Information retention of orthodontic patients and parents: A randomized controlled trial

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Introduction: A randomized controlled trial was undertaken to compare the efficacy of 3 methods of delivering information on short- and long-term recall of information in orthodontic patients and parents. **Methods:** Participants who received an audiovisual presentation on orthodontic treatment were randomly allocated to 1 of 3 written information groups (leaflets, generic mind map, or participant's customized mind map). A questionnaire was used to assess short- and long-term retention of information (maximum score 30). **Results:** Eighty-eight patients (94.6%) and 77 parents (86.5%) completed the study. The average knowledge scores at baseline for the patient groups were 17.71 95 CI 16.28-19.14), 16.58 (14.67-18.49), and 17.37 (15.92-18.81), respectively. The parents' knowledge scores for the 3 groups were 19.06 (17.51-20.62), 19.39 (17.44-21.35), and 18.76 (17.19-20.33), respectively. The short- and long-term knowledge scores improved over baseline in all 3 groups ($P < 0.0001$). The parents achieved higher scores than the patients ($P = 0.002$) and their rate of forgetting information was less. The knowledge scores of the mind map groups were higher than that of the leaflet group for all cohorts ($P = 0.025$). No statistical difference was found between the type of mind map. The correlation between patient and parent knowledge scores was significant ($P < 0.0001$) at all 3 time points. **Conclusions:** Provision of an audiovisual presentation supplemented with 1 of 3 written information methods is an effective way of delivering information. There was a significant improvement in the retention of information with the use of mind maps compared with leaflets. The generic mind map is equally as effective, more consistent in information delivered, and less labor intensive than the individual customized mind map and therefore would be our recommendation. Participation of parents is important because they comprehend and retain information better. In this study, 100% of parents shared information with their children, perhaps improving the patients' recall. (Am J Orthod Dentofacial Orthop 2019;156:169-77)

Good communication and effective delivery of information are key processes in health care provision.[1] Evidence suggests that patients' overall satisfaction with care received is greatest when they believe adequate information has been provided.[2] Good communication also supports the patient to understand and retain more quality information, which may lead to reduced anxiety, improved patient compliance, and subsequently better treatment outcome by altering behavior patterns.[3-5] Spelman et al[6] stated that communication is deemed to be effective when the patient understands and retains the information given. Many studies have reported that orthodontic patients and parents do not always comprehend and retain information given, and poor short-term or long-term retention of orthodontic information may lead to patient complaints or even litigation.[7-9] Sufficient information must be delivered in easy format to ensure that patients understand and retain the information given.[10]

McGuire[11] reported that patients immediately forgot 60%-80% of medical information presented and that their recall got worse with increased amount of information. Similar findings were noted in orthodontic studies. Witt and Bartsch[12] assessed the retention of information by orthodontic patients during initial consultation and concluded that only 30% of the information given was recalled correctly after 10 days. In that study, patients

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were more likely to retain information that concerned or interested them and affected everyday life. Baird and Kiyak[7] studied 21 orthodontic patients who had been in treatment for 1-24 months as well as one of their parents or guardians to assess their understanding of orthodontic treatment. That study concluded that both patients and parents had poor recall of diagnosis and risks associated with orthodontic treatment, and that there was a positive correlation between parents' vocabulary or educational levels and the level of comprehension of the orthodontic information given. A similar study was conducted with 29 orthodontic patients and their parents at the orthodontic case presentation appointment in the same university by Mortensen et al.[8] That study concluded that short-term recall of patients and parents was poor, especially of significant associated risks, such as relapse, caries, and periodontal problems.

Individuals differ in how they learn, and tailoring instruction according to individuals' learning style may improve recall of information given.[13] Some individuals may have strong preference to visual learning, whereas others may prefer to learn through kinesthetic modalities.[14] Verbal communication is a commonly used source of information, but often it is not effective, because medical professionals use technical terminologies that are unfamiliar to the general public.[15] Medical research has suggested that patients retain only about 20% of verbal information given and that this may increase by 50% when supplemental written or visual information is provided.[16] A number of research papers also concluded that medical patients favored verbal instructions with supplemental written leaflets and retained more information, resulting in better understanding and compliance.[17-19] The readability of orthodontic leaflets is recommended to be aimed at grade 8 (13-14 years) and grade 5-6 (10-11 years) for U.S. and U.K. populations, respectively.[20] A mind map is a simple visual method of providing information in a 1-page "snap-shot" representation that promotes critical thinking skills and enhances memory recall by encouraging individuals to think in their own radial manner.[21,22] Incorporating pictures, images, and colors has been shown to facilitate the retention of information and may also have a positive effect of attracting those who prefer a visual learning style.[23] A number of studies in the literature compared different methods of delivering information, such as patient leaflets, mind map, and audiovisual slides, and evaluated the effectiveness of each method by assessing patient retention of treatment information.[24-29] Thickett and Newton (2006) evaluated short-term and long-term recall of orthodontic patients and concluded that the use of a mind map demonstrated a superior outcome compared with information leaflets.[29]

