Factors Associated With Follow-Up Visits in Parents With Myopic Children Wearing Orthokeratology Lens

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ABSTRACT

Background: Orthokeratology (Ortho-k) is an effective method for slowing the progression of myopia and correcting refractive error in school children. Although parents of children aged < 10 years play a major role in Ortho-k lens care, they have a generally low level of compliance in performing regular follow-up visits.

Purpose: This study was developed to analyze the associations between follow-up visits by parents of Ortho-k lens wearers aged < 10 years and, respectively, the Ortho-k-related knowledge of these parents and information resources promoting Ortho-k use.

Methods: A cross-sectional study design was used. Parents of children who wear Ortho-k lenses were recruited through a private Facebook group with 3,500 members in 2020 that was created in 2018 for information sharing and exchange among parents of these children. The following data were collected: demographics of the parents and their children, four-item Ortho-k-related knowledge, information resources that prompted the decision to use Ortho-k, and the regularity of follow-up visits. These data were presented in terms of means, standard deviations, and percentages. Logistic regression was performed to compute the odds ratios (ORs) and 95% confidence intervals (CIs).

Results: The study showed that 83.11% had regular follow-up visits. The correct response rate on Ortho-k-related knowledge was > 80%. However, 15.51% of the participants did not recognize axial length as an indicator for monitoring myopia progress, and 10.76% did not know that at least 6 hours of nighttime sleep is required for myopia control with Ortho-k. The most common information resource leading to Ortho-k use was self-acquisition from Internet sources. The spherical equivalent refraction of ≤−2.0 D was 2.58 times higher in participants with regular follow-up visits than in their peers with irregular follow-up visits (OR = 2.58, 95% CI [0.22, 5.63]). In addition, acknowledgment of “There is no need to change the Ortho-k lenses regularly as long as there is no discomfort” was 7.19 times higher in participants with regular follow-up visits than in their peers with irregular follow-up visits (OR = 7.19, 95% CI [1.26, 13.93]). However, participants with regular follow-up visits did not receive Internet ophthalmology advertisements prompting their decision to use Ortho-k 2.62 times higher than their peers with irregular follow-up visits (OR = 2.62, 95% CI [0.04, 4.29]).

Conclusions: The results support that both information sources and knowledge of Ortho-k use influence the frequency of follow-up visits among parents of Ortho-k lens wearers aged < 10 years. Related support from health professionals in terms of providing appropriate information and guidance is recommended to promote higher rates of regular follow-up visit attendance.

KEY WORDS: follow-up visit, orthokeratology lens, myopic children.

Introduction

According to the World Health Organization (WHO), myopia will affect 4.949 billion people by 2050, inferring that the number of people with myopia will nearly double during the coming 30 years. Moreover, high myopia (≤ −5.0 D) is expected to reach 10% of the world population (925 million) by 2050 (WHO, 2015). This condition is expected to impose a considerable economic burden through higher related medical expenditures and productivity losses (Naidoo et al., 2019).

Of the global population with myopia, approximately 312 million are aged ≤ 19 years (Rudnicka et al., 2016). In Asian countries such as Taiwan, Japan, Singapore, South Korea, and China, the prevalence of myopia exceeds 70%, making it a major public health issue (WHO, 2019).

Abnormal axial elongation resulting from myopia is the cause of many ocular complications and the main cause of blindness in later life among adults (Haarman et al., 2020).

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In Taiwan, the incidence of high myopia is 1% in elementary students and > 2% in seventh-grade students (I. J. Wang, 2018). The prevalence of high myopia is 15.2% in Japan (Yotsukura et al., 2019) and 5.5% among 12-year-old children in Tianjin, China (Chakravarthy et al., 2017). The prevalence of high myopia among Taiwanese elementary school students increased from 6.5% in 2010 to 10.3% in 2018 and was 28% among ninth-grade students in 2018 (I. J. Wang, 2018). Asian countries where school-aged children experience a high prevalence of myopia are typified by highly stressful learning environments. In environments such as these where myopia cannot be effectively prevented, proactive approaches that work to retard the progression of myopia have proven to be highly beneficial (Ramamurthy et al., 2015).

