggest that such tools may provide reliable clinical data and support remote assessment of treatment progress [25]. Despite these promising findings, the long-term effectiveness of digital technologies in improving adherence, as well as their impact on clinical treatment outcomes, still requires further investigation [24–26].

Despite growing interest in compliance, it remains unclear which factors play the most important role in shaping cooperation among orthodontic patients. Research findings are often heterogeneous, which makes it difficult to identify the key determinants of adherence and the most effective methods for improving it. The aim of this narrative review is to summarize current evidence on the influence of behavioral, social, treatment-related and digital technology-related factors on adherence to recommendations among orthodontic patients, and to discuss potential strategies for improving patient cooperation and treatment outcomes.

Methodology

The present study was conducted as a narrative literature review based on full-text scientific publications available in the PubMed, Scopus, and Google Scholar databases. The literature search used keywords such as *patient compliance, patient adherence, orthodontic treatment, behavioral factors, psychological factors, social support, health literacy, digital technologies, teleorthodontics, artificial intelligence, social media, and remote monitoring*, combined with the Boolean operators AND and OR.

The analysis included publications published between 1990 and 2026. Studies were selected through title and abstract screening, followed by full-text evaluation. Inclusion criteria covered original studies, systematic reviews, meta-analyses, and narrative reviews addressing behavioral, social, treatment-related, and digital factors influencing patient compliance during orthodontic treatment.

The collected data were analyzed using qualitative descriptive methods and synthesized into thematic categories reflecting the multidimensional determinants of patient compliance in orthodontic treatment.

Results

Behavioral and psychological factors

The studies analyzed indicate that adherence to orthodontic recommendations depends on a range of interrelated factors, including patient motivation, attitudes toward treatment, a sense of responsibility for treatment outcomes, and the way patients perceive their own role in the therapeutic process [12–14]. Patients who are more motivated to undergo treatment are more likely to report a willingness to follow orthodontic instructions, including wearing auxiliary components and retention appliances as prescribed [13]. However, a recent scoping review of adherence in orthodontics emphasizes that studies differ in terms of definitions, assessment methods and the determinants analyzed, which makes it difficult to identify a single dominant factor responsible for compliance [26].

Attitudes toward treatment, expected benefits and a sense of responsibility for treatment outcomes have been examined as factors associated with patients' intention to follow orthodontic recommendations. In a study based on the Theory of Reasoned Action, patients' intention to comply was significantly associated with their attitude toward adherence, motivation to cooperate and anticipated regret in the event of not following the orthodontist's instructions [20]. The authors also indicated that patients' intention to cooperate can be partly related to parental attitudes toward compliance [20]. In a prospective study of orthodontic patients, motivation for treatment was correlated with overall satisfaction with treatment outcomes, whereas patients' expectations regarding treatment showed no significant association with satisfaction after treatment completion [27].

Aesthetic self-perception and the way patients view their own dentofacial appearance also influence their attitude toward treatment. In adolescent patients, dissatisfaction with dental appearance, the desire to

improve the smile and the impact of dentofacial appearance on social relationships strengthen motivation to seek orthodontic treatment [2,14,16]. At the same time, the available data do not allow compliance to be predicted in a straightforward way on the basis of single psychological characteristics. Studies on cooperation have shown that individual psychosocial and psychological variables have limited predictive value, whereas the patient–orthodontist relationship and the broader context of treatment-related attitudes and patient characteristics can be more relevant [28,29]. Psychological factors also influence appliance acceptance and the way patients experience pain, discomfort and adaptation difficulties associated with orthodontic treatment [30].

Social and environmental factors

Cooperation among orthodontic patients is strongly embedded in a social context. In children and adolescents, parental attitudes, involvement in the treatment process and willingness to support the child in following daily recommendations are clinically relevant [13,14,20]. Parents can strengthen the patient's motivation, encourage regular attendance at follow-up appointments, promote proper oral hygiene and help ensure adherence to instructions related to the use of appliances or auxiliary components [13,14,20]. Parental influence is often stronger during the earlier stages of treatment, whereas with increasing age, the patient's autonomy and own sense of responsibility become more important [14]. A systematic review on the influence of parents on orthodontic treatment indicates that caregiver involvement, parental attitudes toward therapy and the level of involvement in the treatment process contribute to the motivation and adherence of adolescent patients [31].