A mind map may be more effective in enhancing recall than other methods of presentation, but it may depend on the nature of the mind map. A mind map designed by the individual themselves would be anticipated to enhance cognitive engagement with the task. A systematic review and meta-analysis of 55 studies across 5818 participants found that mind maps resulted in greater knowledge retention compared with more traditional methods of information presentation, and that the effect was increased if the participants were engaged in the development of the map.[30] The present study sought to compare the benefits of a pre-prepared mind map with a mind map produced by the patients themselves.

Objectives and hypothesis

The aim of this trial was to determine the most effective way of communicating and delivering orthodontic information to patients and parents to maximize their short- and long-term retention of information. This study was designed to compare the effectiveness of 3 methods of delivering information (audiovisual presentation supported by one of 3 written information: British Orthodontic Society (BOS) leaflets, generic pre-prepared mind map, or custom-made mind map by the participant). The null hypothesis was that the 3 different methods of providing information did not make any difference to the recall of information of patients and their parents in the short- or long-term.

MATERIAL AND METHODS

Trial design and any changes after trial commencement

This study was a single-center, prospective, randomized controlled trial. Ethical approval was obtained from the London Bridge Research Ethics Committee (reference 17/LO/0422). The Committee approved the trial design, including randomization and blinding processes, and no changes were made to the trial after its commencement.

Participants, eligibility criteria, and setting

This study was conducted in the orthodontic department at a district hospital in the U.K. All patients and parents who attended the workshop appointment before commencement of orthodontic treatment were recruited to the study. Patients who were 10 years of age or older were eligible for inclusion, and all parents whose child agreed to join the study were included.

