Understanding factors influencing compliance with removable functional appliances: A qualitative study

Anas El-Huni,[a] Fiorella B. Colonio Salazar,[b] Pratik K. Sharma,[c] and Padhraig S. Fleming[c]
Benghazi, Libya and London, United Kingdom

Introduction: Lack of compliance during functional appliance therapy may lead to extended treatment or even induce treatment failure. The aims of this study were to explore factors influencing compliance in adolescents treated with a Twin-block appliance. **Methods:** A qualitative study using one-to-one semistructured interviews involving a sample of adolescents undergoing Twin-block therapy with objectively recorded wear durations was undertaken. A topic guide was used to standardize data collection. Participants' views were tape recorded and field notes taken. Data were transcribed verbatim and analyzed with the use of framework methodology. **Results:** A total of 22 participants were interviewed. Factors influencing compliance with removable functional appliance included: self-motivation, peer and authority influence, quality of life impairment and adaptability, perceived treatment progress, and pragmatic and recall issues. These factors were found to exert important roles as enablers, barriers, or both. Patient recommendations to improve compliance included effective communication, tailoring of prescribed wear duration, physical alteration of the appliance, and use of reminding tools. **Conclusions:** The study highlights the multifaceted perceptions of removable functional appliance wear, with compliance fluctuating over time and a range of factors influencing this. The potential for professional and parental influence as well as customized reminders to enhance compliance were also reported. (Am J Orthod Dentofacial Orthop 2019;155:173-81)

Children with increased overjet are more susceptible to maxillary incisor trauma and to teasing in relation to dentofacial appearance.[1,2] Early interceptive treatment with functional appliances has proven to be effective in reducing the risk of trauma, improving self-confidence, and avoiding negative social experiences,[3] with the Twin-block the most commonly used in the United Kingdom.[4] Notwithstanding this, removable functional appliances are not without limitations, with noncompliance rates ranging from 10% to 49% reported in prospective research.[5,6]

Poor compliance is known to affect orthodontic treatment with both fixed and removable appliances. Although poor compliance with fixed appliance treatment tends to increase the risk of deleterious changes, including plaque-related disease, treatment failure is particularly problematic with removable appliances. Specifically, failure to wear removable functional appliances and headgear by up to 6 hours less than prescribed is not uncommon.[7] This may lead to unwanted lengthening of the functional phase to achieve Class II correction, compromised outcomes, or even abandonment of treatment if compliance does not recover. Yet there is relatively little understanding of the barriers and facilitators of optimal appliance wear and compliance levels with the use of removable functional appliances.

The currently available literature concerning factors affecting compliance with the Twin-block is sparse, with studies either focusing on other appliances or using patient accounts of compliance.[8,9] There is also little understanding of patients' beliefs in relation to factors

[a]Barts and London School of Medicine and Dentistry, Queen Mary University of London, London, United Kingdom; Department of Orthodontics, Faculty of Dentistry, University of Benghazi, Benghazi, Libya.
[b]Barts and London School of Medicine and Dentistry, Queen Mary University of London, London, United Kingdom; Division of Population and Patient Health, King's College London, Dental institute, London, United Kingdom.
[c]Barts and London School of Medicine and Dentistry, Queen Mary University of London, London, United Kingdom.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Padhraig S. Fleming, Queen Mary University of London, Barts and the London School of Medicine and Dentistry, Institute of Dentistry, New Road, Whitechapel, London E1 1BB, United Kingdom; e-mail, padhraig.fleming@gmail.com.
Submitted, January 2018; revised and accepted, June 2018.
0889-5406/$36.00

https://doi.org/10.1016/j.ajodo.2018.06.011

that might improve wear rates or durations. Cirgic et al,[9] in a qualitative analysis of compliance among adolescents wearing either Andreasen activators or prefabricated functional appliances, related compliance to motivation, external and clinician support, and individual strategies. Estimation of compliance rates are typically based on patient reporting; these are known to be notoriously unreliable, with patients routinely overstating compliance rates.[7] The aims of the present study were to qualitatively understand the factors associated with different levels of compliance in adolescents undergoing removable functional appliance therapy and to obtain a patient perspective on possible approaches to improving compliance levels with the use of removable functional appliance therapy.

MATERIAL AND METHODS

A qualitative design involving semistructured interviews was used. Ethical approval for this study was obtained from the Barts and the London School of Medicine and Dentistry and the National Research Ethics Services Ethical Committee (REC reference 13/LO/1512). Adolescents participating in an ongoing randomized controlled trial were included in this qualitative element, with efforts made to obtain variation regarding gender, phase of Twin-block treatment, and levels of compliance. The following inclusion criteria were applied in the original study: Class II division 1 incisor relationship; overjet measuring ≥7 mm; boys aged 12-14 years at the start of treatment; girls aged 11-13 years at the start of treatment.