Clinical studies have shown that orthokeratology (Ortho-k) lens wear can reduce 40%–60% of axial elongation and delay the progression of myopia in children more effectively than other optical correction methods (Lipson et al., 2018). The preference of parents of children with myopia for Ortho-k lenses is influenced primarily by its effectiveness in controlling myopia progression (X. Wang et al., 2021) and improving visual quality and wearing satisfaction (Yang et al., 2021). Therefore, Ortho-k lenses have become popular among ophthalmologists, patients, and their parents (Wen et al., 2015). However, awareness of myopia treatment and lens handling is an essential first step in compliance. Chang, Li, et al. (2021) found that parents are typically influential in the decision to use Ortho-k lenses as the treatment modality for myopia in their children. However, Ortho-k-related knowledge and information resources prompting the decision to use Ortho-k are generally disseminated by word of mouth, and parents usually assume that they are sufficiently knowledgeable (X. Wang et al., 2021). Another study found that 45.61% of optometrists do not possess sufficient background knowledge on Ortho-k lenses (Douglass et al., 2020). Compliance with follow-up visits and monitoring allows for prescription adjustments to control myopia progression and reduce the risk of Ortho-k lens-related infections (Hiraoka et al., 2018). The Ortho-k clinical practice guidelines of Cho et al. (2008) state that the first 3 months of Ortho-k lens wear is a critical observation period for assessing the ability of parents to care properly for Ortho-k lenses. After confirming this ability over the 3-month observation period, regular aftercare visits once every 3 months in the first year and once every 6 months thereafter are recommended. A study on Ortho-k guideline compliance among Chinese participants revealed a low rate of compliance, with less than 15% of patients exhibiting full compliance with periodic follow-up visits. A key reason for this was cited as an absence of obvious symptoms (Jiang et al., 2018). In young children (< 10 years old), parents play a major role in Ortho-k care. In addition to periodic follow-up visits, parents are required to provide long-term assistance to their children in daily Ortho-k lens care, as they usually feel apprehensive about letting their children perform this care independently, which results in parents shouldering increased physical and mental burdens.

Methods

In this study, the partial results for compliance among parents of Ortho-k lens wearers were analyzed. From July to August 2019, qualitative interviews were conducted with 20 parents, and online questionnaires were completed by 257 parents (Chang, Sun, et al., 2021). On the basis of recent findings in the literature that highlight the importance of axial elongation in 7- to 10-year-old myopic children (Chamberlain et al., 2021; Weiss & Park, 2019), we extracted the sample to analyze their follow-up visit behavior and related factors.

Participants

Parents of children who wear Ortho-k lenses were recruited through a private Facebook group with 3,500 members in 2020 that was created in 2018 for information sharing and exchange among parents of these children. The inclusion criteria were as follows: (a) parents of Ortho-k lens wearers aged 6–10 years, (b) parents who were mainly responsible for Ortho-k lens care on behalf of their children, (c) parents who were able to read and communicate in Chinese, and (d) parents who resided in Taiwan with their myopic children.

Measures

The instrument in this study included a demographic datasheet covering information on the parents and their children, an Ortho-k-related knowledge scale, information resources prompting the decision to use Ortho-k, and follow-up visit behavior. An online Google questionnaire with structured questions was designed as follows:

1. Demographics of the parents and their children. Data on the parents included identity, educational level, and degree of myopia. Data on the children included age and degree of myopia at diagnosis, duration of Ortho-k lens wear, and current age.
2. Ortho-k-related knowledge. The knowledge items, adopted from the Ortho-k guidelines (Cho et al., 2008), included axial length, lens wearing, required duration of nighttime sleep, and lens replacement. Correct answers were scored as 1, and incorrect answers or blank responses were scored as 0.
3. Information resources prompting the decision to use Ortho-k. The participants were asked to answer the question: “What is the source of information for deciding to wear lenses?” This item allowed for multiple answers including Internet advertisements by ophthalmology clinics, recommendations from healthcare professionals, information self-acquired from the Internet (excluding advertising), bulletin boards in healthcare institutions, and recommendations from others.