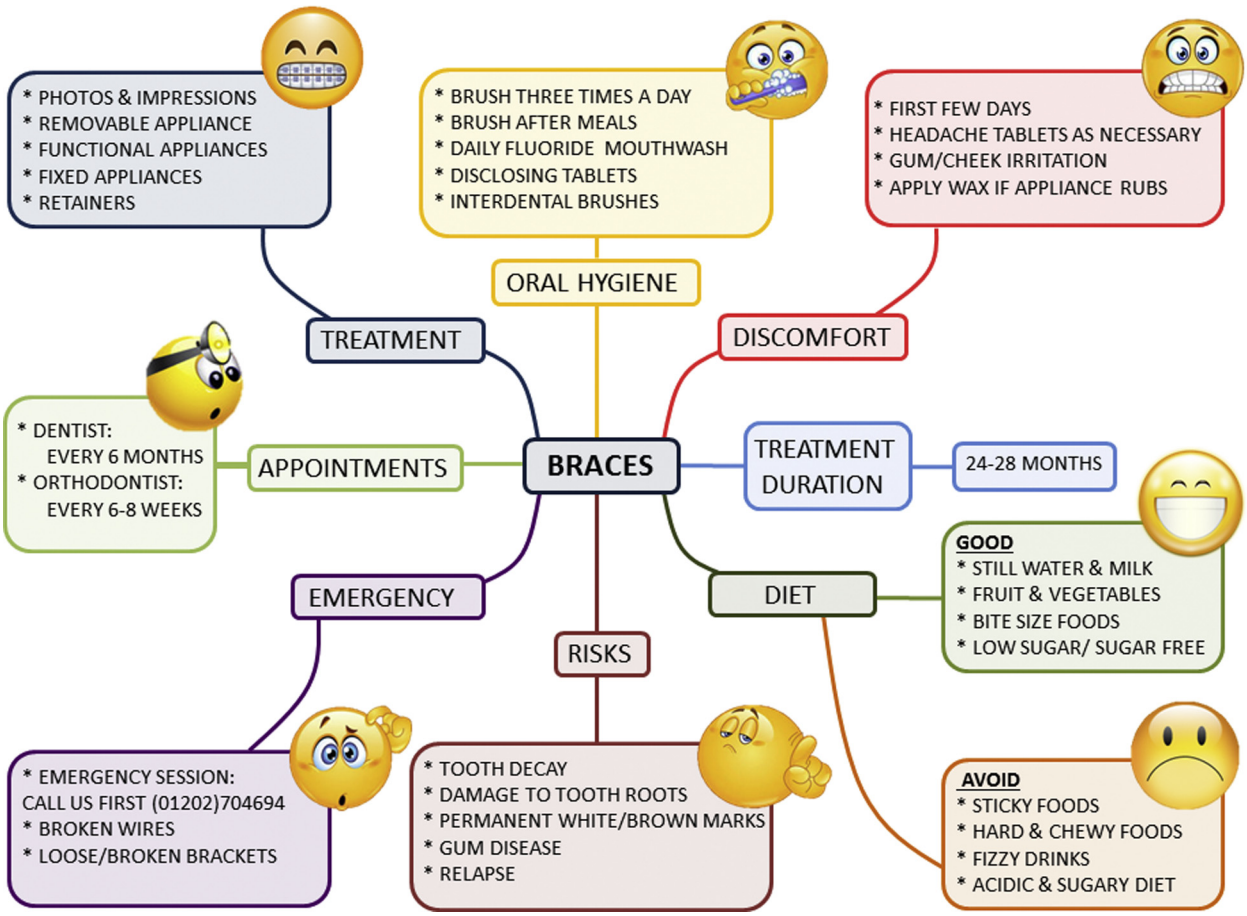

Fig 1. The pre-prepared generic mind map.

The criteria for exclusion included patients or parents who lacked capacity to consent, patients with craniofacial abnormalities or previous orthodontic experience, and patients or parents who did not speak English.

The invitation letter and patient information sheet were posted to patients along with their workshop appointment. More than 24 hours was given for the patients to decide to participate in the study. Before the workshop began, a PowerPoint (Microsoft, Redmond, Wash) presentation regarding the research was given by the researcher, and the patients and parents were given time to ask any questions. When patients agreed to join the study, consent was obtained from the patients and parents. Participants were recruited from May 2017 to December 2017.

Interventions

The routine workshop appointment involved 1 of 3 Dental Care Professionals (DCPs) who provided a 45-minute audiovisual presentation on orthodontic information followed by BOS leaflets. Several studies have reported that these leaflets are relatively easy to read and written such that 70%-80% of the U.K. population would be able to understand them.[20,31] This standard workshop protocol was chosen as the control group.

The second group was given the same audiovisual information as the control group except that the written information was given as a mind map. The mind map was prepared with the use of PowerPoint and printed as a color laminated A4 (210 × 297 mm) sheet (Fig 1). The mind map information was clustered into 8 main categories, and emojis and colors were incorporated to draw attention for young patients and facilitate the recall of information. The information on the mind map was checked and approved by 2 consultant orthodontists. The mind map was also shown to a group of patients to obtain lay opinion. Positive feedback, including that is was easy to read and understand, was obtained.

The third group received the same audiovisual information as the other groups, but they were asked to draw

their own mind map with the use of orthodontic information that was important to them. A blank A4 paper and colored pens were provided to draw the mind map. Guidance on how to draw a mind map was given to the group without providing additional orthodontic information.

When designing the study, the researcher had a meeting with the 3 DCPs and went through the Powerpoint slides to structure the presentation so that full, accurate, and consistent oral health advice was given each time to enable participants to achieve the maximum score.

A research questionnaire (Appendix) was designed to assess the short- and long-term recall of participants. The questionnaire comprised 13 questions with a maximum total score of 30. It was designed in a closed-ended format to allow for greater uniformity of responses. An independent nurse, not involved in the research, handed out the questionnaire to patients and parents before the workshop (T0) to determine baseline knowledge. Thirty minutes after administration of the audiovisual presentation and written information (T1), the questionnaires were given to assess the short-term recall of information. The participants were monitored during this process to ensure that answers were not affected by any external influence. The same questionnaire was repeated at the beginning of their follow-up appointment 6 weeks later (T2) without repetition of information.

Outcomes (primary and secondary)

The primary outcome measure was the knowledge scores of participants 30 minutes after administration of the information to assess short-term retention and without repetition of the information 6 weeks later to assess long-term retention. These knowledge scores were compared with the baseline to assess the intervention effect. Demographic information and other participant-related factors were recorded to assess whether there were any variables that might affect the retention of orthodontic information.

Sample size calculation

The sample size calculation for this study was based on 1-way analysis of variance for comparing mean difference (before and after the workshop) in the knowledge scores among 3 groups. A study with an effect size of 0.4 and 80% power required a total sample of 66 (22 per group) to test the difference at 5% level of significance with the use of 2-tailed tests. Anticipating a dropout rate of 30%, a total sample of 93 (31 per group) was considered for this study. The analysis was based on an intention-to-treat approach.