Those with a history of previous orthodontics and with craniofacial syndromes were excluded.

A standardized Twin-block design was used with Adams clasps on all first premolars and first permanent molars, ball-ended clasps in the mandibular anterior region, and blocks intersecting at 70° with 6 mm in height in the premolar region. A temperature-sensitive Theramon microsensor (Handelsagentur Gschladt, Hargelsberg, Austria; or Forestadent, Pforzheim, Germany) was imbedded in the buccal aspect of the upper Twin-block component to permit objective assessment of wear duration. Theramon data were taken as the measure of compliance in those not responding to treatment. Participants who had been wearing the appliance for ≥3 months were considered for inclusion in this qualitative element. All participants had their compliance measured twice or more at 6–8-week intervals but were blinded to the presence of the microsensor.

Participants had been randomly allocated to either a full-time group (24 hours per day except for brushing, eating, or playing contact sport) or a part-time group (12 hours per day). Arbitrarily, based on objective readings from the microsensors, better compliance was inferred as average wear of the appliance for ≥16 hours per day for full-time wearers or ≥8 hours for part-time wearers. Poor compliance referred to an average wear-time of <16 hours in the full-time group and an average of <8 hours in the part-time group. Fluctuating compliance reflected variation in wear-time levels from poor to better or vice versa.

Twenty-two participants were approached for inclusion by a researcher (A.E.-H.) at a routine follow-up appointment. Formal sample size calculations are not recommended in qualitative research. It was initially anticipated that ~20 interviews would be required to achieve sufficient saturation of data to allow in-depth analysis. Potential participants were given an invitation pack containing an information sheet detailing the aims of the study and a consent form. They were given 1 week to make a decision about participating. Before giving written consent, participants had the opportunity to clarify doubts and to ask questions.

A topic guide was developed based on existing literature and professional experiences facilitating discussion around the objectives of the research. The design of the topic guide was reassessed after piloting and modified accordingly; however, the main structure was preserved and the duration of interview was considered to be realistic while allowing sufficient breadth and depth of information. Five key topics were explored in the semistructured interviews: demographic background, oral health–related behavior practices, treatment experience, factors influencing compliance, and recommendations to improve compliance.

Semistructured interviews were conducted in a nonclinical setting at the Institute of Dentistry, Queen Mary University of London, by 1 researcher (A.E.) who had been trained in qualitative methods by an expert in the area (F.B.C.S.). Interviews were timed (lasting ~45 minutes), audio recorded, and transcribed verbatim. All data were anonymized and entered into Microsoft Office Excel. Framework methodology was used to analyze the qualitative data. This rigorous approach facilitates the thematic analysis of qualitative data in a structured way around the key questions in the topic guide and enables comparison within and across participant groups. Specifically, data are transcribed, read, and reread by the research team, with subsequent coding of the data to permit development of major themes. An analytic framework is then developed and tested. The team regularly met during data collection and analysis to discuss and agree

Table I. Participants

No	*Gender*	*Compliance*
1	M	Poor to good
2	M	Good
3	M	Better
4	M	Better
5	M	Poor
6	M	Poor
7	M	Better
8	M	Better
9	M	Poor to better
10	F	Better
11	F	Poor to better
12	F	Better to poor
13	F	Better
14	F	Better
15	M	Poor to better
16	M	Better
17	F	Better
18	M	Poor to better
19	F	Poor to better
20	M	Poor
21	M	Better
22	M	Better

Poor to better, started with poor compliance, improving over time; *better to poor*, started with better compliance, worsening over time.

on the emerging themes, and any disagreement was discussed and resolved jointly.

RESULTS

Semistructured interviews were conducted involving 22 participants. The majority (68%; n = 15) were male (Table I), and the overall mean age was 12.5 years at the time of interview. Approximately one-half (54%) of the sample had better compliance, 32% (n = 7) had fluctuating compliance, and 14% (n = 3) were considered poorly compliant.

Factors influencing compliance with Twin-block wear

Five distinct themes were identified: self-motivation, social influence, quality of life impairment and adaptability, perceived treatment progress, and pragmatic and recall issues (Fig 1). The findings suggested that these factors played important roles as enablers, barriers, or both. Quotations, referenced to the source interview, illustrate the type of language and concepts that participants used to discuss these, with PT indicating the part-time group and FT the full-time group, and the interview number indicated as well.