Peer relationships and the need for social acceptance are also relevant. The appearance of the teeth and smile may influence self-confidence, participation in social interactions and the willingness to smile in social situations [15,16]. In some patients, positive expectations regarding aesthetic improvement strengthen motivation for treatment. Conversely, embarrassment, negative comments from others, and difficulties related to dentofacial appearance or appliance wear can reduce acceptance of therapy and affect the patient's attitude toward treatment [14,16]. In practice, this means that assessment of compliance should take into account not only the patient's behavior in the dental office, but also their everyday functioning within the family, school and peer group [14,26,31].

Socioeconomic factors have been analyzed as potential determinants of compliance, but their significance remains unclear. Mandall et al. found that socioeconomic status, age, sex, type of treatment and clinical need for treatment were not significant predictors of treatment completion or patient cooperation [17]. These findings suggest that simple demographic variables are insufficient for predicting patient behavior, and that assessment of cooperation should also include psychological, family-related, relational and organizational factors [17,26].

Another important environmental factor is the patient's level of understanding of recommendations and the quality of health education. Clear, repeated and age-appropriate instructions can help patients maintain oral hygiene and better understand the consequences of poor cooperation. Reviews on oral health promotion in patients treated with fixed appliances indicate that educational and motivational interventions improve plaque indices and gingival health in the short term [18,32]. This effect can be further reinforced by regular reminders, text messages, visual materials and the involvement of parents or caregivers [23,32–34]. Studies on mobile applications also suggest that digital tools can facilitate adherence to oral hygiene recommendations in patients undergoing treatment with fixed appliances [35].

Treatment-related factors in orthodontics

Compliance is also influenced by factors directly related to the nature of orthodontic treatment. The literature has examined, among other aspects, the type of appliance used, the need to wear auxiliary components, the prescribed appliance wearing time and the stage of treatment [4,36]. The complexity of therapeutic recommendations should also be considered [20], as well as the type of retainer and the prescribed retention protocol in the retention phase [19]. In the case of removable appliances, extraoral appliances and intermaxillary elastics, the course and effectiveness of treatment depend to a large extent on the actual wearing time in accordance with clinical recommendations [4,36,37].

Studies using objective methods to assess appliance wearing time have shown that actual use is often shorter than prescribed, while patients' self-reports often overestimate their level of compliance [4,10,36]. This suggests that patient self-assessment or clinical history alone can be insufficient for a reliable evaluation of adherence [10,36]. The use of microsensors allows a more objective assessment of appliance wearing time, although awareness of being monitored may itself influence patient behavior [36]. Assessment of compliance in orthodontics should therefore include different indicators, such as actual appliance wearing time, attendance

at appointments, oral hygiene and clinically observed behaviors [26]. In clinical practice, behaviors such as missed appointments, appliance breakages and the level of oral hygiene are also considered [17,38].

Pain and discomfort are important factors affecting acceptance of orthodontic treatment. Symptoms occurring after appliance placement or activation can interfere with eating, oral hygiene and everyday functioning, thereby influencing appliance acceptance and patient cooperation [21,22,30]. Studies also indicate that the severity of initial pain and discomfort may be associated with appliance acceptance and the level of compliance during treatment [30]. Some studies suggest that orthodontists sometimes underestimate the intensity of pain reported by patients, which highlights the importance of actively asking about symptoms and discussing strategies for their relief [22]. A patient's response to pain and discomfort depends not only on symptom intensity, but also on their attitude, expectations, perceived self-efficacy and prior discussion of possible symptoms and ways to manage them [22,30].