Randomization (random number generation, allocation concealment, implementation)

Patients were allocated in a ratio of 1:1:1 to the intervention groups based on random numbers generated in a standardized way with the use of a computer program. Block randomization was designed with blocks of 3 (each block contained all 3 interventions in a random order) to allow a random allocation of the patients and to ensure equal numbers in comparison groups throughout the research. The table was produced by a third party at the Bournemouth University Local Research Department.

A unique identifier code was provided to each patient to blind the study. The code and information of a proposed intervention were enclosed in the sealed opaque envelopes that were prepared by a third party at the Local Research Department. The envelopes were double protected with a sticker and sequentially numbered.

These envelopes were assessed just before the workshop to ensure the envelope seal was not broken and were handed out in the correct order by an individual nurse who was not involved in the research. The nurse accessed the envelopes with the patients and provided written information as recorded in the envelopes.

Blinding

The researcher was blinded from the study by involving the nurse who did not take part in the study. Information on the study groups was also blinded from the statistician to prevent systematic distortion of the data analysis and results. It was not possible to blind the participants because they knew what written information was provided to them.

Statistical analysis

Descriptive statistics, such as mean, standard deviation, median, minimum, and maximum, were used to summarize the knowledge scores for various demographic variables across groups. Percentages were used to summarize the study sample characteristics. The distribution of knowledge scores was assessed with the use of histogram, box plot, and Shapiro Wilks test. Because the knowledge scores followed normal distribution, parametric analyses were carried out to assess the influence of various factors such as time, age, status, group (intervention), and ethnicity on the knowledge scores. The missing data were handled by using a random-effects model, which includes all of the available observations in the analysis. If any of the interaction effects