Self-motivation. Self-motivation emerged as an important enabler and barrier. Internal motivation was reported by the majority of participants as the main reason for seeking orthodontic treatment. This drive encouraged adherence with the prescribed wear time. Commonly, participants wished to enhance dental and facial esthetics to prevent negative social consequences while also improving their quality of life, and physical and emotional well-being.

> "I would like to have nice teeth in photographs, I would like to smile, because, right now, I don't smile with my teeth." (17–female–PT–better compliance)

> "If my teeth aren't sticking out and my lips are closed and covering them, then children will not pick on me and call me names saying I'm like a rabbit." (13–female–FT–better compliance)

Furthermore, conforming to a perceived norm (being like everyone else) was commonly reported by participants as another enabler of compliant behavior. This psychologic power of attraction, which keeps a group together, was demonstrated by participants reporting a strong desire to be included and accepted. Some participants yearned for similarity and closeness with other group members.

> "I'm the only person in my family with my teeth sticking out. I'm the only person in my family that doesn't have straight teeth. I am like the leftover person without straight teeth, that's why I think there is a problem. I just wanted to be like my family, have straightened teeth, and I can be able to close my lips." (13–female–FT–better compliance)

Conversely, lack of self-motivation to undergo orthodontics at the outset of treatment translated into a barrier to compliance; these participants were more likely to have poorer levels of compliance during treatment.

> "You need to go for a check-up every month or something; to me, that's a waste of time. To me, it [malocclusion] was minor, I did not think it mattered. If my teeth were so bad, then it would matter. I did not want the braces." (20–male–FT–poor compliance)

Social influence. Compliance to the prescribed Twin-block wear time appears to be affected by social influences, including the orthodontist, parents, and peers. Some evidence suggested that it was difficult for participants not to adhere to social norms and to respond to influential peers and authorities, ie, orthodontists, family, and friends.

Orthodontist-patient relationship—Participants widely reported on the importance of a positive orthodontist-patient relationship on compliance levels. Developing rapport by being supportive and having detailed pretreatment discussion about the malocclusion and explanation of the benefits of treatment and the appliance's

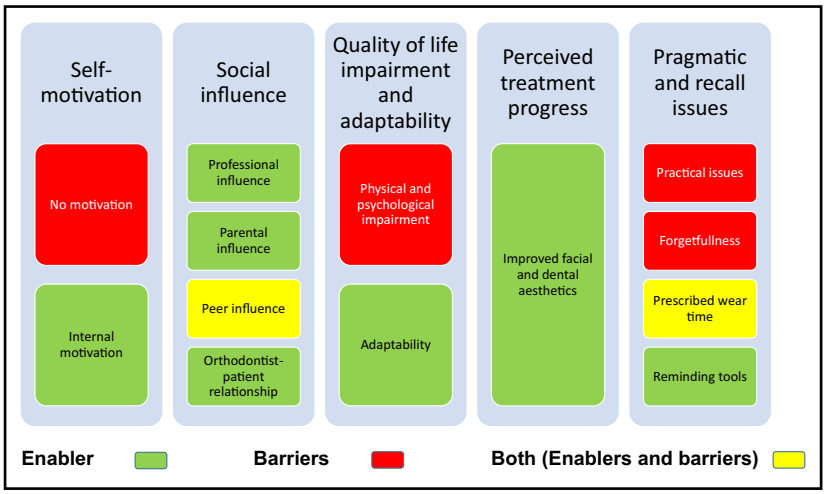

Fig 1. Factors influencing compliance to wearing the Twin-block appliance.

mode of action were seen as a positive influence on compliance.

> "They [dentist] said that they're going to need to realign the jaw … and the braces, or the appliance, would help my jaw to realign into position. I felt it was going to be something could impact … my life." (16–male–PT–better compliance)

Along the same lines, participants stated that positive reinforcement by pointing out the improvement in the jaw position, and informing the participants about the temporary nature of functional impairment, were useful in maintaining or improving compliance levels.

> "They said that before, my jaw gap was 13 mm and then since I have been wearing them, it pushed forward to 5 mm. So they can see that it has been improved." (13–female–FT–better compliance)

> "Every time, when I spoke, saliva kept on coming out and the dentist said that would happen but I just wanted to keep on wearing it just to get over with it because I knew, in a couple of weeks, it would feel better, because the dentist told me." (22–male–FT–better compliance)

Importantly, informing participants of the consequences of poor compliance, such as extended duration of treatment and the possibility of the need for surgical correction in the future, was recognized as another enabler to improve compliance.