4. Follow-up visits. The participants were asked to indicate the number and frequency of Ortho-k follow-up visits during the last year. The visits were classified as either regular or irregular based on the duration of Ortho-k lens wear and the reason for return visit frequency based on the guidelines.

Chang, Sun, et al. (2021) provide a detailed description of the content of this questionnaire.

Data Collection
The researchers obtained approval from the administrator of the Facebook group to post a participant recruitment advertisement containing a link to the online questionnaire, which was accessible from January to May 2020. Each participant was required to log into their Google account to access the questionnaire, which took approximately 15 minutes to complete and could only be completed once. None of the items asked for personal information. Each participant received an NT$100 convenience store voucher after questionnaire completion. This study was conducted with the formal ethical approval of the Chang Gung Memorial Hospital Institutional Review Board, Taiwan (reference number: 201900554B0).

Data Analysis
The data were collected from Google Forms, tabulated using Microsoft Excel 2010, and analyzed using SPSS software Version 23 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to measure the frequencies, means, and standard deviations. Logistic regression analysis was adopted, and odds ratios (ORs) were used to evaluate the associations between Ortho-k follow-up visits and Ortho-k knowledge, information resources for decision making, and parent- and child-related factors.

Results
Demographics of the Orthokeratology Lens Wearers and Their Parents
Most of the 148 questionnaire respondents were mothers ($n = 135, 91.22\%$), and 75% held a university level of education or above. Of the 129 (87.16\%) parents with myopia, 75 (50.68\%) had high myopia. The current mean age and mean age at diagnosis of the 148 Ortho-k lens wearers were 9 years ($SD = 1.03$) and 7.22 years ($SD = 1.09$), respectively. Slightly more than one third (38.51\%) had worn Ortho-k lenses for $\leq 6$ months, and 83.11\% engaged in regular follow-up visits (Table 1).

Orthokeratology-Related Knowledge and Information Resources Prompting the Decision to Use Orthokeratology
All 148 parents achieved a $>80\%$ correct response rate for Ortho-k-related knowledge (Table 2). However, 15.51\% were unaware of axial length being a marker for clinical myopia.

### Table 1
Demographic Information of Myopic Children and Their Parents ($N = 148$)

| Variable                        | $n$ | %   |
|---------------------------------|-----|-----|
| Parents                         |     |     |
| Father                          | 13  | 8.78|
| Mother                          | 135 | 91.22|
| Educational level               |     |     |
| College                         | 37  | 25.00|
| University and above            | 111 | 75.00|
| Myopia                          |     |     |
| No                              | 19  | 12.84|
| Yes                             | 129 | 87.16|
| SER of parents (dioptres)       |     |     |
| No myopia                       | 19  | 12.84|
| $>$ −5.00 D                     | 54  | 36.49|
| $\leq$ −5.00 D                  | 75  | 50.68|
| Onset age of child (years; mean and $SD$) |     |     |
| 6                               | 45  | 30.41|
| 7                               | 51  | 34.46|
| 8                               | 33  | 22.30|
| 9                               | 13  | 8.78 |
| 10                              | 6   | 4.05 |
| Child’s current age (years; mean and $SD$) |     |     |
| 6                               | 1   | 0.68 |
| 7                               | 13  | 8.78 |
| 8                               | 32  | 21.62|
| 9                               | 40  | 27.03|
| 10                              | 62  | 41.89|
| SER of child (dioptres)         |     |     |
| $\geq$ −2.0 D                   | 84  | 56.76|
| $−2.25$ to $−4$ D               | 49  | 33.11|
| $\leq$ −4 D                     | 15  | 10.14|
| Duration of Ortho-k lens wear (months) |   |     |
| $\leq$ 6                        | 57  | 38.51|
| 7–12                           | 46  | 31.08|
| >12                            | 45  | 30.41|
| Follow-up visitation during the last year |     |     |
| Regular                        | 123 | 83.11|
| Irregular                      | 25  | 16.89|