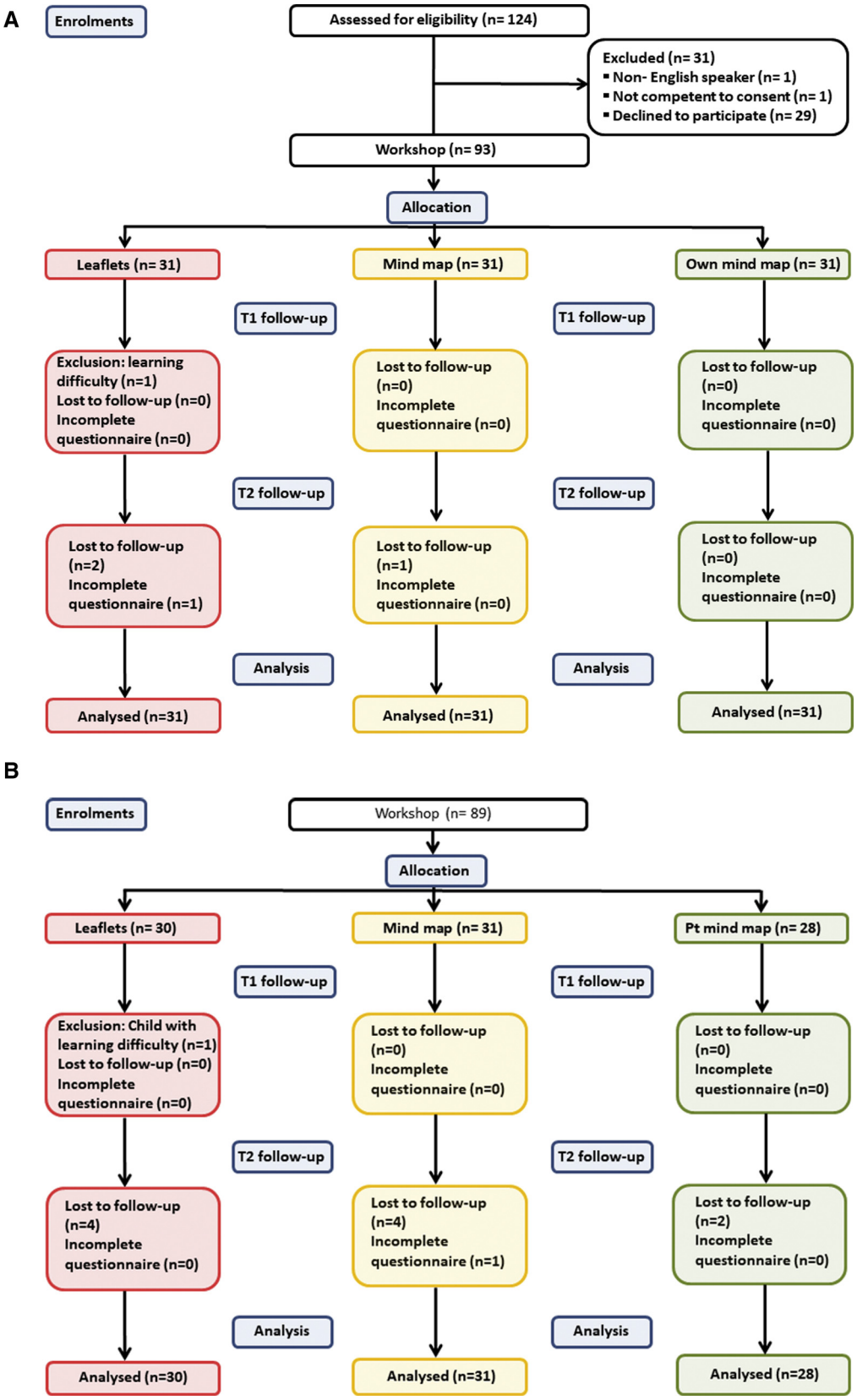

Fig 2. A, CONSORT flow diagram of patients. **B,** CONSORT flow diagram of parents.

Table I. Demographic details of study sample

Participants	*Characteristic*	*Mind map*	*Patient mind map*	*BOS Leaflet*
Patients	Sex			
	Male	11 (35.5)	16 (51.6)	14 (46.7)
	Female	20 (64.5)	15 (48.4)	16 (53.3)
	Missing	0	0	1
Parents	Sex			
	Male	4 (13.3)	9 (32.1)	4 (13.8)
	Female	26 (86.7)	19 (67.9)	25 (86.2)
	Missing	1	3	2
Patients	Ethnicity			
	White British	27 (87.1)	25 (86.2)	26 (89.7)
	Other	4 (12.9)	4 (13.8)	3 (10.3)
	Missing	0	2	2
Parents	Ethnicity			
	White British	27 (87.1)	25 (86.2)	27 (90.0)
	Other	4 (12.9)	4 (13.8)	3 (10.0)
	Missing	0	2	1
Patients	Age			
	Mean (SD)	12.74 (1.73)	13.32 (1.99)	13.60 (1.81)
	Median (min, max)	13.00 (10, 16)	13.00 (10, 18)	13.00 (10, 19)
Parents	Age			
	Mean (SD)	44.80 (11.67)	45.28 (6.90)	46.48 (8.81)
	Median (min, max)	46.00 (30, 82)	47.00 (30, 56)	46.00 (23, 62)

were not significant in the initial model, they were removed from the final model. Thus, the final model included all the main effects and significant interaction effects. If the interaction effect was significant in the final model, then further analyses were carried out to find out which combination of interaction effects were significant.

RESULTS

Participant flow

A total of 124 patients were screened and 31 were excluded from the study owing to selection criteria or patients' refusal to take part (Fig 2, *A*). Five patients were subsequently lost during the course of the study. A total of 89 parents participated in the study, and 12 parents were lost during the course of the study (Fig 2, *B*).

Baseline data

Demographic characteristics of the participants are presented in Table I. The mean age of the patients and the parents were 13.2 (±1.8) and 45.5 (±9.1) years respectively. There was no significant difference between the three groups with respect to age ($p>0.05$). The results showed that while the majority of parents attending with the patients were mothers, there was no significant difference observed in the sex distributions within the three groups for either patients or parents ($p>0.05$ for both patients and parents). Table II summarizes the knowledge scores for various demographic variables across groups.

Numbers analyzed for each outcome, estimation and precision, subgroup analysis

Because the percentage of missing observations was high (5.91%) across various time points, random-effects models were used to assess the influence of various factors on the knowledge scores. The initial model included the main effects of time, status (patient or parent), group (BOS leaflets, generic mind map, participant customized mind map), ethnicity (white British or other), age, and the interaction effects of time versus group, time versus sex, time versus status, and time versus ethnicity. Statistical significance was assumed at the 5% level.