> "He [clinician] told me if I did not wear the brace properly I may need to break my jaw and move it forward. I did not want to break my jaw, so I just wear it." (10–female–FT–better compliance)

Parental influence—Parents appeared to have a positive influence on most participants' compliance, especially those showing fluctuating compliance levels. Various parenting strategies to cope with participants' noncompliant behavior were discussed, including identifying pretreatment malocclusion, reminder of the need to wear the appliance, encouragement to see the orthodontist, and highlighting improvement in facial appearance. Some participants referred to the importance of avoiding conflict with their parents, rather than persisting with noncompliant behavior. As such, parents were often instrumental in achieving the required compliance.

> "Sometimes my parents tell me I have to put on my braces, and then I just do that. I just sometimes remember by myself, and sometimes my parents remind me that I have to put on the braces." (18–male–PT–fluctuating compliance)

> "My mum persuaded me and told me it is for your own benefit, it is for your teeth and if you don't want to have straight teeth, don't wear it and if you want straight teeth, then wear it. I understood her and I realized that it is quite important for me to wear it." (1–male–FT–fluctuating compliance)

> "I think my mum said I looked different, like my jaw's bigger, or something like that. I wore them more, because I thought if I wear them more, it can make a difference." (18–male–PT–fluctuating compliance)

Peer influence—Peers can act as both enabler and barrier to compliance with recommended wear time. For some participants, their peers considered it "absolutely normal" to have orthodontic treatment as an adolescent, especially when this treatment was commonplace among schoolmates; this social

acceptance positively influenced participants' compliance to prescribed wear times.

> "They [peers] said to me: 'Do not worry, it happens … You are not the only one' because there are so many other people in my school wearing the appliance." (22–male–FT–better compliance)

> "I just wanted to wear it. Because many people have braces." (15–male–PT–fluctuating compliance)

Conversely, if peers had a negative attitude toward orthodontic treatment, some participants seemed to be more reluctant to comply. Conversely, these participants felt that wearing the Twin-block was harmful to their image, social interaction, self-esteem and confidence; thus, dissuading them from compliant behavior.

> "All my friends say when you talk you're like a baby, so I did not wear them in school for maybe 3 days or something." (20–male–FT–poor compliance)

Quality of life impairment and adaptability. There was universal agreement that participants experienced a degree of physical and/or psychologic impairment related to functional appliance treatment, particularly during the initial stages. The most commonly reported examples of physical impairment included: discomfort and difficulty to speak and eat. For some participants, especially those with full-time wear prescription, these negative experiences were problematic to overcome, affecting their levels of compliance.

> "When I went to bed, it hurt really bad and I woke up at midnight crying. I just sometimes did not like putting them on because of how they felt." (18–male–PT–fluctuating compliance)

> "I stopped wearing it because of the pain and the way I spoke with it … I couldn't really close my mouth with it." (11–female–FT–fluctuating compliance)

Furthermore, social concerns regarding esthetics and a history of teasing or receiving negative comments while wearing the appliance appeared to affect some participants emotionally and psychologically, particularly at the beginning of the treatment.

> "You can not talk properly with it. No one can understand me. I just stayed quiet and after a while I took it off." (6–male–PT–poor compliance)

The initial negative impact on quality of life was often followed by a period of adaptation, with comfort levels improving and participants becoming more receptive. These participants then committed to the treatment and began to comply with the prescribed wear time.

> "I got used to it; in the beginning I sometimes did not wear it but then after that I got used to it, and it got into a habit." (15–male–PT–fluctuating compliance)

> "I'd get teased about the way I talked with my brace in. It wasn't great at the start, but it stopped after a while." (14–female–FT–better compliance)

Perceived treatment progress. A positive attitude toward treatment and objective improvement was associated with perceived orthodontic treatment progress. Indeed, perceived improvement in dental and/or facial esthetics either personally or by others seemed to prompt more sustained wear of the appliance.

> "I sort of noticed the changes. I can feel it as well, I can see improvements. I wanted to wear it more because I can feel it is working and that encouraged me to wear it more" (7–male–PT–better compliance)

Pragmatic and recall issues. Practical issues, such as prescribed wear time, forgetfulness, interference with daily activities, and reminding tools, were seen to have a variable effect on compliance levels.

Prescribed wear time—The prescribed wear time, either part- or full-time, had a variable effect, with some stating that part-time wear, allowing rest periods, had a positive influence on their level of compliance compared with full-time wear. Part-time wear also entailed less interference with daily activities, including eating, speech, and sleep.