Note. Range of children’s age and onset age all from 6 to 10 years. SER = spherical equivalent refraction; Ortho-k = orthokeratology.
Table 2
Knowledge of Myopia and Ortho-k Lenses (N = 148)

| Question (Answer)                                                                 | True (%) | False (%) | Don’t Know (%) |
|----------------------------------------------------------------------------------|----------|-----------|----------------|
| 1. The ocular axial length is a clinical indicator of myopia control. (True)     | 84.49    | 1.41      | 14.10          |
| 2. There is no need to change orthokeratology lenses regularly as long as there is no discomfort. (False) | 4.67     | 91.93     | 3.40           |
| 3. Users can adjust the number of wearing days according to their personal habits. (False) | 8.13     | 88.47     | 3.40           |
| 4. At least 6 hours of sleep at night is required for myopia control with orthokeratology. (True) | 89.24    | 10.76     | 0              |

Note. Ortho-k = orthokeratology.

Factors Affecting Follow-Up Visits During 1 Year of Orthokeratology Lens Use

The spherical equivalent refraction of ≤ −2.0 D found in participants who engaged in regular follow-up visits was 2.58 times higher than in those who only engaged in irregular follow-ups (OR = 2.58, 95% CI [0.22, 5.63]). In addition, agreement with the statement “There is no need to change the Ortho-k lenses regularly as long as there is no discomfort” was found to be 7.19 times higher in regular-follow-up participants than in their irregular-follow-up peers (OR = 7.19, 95% CI [1.26, 13.93]). However, participants with regular follow-up visits did not receive Internet ophthalmology advertisements prompting their decision to use Ortho-k 2.62 times higher than their irregular-follow-up peers (OR = 2.62, 95% CI [0.04, 4.29]; Table 4).

Table 4
Factors Affecting Follow-Up Visit of Ortho-k Lens Within 1 Year (N = 148)

| Variable                                           | OR     | 95% CI    |
|----------------------------------------------------|--------|-----------|
| Myopic father                                      | 0.71   | [−0.15, 3.48] |
| High myopic father                                 | 1.39   | [−0.50, 3.84] |
| Educational level of parents                       | 1.28   | [−0.38, 4.39] |
| SER of children ≤ −2.0 D                           | 2.58*  | [0.22, 5.63] |
| Self-acquired from Internet sources                | 0.33   | [−0.09, 1.23] |
| No message from advertisement                      | 2.62** | [0.04, 4.29] |
| Recommendations from others                        | 1.19   | [−0.39, 3.60] |
| Bulletin boards in healthcare institutions         | 0.44   | [−0.14, 1.40] |
| Recommendations from healthcare professionals      | 1.26   | [−0.43, 3.74] |
| Myopia and Ortho-k knowledge:                      | 7.19*  | [1.26, 13.93] |
| “There is no need to change orthokeratology lenses regularly as long as there is no discomfort.” |       |           |
| “At least 6 hours of sleep at night is required for myopia control with orthokeratology.” | 0.60   | [−0.14, 2.55] |

Note. Reference groups are as follows: myopic mother, educational level of parents with below college, SER of children > −2.0 D. Source: not self-acquired, message from advertisement, no recommendations from others, not from bulletin boards, and no recommendations from healthcare professionals. Ortho-k = orthokeratology; SER = spherical equivalent refraction. *p < .05. **p < .01.

Discussion

To the best of the authors’ knowledge, this is the first study to focus on the follow-up visit efficacy of 6- to 10-year-old Ortho-k lens users. Compared with similar studies, the participants in this study were of younger age at diagnosis, had a lower degree of myopia, and had worn Ortho-k lenses for a shorter duration (X. Wang et al., 2021). Therefore, the results of this study may serve as a reference for care in developed countries affected by a high incidence of myopia.