Because the interaction effects, namely, time versus group ($P = 0.19$), time versus sex ($P = 0.11$), and time versus ethnicity ($P = 0.56$), were not statistically significant in the initial model, these effects were removed. Therefore, the final analysis model included the main effects of time, status, group, ethnicity, and age along with the interaction of time versus status. The results are summarized in Table III. The knowledge scores increased significantly from T0 to T1 and T2. The knowledge scores for parents were significantly higher ($P = 0.002$) than for patients. The significance between groups indicates that the interventions had significant influence on the knowledge scores. The leaflet and

Table II. Summary statistics of scores at various time points

Participants	*Time*	*Mind map*	*Patient mind map*	*BOS Leaflet*
Patients	T0 (baseline)			
	Mean (SD)	17.71 (3.89)	16.58 (5.21)	17.37 (3.86)
	Median (min, max)	17 (11, 25)	16 (7, 25)	16.50 (10, 25)
Parents	T0 (baseline)			
	Mean (SD)	19.06 (4.24)	19.39 (5.04)	18.76 (4.12)
	Median (min, max)	20 (10, 26)	20 (6, 30)	19 (9, 27)
Patients	T1 (30 minutes after)			
	Mean (SD)	27.61 (1.43)	25.48 (1.95)	26.07 (1.87)
	Median (min, max)	28 (25,30)	26 (21, 29)	26 (20, 29)
Parents	T1 (30 minutes after)			
	Mean (SD)	27.00 (2.48)	26.29 (1.96)	25.79 (2.26)
	Median (min, max)	28 (18, 30)	26 (22, 30)	26 (19, 29)
Patients	T2 (6 weeks after)			
	Mean (SD)	25.47 (2.60)	25.48 (1.29)	24.48 (2.46)
	Median (min, max)	26 (19, 29)	25 (23, 28)	25 (17, 29)
Parents	T2 (6 weeks after)			
	Mean (SD)	26.31 (1.89)	25.58 (1.98)	24.96 (1.77)
	Median (min, max)	27 (20, 29)	26 (22, 30)	25 (22, 28)

mind map groups did not differ significantly. However, the knowledge scores for participants in the mind map groups were significantly higher ($P = 0.025$) than the knowledge scores of participants who were in the leaflet group for all cohorts. The difference was not statistically significant between the 2 mind map groups. The knowledge score did not differ between ethnic groups. The interaction between time and status were statistically significant ($P = 0.0002$), so further comparisons were carried out to find out which combinations were statistically significant.

The knowledge score of patients at T0 was significantly ($P <0.0001$) lower than at T1 and T2, indicating that the intervention had increased their oral health knowledge, and similar results were observed for parents. At T1 and T2, the knowledge scores did not differ significantly between patients and parents ($P >0.05$). The correlation between patient and parent knowledge scores were significant ($P <0.0001$) at all 3 time points. All (100%) of the parents answered in the T2 questionnaire that they shared the information obtained with their children, suggesting that the knowledge of the parents affected the knowledge of the children. The rate of forgetting information was less for parents compared with patients.

Table III. Predictors, effects, 95% confidence intervals (CIs), and significance from the random-effects model

Predictor	*Compared with*	*95% CI*	P *value*
Time: T0			
T1	9.25	8.50 to 9.99	<0.0001
T2	7.99	7.23 to 8.75	<0.0001
Status: Patient			
Parent	3.29	1.26 to 5.33	0.002
Group: Mind map			
Patient mind map	0.66	−1.54 to 0.21	0.14
BOS Leaflet	−0.99	−1.85 to −0.12	0.025
Ethnicity: White British			
Other	−0.47	−1.57 to 0.64	0.41
Interaction			
Time × status			0.0002

DISCUSSION

Main findings in the context of the existing evidence, interpretation

Provision of an audiovisual presentation and 1 of 3 written information methods is an effective way of producing significant improvement in short- and long-term recall of information in patients and parents. In the present study, the null hypothesis was rejected because the administration of mind maps was demonstrated to better improve the recall of information in both patients and parents compared with leaflets. A similar result was observed in previous research by Thickett and Newton[29] where the use of a mind map demonstrated a superior outcome compared with leaflets.[29] The U.K. study by Aljabaa et al[24] found no statistical significance between the use of a mind map and leaflets in terms of adherence to oral hygiene instructions.[24] However, their mind map did not conform to a recognized concept and was not included in the publication for viewing. Review of the current literature did not show any evidence of past research that assessed the effectiveness of using a mind map produced by orthodontic patients on recall of information.

This research demonstrates the importance of parental involvement in provision of medical

information. Parents comprehend and retain information better and share this with their children, thereby improving the patients' recall of information. Regardless of the type of written information, recall of patients and parents degraded from short- to long-term in all groups, a finding similar to previous research by Thickett and Newton.[29] It is, therefore, suggested that information be repeated at follow-up appointments.

Patients and parents in all groups of this study reported that the written information given was easy to read and comprehend. However, their perception on readability and comprehension of information was not reflected in their knowledge score. When readability of written information reaches a certain level, it may not be a significant factor that affects recall of information by patients and parents. This is supported by the U.S. study by Kang et al[26] which demonstrated that the use of information leaflets with enhanced readability did not improve recall or comprehension of patients and parents.