> "I think 12 hours can make a difference, because it sounds a lot for me. I'd prefer to wear them when I go to sleep, so they don't distract me in school." (18–male–PT–fluctuating compliance)

For others, full-time wear was advantageous because the regime was simple and the likelihood of forgetting to wear the appliance was lower. Moreover, by wearing the appliance for 24 hours per day it was considered more likely to promote a successful outcome.

> "I prefer 24 hours because I know I get more benefits by wearing it for 24 hours." (11–female–FT–fluctuating compliance)

> "It's much easier to remember to wear it 24 hours, because if you ask me to wear for 12 hours, it will be difficult to remember wearing it." (10–female–FT–better compliance)

Convenience in relation to time of initiation of functional appliance treatment, eg, commencing treatment during school holiday periods or increasing the wear time gradually to facilitate adaptation without interfering with any daily activity, was found to be helpful in improving compliance levels.

> "It [impaired function] was only going to be like for 2 weeks, I think. I know it was going to be in the holidays as well, so it did not really matter. I started treatment in summer holiday, so when I wore it at school people did not realize." (21–male–FT–better compliance)

Forgetfulness—Remembering to wear the appliance at the prescribed times and reinserting it after meals and sports was problematic for many participants, especially at the beginning of treatment when they were less used to the appliance and the associated wear regime.

> "I did not wear it that much, I forgot about it." (18–male–PT–fluctuating compliance)

> "In the beginning, I sometimes forgot, but then after that I got used to it, it got into a habit." (15–male–PT–fluctuating compliance)

> "Sometimes I forget but not for that long. Now it is hard to forget because I get used to it. It feels weird not wearing it." (10–female–FT–better compliance)

Interference with daily activities—Wearing the appliance during social and educational activities became problematic for some participants, who reported removal for social occasions, and educational activities including sports requiring a gumshield. The "forced" noncompliant behavior was exacerbated by forgetting to replace the appliance after these activities.

> "Sometimes when I'm playing basketball and I don't want to get injured, I take them off and put them in my blazer, and forget to put them on." (20–male–FT–poor compliance)

Furthermore, concerns related to wearing the appliance during social occasions and educational activities were widely discussed by participants in terms of difficulty with speaking and/or eating and the associated embarrassment, thus leading to suboptimal wear of the appliance.

> "In Drama and in English if I need to raise my hand and volunteer, I would not do so because I can not speak clearly. I did not wear it in the beginning because I thought it was too embarrassing to wear it." (1–male–FT–fluctuating compliance)

> "I did not wear it that much, I think. I did not put them on because parties happened and I'm going to eat there. Basically, I wanted to enjoy the party, without braces. Sometimes the braces irritate me, because they hurt my skin when I put them on." (male–PT–fluctuating compliance–18)

Aide-memoirs—Aide-memoirs that facilitated visibility of the appliance (eg, specific storage locations) together with electronic and digital devices (eg, phone alarms) were commonly reported in the interviews. This proactive behavior undoubtedly facilitated adherence.

> "I had my alarm watch as well and then when it is peeping then I can wear it." (9–male–PT–fluctuating compliance)

> "I put it next to the bathroom sink, so that every time I brush my teeth I will remember to put it on." (15–male–PT–fluctuating compliance)

Overall, almost all participants experienced some or all of the barriers listed in the initial stages of treatment (Fig 2), which temporary impaired compliance, particularly in the fluctuating-compliance group. Over time, participants were exposed to the enablers, which appeared to have improved the level of compliance. In the better-compliance group, strong internal and external motivation safeguarded optimal compliance throughout the treatment, and this was not the case for those with poor compliance.

Recommendations for improving compliance

Four main subthemes emerged from the data (Fig 3).

Effective communication. There was common agreement that effective communication between the orthodontist/orthodontic dental team and patient before and during treatment would enhance the adoption and maintenance of compliant behavior. Clear and specific information concerning the importance of the appliance, wear time, and treatment duration was mentioned. To facilitate this, participants reported that the use of visual aids would be of benefit. One participant went further and discussed the importance of explaining the temporary nature of functional interference and potential consequences of posttreatment relapse.

> "If you want to prescribe a retainer, you should show a picture of it and a picture of it on someone and explain to them that they are going to have a lisp and they are going to talk a bit funnier and the speech is going to be a bit slurred." (11–female–FT–fluctuating compliance)

> "[Provide] a picture of how it looks. Tell them all the information, what you are going to wear, when you are going to wear it, how long it's going to take." (21–male–FT–better compliance)

Positive reinforcement by pointing out improvement was also considered to be important.