The patient–orthodontist relationship is also important. Studies on orthodontist behaviors as perceived by patients emphasize that positive communication, courtesy, empathy, clear explanation of the treatment plan, reduction of patient concerns and expressions of care may strengthen the therapeutic relationship, increase satisfaction and promote better cooperation [38]. Conversely, poor understanding of recommendations, insufficient explanation of the patient's role or negative experiences during visits can weaken motivation to follow instructions. In clinical practice, therefore, not only the technical quality of treatment is important, but also the way in which the patient is guided through a long and often demanding therapeutic process. The relationship between patient satisfaction, motivation and expectations should be interpreted with caution, as a prospective study showed a correlation between motivation and overall post-treatment satisfaction, whereas patients' expectations were not significantly correlated with satisfaction after completion of therapy [27].

Digital technologies supporting compliance

Digital technologies may help promote patient engagement in orthodontic treatment. Mobile applications, messaging platforms and SMS reminders can facilitate communication with patients between appointments, the delivery of instructions and the regular reinforcement of oral hygiene recommendations [23,33,34].

Teleorthodontic platforms and remote monitoring systems, such as Dental Monitoring, make it possible to monitor selected aspects of treatment, improve communication and reduce the number of in-office visits [24,39]. They also facilitate earlier detection of problems, such as insufficient aligner fit, damage to appliance components or deterioration in oral hygiene [24,25,39]. Studies on smartphone-based monitoring also suggest that such tools provide clinically useful data for the remote assessment of selected treatment parameters [25].

Particularly promising findings have been reported in relation to improving oral hygiene among patients treated with fixed appliances. In the study by Zotti et al., an intervention based on a mobile application, group communication and the regular submission of photographs was associated with significantly lower plaque and gingival inflammation scores, as well as a lower incidence of new white spot lesions, compared with the control group [23]. Interventions based on SMS reminders and mobile applications have also been shown to improve adherence to oral hygiene recommendations between follow-up visits [33,34,40]. A randomized clinical trial evaluating the Brush DJ app indicates that mobile applications help improve oral hygiene in patients with fixed appliances, particularly as an adjunct to standard oral hygiene instructions [35].

Despite these promising findings, the effectiveness of digital technologies in improving adherence remains inconclusive and may depend on patient engagement, ease of use, quality of communication and the way remote monitoring is implemented in clinical practice [24,26,39]. Digital solutions should not be regarded as a replacement for the doctor–patient relationship, but rather as a complement to it [24]. Their clinical value appears to be greatest when they are selected individually and linked to specific therapeutic goals, such as improving oral hygiene and regularly reinforcing recommendations [23,35], or monitoring selected aspects of treatment and enabling earlier detection of problems during therapy [24,25].

Strategies for improving compliance

Strategies intended to improve compliance should combine health education, patient motivation, clear communication and, in adolescent patients, family support [18,20,22,31]. Instructions regarding oral hygiene, the prescribed wearing time of appliances or auxiliary components, and the management of pain and discomfort are particularly important [4,18,21,22]. Motivational and communication strategies can also be helpful, including positive reinforcement, regular feedback and emphasizing the impact of the patient's behavior on the course of treatment [14,38].

In children and adolescents, involving parents or caregivers is especially important, particularly at the beginning of treatment, when the patient is still learning new responsibilities related to orthodontic appliance

use [13,14,20]. Evidence on parental influence suggests that their role may include both emotional support and practical assistance in maintaining the patient's daily treatment-related behaviors. Cooperation with caregivers should therefore be considered an element of the therapeutic strategy [31].

Digital technologies may be a useful adjunct to traditional compliance-improvement strategies, especially when they are used to achieve specific clinical goals, such as oral hygiene education, reinforcement of recommendations or monitoring of selected aspects of treatment [23–25,35]. Given the diversity of adherence measures analyzed in the literature and the inconclusive findings regarding many factors influencing cooperation, it seems appropriate to tailor supportive strategies to the individual needs of the patient and the nature of treatment [26]. Further research should focus on identifying which patient groups benefit most from particular interventions, as well as on assessing their long-term impact on adherence, treatment progress and clinical outcomes [26].

Discussion

The findings of this review indicate that compliance in orthodontic treatment should not be understood as a single patient behavior, but rather as a dynamic process influenced by multiple overlapping factors. The available literature does not point to a single dominant predictor of good or poor cooperation. It seems more appropriate to view adherence as the result of interactions between patient motivation, treatment-related experiences, the relationship with the orthodontist, family support and the demands associated with the therapeutic method used [1,12,14,26].