Limitations

The participants of the study might pay more attention to the audiovisual presentation and written information to obtain a higher score during the research. In addition, the T0 questionnaire was given to them before the workshop to assess their baseline knowledge. It is possible that some participants memorized the questions and selectively learned the related information during the interventions, leading to increased short-term knowledge score. The long-term knowledge score was high after 6 weeks, but was lower than the short-term knowledge score. This can be due to decay of knowledge or selective learning of the information. The positive effect with the intervention of the study may be overstated.

The leaflets on fixed appliances recommend tooth brushing twice daily. This is a different tooth brushing regimen from our department's recommendation. Therefore, the researcher crossed it out and wrote in "three times daily" instead. As a consequence, this information might stand out and helped the participants in the leaflet group to retain this particular knowledge.

Generalizability

This study was conducted in a single secondary care setting funded by the National Health Service, and this may limit its clinical application to other care settings. Patients accepted for hospital treatment generally have more severe malocclusions with a higher treatment need compared with primary care settings, and their behavior and motivation toward treatment may be greater. Treatment is free of charge, and responsibility or behavior patterns of patients and parents could be different from those who pay for treatment. This limitation can be overcome by conducting a multicentered study.

Not all hospitals or orthodontic practices have facilities to provide an audiovisual presentation. Conducting further research on the effectiveness of combining verbal communication with 1 of the 3 written information methods in a multicentered setting may provide more meaningful evidence.

CONCLUSIONS

All 3 methods of delivering information significantly improved the short- and long-term recall of information given. There was a small but significant improvement in the retention of information with the use of the mind maps compared to the leaflets. The generic mind map was equally as effective as the individual custom-made ones. Therefore, provision of a pre-prepared mind map as supplementary written information is recommended because it is less labor intensive and potentially cheaper and more consistent in information delivered. Because information recall degraded from short to long term in all groups, it is suggested that information be repeated at follow-up appointments.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.ajodo.2019.03.017.

REFERENCES

1. General Dental Council. Standards for the dental team: London; 2018. https://www.gdc-uk.org/api/files/NEW%20Standards%20for%20the%20Dental%20Team.pdf.
2. Callender RS, Barbour A. Effective communication with clients: retention of information. J Clin Orthod 1979;13:321-4.
3. Bishop P, Barlow J, Williams N, Hartley P. Reflections on a multidisciplinary approach to evaluation of patient-literature materials. Health Educ J 1997;56:404-13.
4. Ley P. Communicating with patients: Improving communication, satisfaction and compliance. New York: Croom Helm; 1988.
5. Thomson AM, Cunningham SJ, Hunt NP. A comparison of information retention at an initial orthodontic consultation. Eur J Orthod 2001;23:169-78.
6. Spelman MS, Ley P, Jones C. How do we improve doctor-patient communications in our hospitals? Hosp Top 1967;45:28-9.
7. Baird JF, Kiyak HA. The uninformed orthodontic patient and parent: treatment outcomes. Am J Orthod Dentofacial Orthop 2003;124:212-5.
8. Mortensen MG, Kiyak HA, Omnell L. Patient and parent understanding of informed consent in orthodontics. Am J Orthod Dentofacial Orthop 2003;124:541-50.
9. Newton JT. Dentist/patient communication: a review. Dent Update 1995;22:118-22.