> "[It] gives people good news, it makes them want to wear it more, because everyone wants improvement, everyone wants to achieve something." (20–male–FT–poor compliance)

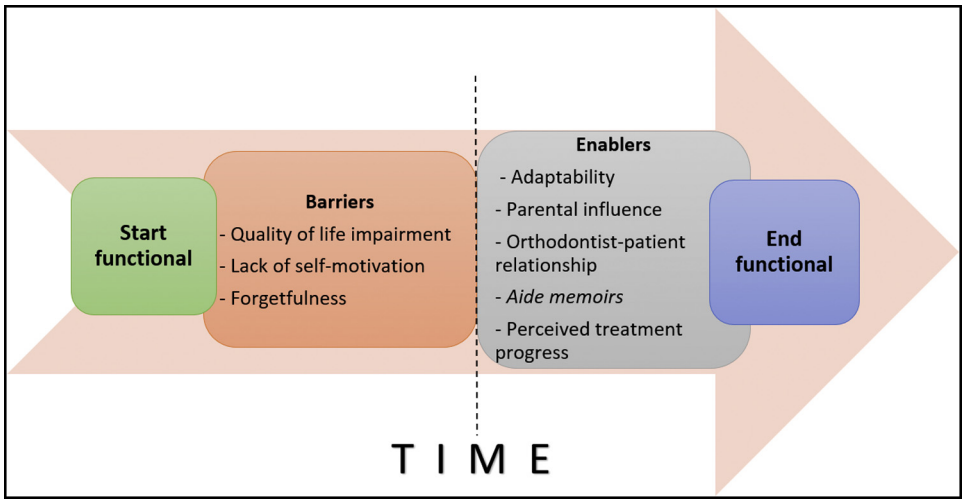

Fig 2. Factors affecting compliance in chronologic order.

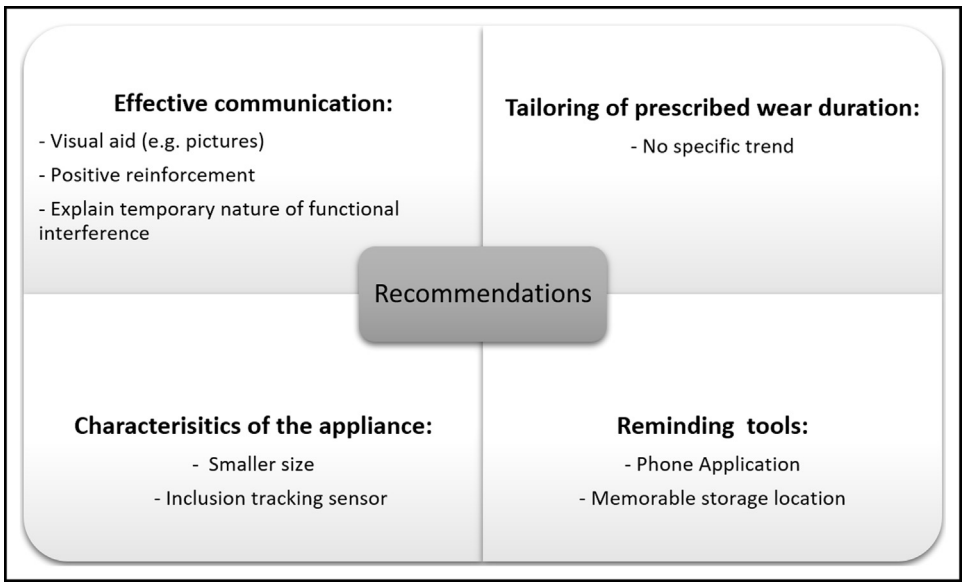

Fig 3. Recommendations to improve compliance.

Tailoring of prescribed wear duration. There was no consensus regarding preferred wear time among participants. For some, full-time wear was linked with minimizing the overall duration of treatment or increasing treatment efficiency.

> "It would be better if you could wear it all the time, because you would wear it more and it would reduce how long you wear it." (21–male–FT–better compliance–21)

However, other participants stated that they would prefer a part-time regime to avoid functional, social, and educational interference associated with full-time wear.

> "I can not do it while I'm sleeping because I would get no sleep if I do it. Because I go to sleep and then I'd choke and gag and then I'd wake up." (19–female–PT–fluctuating compliance)

> "Don't make it 24 hours, because some people will be insecure at school." (17–female–PT–better compliance)

Characteristics of the appliance. Participants felt that modifying some characteristics of the appliance would enhance compliance as well as treatment experience. These changes were mainly related to the dimension, retention, size, and color of the Twin-block.