Previous studies that have analyzed the decisions of parents to select Ortho-k have reported that parents exhibit positive attitudes toward using Ortho-k for myopia control (Chang, Li, et al., 2021; Cheung et al., 2014) and that they had received knowledge regarding Ortho-k treatment under sufficient-information conditions (X. Wang et al., 2021). However, in this study, 16.9% of the participants did not comply with the recommended follow-up visit guidelines, which corresponds with the results reported by Jiang et al. (2018). Thus, almost 20% of the participants did not fully comply with follow-up visits, despite these visits being one of control, and 10.76% were unaware of a minimum of 6 hours of nighttime sleep being required for myopia control with Ortho-k. The most common information resource prompting the decision to use Ortho-k was the Internet, followed by recommendations from others (n = 101, 67.56%). Of these participants, 44.15% (n = 66) relied on recommendations from health professionals in decision making (Table 3).
the most important tasks associated with wearing Ortho-k lenses. The results further showed a higher proportion of children < 10 years old with regularly attended follow-up visits. This may be attributed to the fact that these children (with myopia < −2.0 D) are at a greater risk of rapid myopia progression, which may prompt parents to engage in regular follow-up visits for closer monitoring of the myopia progression changes. Parents who are aware of the need to regularly replace Ortho-k lenses may also be aware that regular follow-up visits allow for the regular monitoring of ocular status and assessment of lens quality, resulting in better follow-up compliance.

The results of this study further showed correlations between regular follow-up visits and the following: degree of myopia at diagnosis, not receiving advertisements by ophthalmology clinic promoting Ortho-k use, and responding correctly to the questionnaire question regarding Ortho-k lens replacement. The results of previous research indicate that most ophthalmologists have an inadequate understanding of Ortho-k treatment, which prevents them from considering it as the first-choice option for myopia treatment and from actively providing related information to patients and their families (Douglass et al., 2020). The results of this study showed most of the participants to be highly educated, indicating they likely possess good Internet search capabilities and may have relied on the Internet to make the decision to choose Ortho-k for their children. Most of the parents in this study also reported obtaining information via the recommendations of others, which corresponds with the findings of a previous study (X. Wang et al., 2021).

In addition, the participants in this study who obtained information from advertisements posted online by ophthalmology clinics had a lower average regular follow-up visit rate. This indicates that these online advertisements may not provide sufficient information regarding the importance of follow-up visits. In advertising, product advantages are typically emphasized to attract customers. Thus, it is important that health professionals explain the pros and cons of Ortho-k lens wearing during prewearing evaluations and provide health education sessions to parents to ensure compliance. Moreover, school nurses have a vital role to play and responsibility for monitoring referral results for school children (Chang et al., 2016). This study has practical implications for school nurses in terms of providing parental education to enhance knowledge of Ortho-k lenses and awareness of the benefits of myopia control to encourage regular follow-up visits.

Conclusions

In this study, parents who were not influenced by advertisements, who had children with spherical equivalent refraction of < −2.0 D, and who knew that they needed to replace Ortho-k lenses regularly even if their child feels fine were most likely to make regular follow-up visits. This highlights the importance of health education for parents with myopic children who wear Ortho-k lenses. Health professionals should clarify the information from advertisements for their clients before commencing Ortho-k treatment. Moreover, school nurses should explain and emphasize why Ortho-k wearers must make return visits to the clinic at least once every 3 months, even if they do not have any complaints in school regarding myopia management.

This study was affected by several limitations. Although an email login requirement was set for the questionnaire and the responses had been cross-checked to eliminate repeated submissions, certain biases may have been at play. In addition, because of our inability to collect follow-up visit data from healthcare institutions, there may have been certain inaccuracies in participant recollections that could not be rectified. The enrollment of participants from healthcare institutions is recommended in future studies to allow the acquisition of data on follow-up visits and care behaviors starting from the initial stage of Ortho-k lens wearing. This will greatly benefit the further analysis of causal relationships among the various factors that influence follow-up visits.

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Data analysis and interpretation: LLL, HJC
Drafting of the article: HLL, LLH
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