10. Marcus C. Strategies for improving the quality of verbal patient and family education: a review of the literature and creation of the EDUCATE model. Health Psychol Behav Med 2014;2:482-95.
11. McGuire LC. Remembering what the doctor said: organization and adults' memory for medical information. Exp Aging Res 1996;22: 403-28.
12. Witt E, Bartsch A. The effect of information and communication in the orthodontic consultation. 1. The imparting of the information. Fortschr Kieferorthop 1993;54:187-95.
13. Pashler H, McDaniel M, Rohrer D, Bjork R. Learning styles: concepts and evidence. Psychol Sci Public Interest 2008;9:105-19.
14. Fleming N, Baume D. Learning styles again: VARKing up the right tree. Educ Dev 2006;7(4):4-7.
15. Boyle CM. Difference between patients' and doctors' interpretation of some common medical terms. BMJ 1970;2:286-9.
16. Moult B, Franck LS, Brady H. Ensuring quality information for patients: development and preliminary validation of a new instrument to improve the quality of written health care information. Health Expect 2004;7:165-75.
17. Culbertson VL, Arthur TG, Rhodes PJ, Rhodes RS. Consumer preferences for verbal and written medication information. Drug Intell Clin Pharm 1988;22:390-6.
18. Gauld VA. Written advice: compliance and recall. J R Coll Gen Pract 1981;31:553-6.
19. Mayeaux EJ Jr, Murphy PW, Arnold C, Davis TC, Jackson RH, Sentell T. Improving patient education for patients with low literacy skills. Am Fam Physician 1996;53:205-11.
20. Seehra J, Cockerham L, Pandis N. A quality assessment of orthodontic patient information leaflets. Prog Orthod 2016;17:15.
21. Michelini CA. Mind map: a new way to teach patients and staff. Home Healthc Nurse 2000;18:318-22.
22. Spencer JR, Anderson KM, Ellis KK. Radiant thinking and the use of the mind map in nurse practitioner education. J Nurs Educ 2013;52:291-3.
23. d'Antoni AV, Zipp GP, Olson VG, Cahill TF. Does the mind map learning strategy facilitate information retrieval and critical thinking in medical students? BMC med educ 2010; 10:61.
24. Aljabaa A, McDonald F, Newton JT. A randomized controlled trial to compare 3 methods designed to enhance adherence among orthodontic patients. JDR Clin Trans Res 2016;1:59-68.
25. Carr KM, Fields HW Jr, Beck FM, et al. Impact of verbal explanation and modified consent materials on orthodontic informed consent. Am J Orthod Dentofacial Orthop 2012;141:174-86.
26. Kang EY, Fields HW, Kiyak A, Beck FM, Firestone AR. Informed consent recall and comprehension in orthodontics: traditional vs improved readability and processability methods. Am J Orthod Dentofacial Orthop 2009;136:488.e1-13.
27. Patel JH, Moles DR, Cunningham SJ. Factors affecting information retention in orthodontic patients. Am J Orthod Dentofacial Orthop 2008;133:S61-7.
28. Pawlak CE, Fields HW Jr, Beck FM, Firestone AR. Orthodontic informed consent considering information load and serial position effect. Am J Orthod Dentofacial Orthop 2015;147: 363-72.
29. Thickett E, Newton JT. Using written material to support recall of orthodontic information: a comparison of three methods. Angle Orthod 2006;76:243-50.
30. Nesbit JC, Adesope OO. Learning with concept and knowledge maps: a meta-analysis. Rev Educ Res 2006;76:413-48.
31. Harwood A, Harrison JE. How readable are orthodontic patient information leaflets? J Orthod 2004;31:210-9.

APPENDIX
QUESTIONNAIRE

Unique number:
Gender:
Age:
Ethnicity:

T1 QUESTIONNAIRE

1. Which food and drinks should you avoid?

	Yes	No	Don't know
FRUIT	□	□	□
CHEWING GUM	□	□	□
CRUSTY BREAD	□	□	□
STILL WATER	□	□	□
SWEETS	□	□	□
HARD FOODS	□	□	□
FIZZY WATER	□	□	□
DIET FIZZY DRINKS	□	□	□

2. Should you still visit your High Street Dentist while having braces?
Yes □ No □ Don't know □

3. Should you use a fluoride mouthwash?
Yes □ No □ Don't know □

4. How often should you brush?
Once a day □
Twice a day □
Three times a day □
Don't know □

5. It is important to brush after a meal?
Yes □ No □ Don't know □

6. What does a disclosing tablet do?
Clean your teeth □
Stain food/plaque in your mouth □
Make your breath smell good □
Don't know □

7. How long will treatment take?
Less than 6 months □ 12 months – 15 months □
2- 3 years □ Over 3 years □
Don't know □

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8. If you experience brace-related ache what should be done?

	Yes	No	Don't know
Try to remove bracket/wire yourself	□	□	□
Use some wax	□	□	□
Do take painkillers	□	□	□

9. What do you do if the brace gets damaged?

Do nothing & wait until you next appointment	□
Phone your own dentist for an appointment	□
Phone the hospital to book an emergency session	□
Don't know	□

10. How long should you wear retainers?

6 months □ 1 year □ Indefinite (Forever) □ Don't know □

11. Can poor brushing lead to the following?

	Yes	No	Don't know
Gum swelling/infection	□	□	□
Decayed teeth (cavity)	□	□	□
Bad breath	□	□	□

12. Is it ok to bite nails whilst wearing a brace?

Yes □ No □ Don't know □

13. What are the complications of orthodontic treatment?

	Yes	No	Don't know
Permanent white/brown marks	□	□	□
Gum disease	□	□	□
Indigestion (stomach upset)	□	□	□
Damage to tooth root	□	□	□
Jaw joint pain	□	□	□
Relapse (teeth move back)	□	□	□
Dry mouth	□	□	□

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