"I think if you made the blocks a bit smaller it would make a difference, because I feel if they're smaller you'd be able to talk a bit better." (19–female–PT–fluctuating compliance)

"The blocks should be thinner because it takes too much space in your mouth and then in the night when you're sleeping, your mouth would either be really dry or you'd be drooling." (17–female–PT–better compliance)

"Fix it exactly to the person's mouth, so that it does not move around too much in the mouth." (16–male–PT–better compliance)

Two participants went further and provided reasons, although divergent, for the need to change the color of the appliance. Although one advocated a less visible appliance to minimize social impact, the other preferred a more visible appearance to act as a reminder.

"Make it visible, so that when you are done you easily know to remember to put it in and to wear more regularly." (20–male–FT–poor compliance)

"My friend's got clear ones, like the blocks are clear. But my ones were bright red, so even if I was trying to hide it, I would not be able to. So if I was to smile or something, you'd see bright red blocks in my mouth." (19–female–PT–fluctuating compliance)

The use of microsensors was also considered to be a useful tool to accurately measure compliance levels, facilitating self-monitoring and identification of opportunities to improve compliance.

"It will make sure I improve the time if I don't wear it as usual or remind me to wear it." (1–male–FT–fluctuating compliance)

"It makes people wear it more; you will see on the computer if you are wearing it for 24 hours." (11–female–FT–fluctuating compliance)

Reminding tools. The use of reminding tools, such as mobile application together with memorable and visible storing location, were considered to be more likely to enhance compliance. Moreover, participants thought that a mobile application would be supported and accepted by adolescents, who currently depend largely on their smartphones.

"An app would be very useful because I am on my phone most of the time, so I can see the notification and that would remind me." (7–male–PT–better compliance)

"I think that could be a good idea, just reminding me I have to wear braces, or the consequences, the things that can happen, like the operation." (18–male–PT–fluctuating compliance)

DISCUSSION

Suboptimal wear of removable orthodontic components is well documented, with a recent systematic review alluding to actual wear durations of 5.7 hours per day less than recommended.[7] Furthermore, patients are known to provide inflated reports of wear duration of the order of 5 hours per day. Suboptimal wear durations are associated with both prolonged treatment and inferior treatment outcomes, and novel approaches to enhancing compliance have shown relatively little benefit.[8] As such, an improved appreciation of potential facilitators of patient compliance and of factors impairing compliance is important.

Qualitative research methods with one-to-one interviews were used in the present study to obtain realistic unvarnished opinions of the experience of appliance wear. Although larger focus groups may have had the advantage of allowing synergistic conversation and more refined discussion, participants may be reticent to provide sensitive information in a group setting.[10] The interviews were based on a piloted topic guide in the present study specifically to direct the discussion, with open-ended questions used where possible to ensure a detailed yield.[11]

The observation of both quality of life impairment and social influences on appliance wear is intuitive. Previous studies have alluded to the effect of both malocclusion and orthodontic treatment itself on quality of life. Specifically, the functional and visual impact and the pain associated with fixed appliances are known to be problematic.[12] However, although these may impair the experience of fixed appliance treatment and have prompted the refinement of appliances, improved appliance esthetics, and shorter treatment times, this impact does not necessarily adversely affect the treatment outcome. Poor cooperation with removable functional appliances may have a more significant negative bearing on treatment progress and outcome. Moreover, although removable functional appliances may have less visual impact than metal fixed components, impairment in terms of function, speech, sleep, and schooling and social interaction were found to be marked in the present sample, although the latter less so in the part-time group. Similarly, Cirgic et al[9] alluded to pain experience, social effects of functional therapy, and even bullying associated with 1-piece appliances, which tend to be slightly bulkier and less retentive than the Twin-block. The relationship between functional and social impairment and compliance was interesting, with temporary deterioration in wear common, particularly in the early stages of treatment, before wear levels recovered. This resilience appeared to be

more likely among self-motivated participants, although extraneous influences, including the effects in terms of motivation and advice of the treating clinician, friends, and parents, were found to be particularly important.

The influence of treatment progress appeared to be significant, although it could be argued that facial and occlusal improvement is most likely in more compliant patients anyway. Notwithstanding this, demonstrable change was frequently reported as a facilitator of appliance wear. As such, the importance of encouragement and positive reinforcement by clinicians and family members in encouraging appliance wear is clear.[13] The prominence of pragmatic and recall issues in limiting appliance wear was interesting and suggests that simple measures to enhance compliance may well be viable. Specifically, reminders, including the use of mobile applications and other electronic reminders, were advocated. These have shown promise in other areas of medicine, specifically in relation to enhancing compliance with glycemic control in diabetes[14] and self-management in chronic obstructive pulmonary disease.[15] The use of apps has also proven to be effective in enhancing compliance with fixed appliance–based treatment in orthodontics.[16] As such, refinement and adoption of these approaches in encouraging removable appliance wear would appear to be overdue.