The way in which patients understand their own role in treatment is of particular importance. Everyday behaviors, such as wearing removable appliances and intermaxillary elastics, maintaining oral hygiene and attending follow-up appointments, influence the course of therapy and the predictability of treatment outcomes [4,10,36,37]. After completion of the active phase of treatment, adherence to retention recommendations also becomes especially important [5]. Patient education should therefore not be limited to a single set of instructions, but should involve repeated explanations of the relationship between the patient's behavior and the clinical outcome. This is particularly relevant in adolescent patients, in whom motivation, self-esteem, family influence and peer relationships may change over the course of treatment [13,14,16,20,31].

Patient cooperation does not depend solely on knowledge or on simple obedience to instructions. Studies suggest that individual psychological characteristics have limited predictive value, and that patient behavior is better understood as the result of a broader emotional, social and clinical context [26,28,29]. In clinical practice, this means that difficulties with compliance should not be interpreted only as a lack of patient responsibility. They can also stem from pain, discomfort, insufficient understanding of recommendations, low motivation, lack of support outside the dental office or poor communication with the treatment team [21,22,30,38].

The patient–orthodontist relationship remains particularly relevant. Clear explanation of the treatment plan, positive feedback, interest in the patient's concerns and discussion of the patient's role in the therapeutic process can strengthen engagement and cooperation [20,38]. At the same time, the relationship between compliance, expectations and patient satisfaction is not straightforward. Compliance assessed by the orthodontist does not always serve as a clear predictor of long-term satisfaction, and patients' expectations may not correlate with satisfaction after treatment completion [11,27]. This highlights the need to regard the patient as an active participant in therapy, rather than merely as someone expected to follow instructions [3].

Digital technologies may support adherence, but their role should be interpreted with caution. Available data suggest that their greatest value is seen when they are used as part of a broader therapeutic strategy, rather than as stand-alone solutions replacing the clinician–patient relationship [24,26,38]. In practice, this means that digital tools should be selected according to a specific clinical purpose, such as supporting oral hygiene, reinforcing recommendations or monitoring selected aspects of treatment [23–25,35].

An important limitation of the available research is the heterogeneity of definitions of compliance and adherence, as well as differences in the methods used to assess them [26]. This makes direct comparison between studies difficult and limits the possibility of formulating clear clinical recommendations. Objective methods of measurement, such as sensors recording appliance wearing time, improve the reliability of assessment, but their results should also be interpreted in the patient's clinical and behavioral context [10,36]. Another limitation of the present review is its narrative design, the absence of a formal meta-analysis and the lack of a standardized risk-of-bias assessment of the included publications.

From the perspective of clinical practice, improving compliance requires an individualized and multifactorial approach. The most reasonable strategy appears to be a combination of education, clear communication, pain control, regular feedback, family involvement and, where appropriate, digital tools [18,20,22,31,32,35,38]. Further studies should focus on the standardization of adherence assessment methods, longer follow-up periods and the identification of patient groups that benefit most from specific forms of support [26].

Conclusions

Compliance is one of the key elements influencing the effectiveness of orthodontic treatment, but it is not determined by a single factor. Patient cooperation is shaped by motivation, understanding of recommendations, treatment-related experiences, communication with the orthodontist, family support and the demands associated with the therapeutic method used.

In clinical practice, improving adherence requires a patient-centered approach. Clear instructions, regular feedback, control of pain and discomfort, reinforcement of motivation and, in children and adolescents, active involvement of parents or caregivers are particularly important. Digital technologies may support this process, especially in reminding patients about recommendations, providing oral hygiene education and monitoring treatment progress. However, they should complement, rather than replace, the clinician–patient relationship.

Future research should focus on more consistent methods of assessing adherence, the long-term effectiveness of interventions and the identification of strategies that are most useful for improving cooperation in specific groups of orthodontic patients.

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Research concept and design - Maria Torchalska, Monika Szerszeń

Data collection and/or compilation - Martyna Smogór, Monika Szerszeń

Data analysis and interpretation - Maria Torchalska, Martyna Smogór

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Supervision, project administration - Maria Torchalska

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