The sample assessed in the present study was obtained from an ongoing trial assessing the relative merits of full-time and part-time wear of a modified Twin-block within a National Health Service hospital setting. Participants were in receipt of treatment free of charge and were under the care of postgraduate students. As such, the generalizability of the findings is questionable, particularly as compliance levels among those paying for treatment is thought to be better.[17] Notwithstanding this, it is possible that compliance levels were lower in the present sample than might have been observed in other settings, thus providing deeper insight into the factors influencing compliance levels. The present study was also undertaken on the Twin-block appliance and therefore may not be applicable to other functional designs. Overall, however, the findings were largely in keeping with analogous research,[9] although participants did variously refer to the possible benefit of streamling the appliance itself or indeed considering the use of fixed alternatives.

CONCLUSIONS

This study highlights the multifaceted patient perceptions of wear of a removable functional appliance. Specifically, the fluctuating temporal nature of compliance and myriad factors, including peer and authority influence, quality of life, perceived progress, and recall issues, were observed. Professional and parental influence as well as customized reminders may help to promote enhanced levels of compliance with Twin-block wear.

REFERENCES

1. Seehra J, Fleming PS, Newton T, DiBiase AT. Bullying in orthodontic patients and its relationship to malocclusion, self-esteem and oral health-related quality of life. J Orthod 2011;38:247-56.
2. Thiruvenkatachari B, Harrison JE, Worthington HV, O'Brien KD. Orthodontic treatment for prominent upper front teeth (class II malocclusion) in children. Cochrane Database Syst Rev 2013;(11):CD003452.
3. O'Brien K, Wright J, Conboy F, Chadwick S, Connolly I, Cook P, et al. Effectiveness of early orthodontic treatment with the Twin-block appliance: a multicenter, randomized, controlled trial. Part 2: psychosocial effects. Am J Orthod Dentofacial Orthop 2003;124:488-94.
4. Chadwick S, Banks P, Wright J. The use of myofunctional appliances in the UK: a survey of British orthodontists. Dent Update 1998;25:302-8.
5. Lee RT, Kyi CS, Mack GJ. A controlled clinical trial of the effects of the Twin Block and Dynamax appliances on the hard and soft tissues. Eur J Orthod 2007;29:272-82.
6. Caldwell S, Cook P. Predicting the outcome of twin block functional appliance treatment: a prospective study. Eur J Orthod 1999;21:533-9.
7. Al-Moghrabi D, Colonio Salazar FB, Pandis N, Fleming PS. Compliance with removable orthodontic appliances and adjuncts: a systematic review and meta-analysis. Am J Orthod Dentofacial Orthop 2017;152:17-32.
8. Veeroo HJ, Cunningham SJ, Newton JT, Travess HC. Motivation and compliance with intraoral elastics. Am J Orthod Dentofacial Orthop 2014;146:33-9.
9. Čirgić E, Kjellberg H, Hansen K, Lepp M. Adolescents' experiences of using removable functional appliances. Orthod Craniofac Res 2015;18:165-74.
10. Bloor M. Focus groups in social research. Sage; 2001.
11. Liamputtong P. Research methods in health: foundations for evidence-based practice. Oxford: Oxford University Press; 2010.
12. Johal A, Fleming P, Al Jawad F. A prospective longitudinal controlled assessment of pain experience and oral health-related quality of life in adolescents undergoing fixed appliance treatment. Orthod Craniofac Res 2014;17:178-86.
13. Richter DD, Nanda RS, Sinha PK, Smith DW. Effect of behavior modification on patient compliance in orthodontics. Angle Orthod 1998;68:123-32.
14. Cahn A, Akirov A, Raz I. Digital health technology and diabetes management. J Diabetes 2017;10:10-7.
15. McCabe C, McCann M, Brady AM. Computer and mobile technology interventions for self-management in chronic obstructive pulmonary disease. Cochrane Database Syst Rev 2017;(5):CD011425.
16. Li X, Xu Z-R, Tang N, Ye C, Zhu X-L, Zhou T, et al. Effect of intervention using a messaging app on compliance and duration of treatment in orthodontic patients. Clin Oral Investig 2016;20:1849-59.
17. Schäfer K, Ludwig B, Meyer-Gutknecht H, Schott TC. Quantifying patient adherence during active orthodontic treatment with removable appliances using microelectronic wear-time documentation. Eur J Orthod 2015;37:73-80.