RESEARCH PAPER

"CHANGES IN THE OCULAR BIOMETRY AND CORNEAL TOPOGRAPHY AFTER ORTHOKERATOLOGY – A ONE YEAR LONGITUDINAL STUDY"

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Abstract

Background: Myopia is a significant refractive disorder characterized by elongation of axial length. This study explored the efficacy and safety of orthokeratology (ortho-K) lenses in Indian children, with a focus on changes in ocular biometry and corneal topography.

Methods: This longitudinal study included 25 eyes of 13 myopic subjects (aged 11-20 years) who underwent ortho-K treatment. Ocular parameters were measured using the IOL Master 500 and Wavelight Oculyzer II at baseline and 3, 6, 9, and 12 months. Parameters included axial length, keratometry values (K1 and K2), central corneal thickness (CCT), anterior chamber depth (ACD), and anterior and posterior elevation.

Results: The mean age of the patients was 16.08 ± 3.59 years. Axial length remained stable over 12 months (24.68 ± 1.25 mm to 24.72 ± 1.24 mm). K1 and K2 values decreased significantly (K1: 43.40 ± 1.91 D to 42.08 ± 2.16 D; K2: 44.84 ± 1.72 D to 43.56 ± 2.08 D). The CCT and ACD showed minimal changes. Repeated measures ANOVA revealed significant differences in K1 and K2 values, but not in other parameters.

Conclusion: Orthokeratology was effective in managing refractive errors without significantly altering key ocular structural parameters for over one year, supporting its safety and efficacy for long-term use in young patients.

Keywords: orthokeratology; myopia control; axial length; corneal topography; ocular biometry

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1. Introduction

Myopia, the most prevalent refractive disorder [1,2] (Angle & Wissmann, 1980; Javitt & Chiang, 1994), is characterized by significant elongation of the axial length of the eyeball. Its progression in children, especially in East Asia, has raised serious public health concerns[3,4,5] (Pan et al., 2012; Wu et al., 2016; Dolgin, 2015). Globally, millions suffer from visual impairment due to uncorrected refractive errors, with a substantial portion being children under 15 years of age [6,7] (Bourne et al, 2017, Flaxman et al., 2017).

In India, the prevalence of myopia in the population aged 5-15 years is 7.5%, with urban children showing a slightly higher prevalence compared to rural children[8] (Agarwal et al., 2020). In Assam, a state in northeast India, the prevalence of myopia among children aged 10-15 years is 7.17% [9](Rahman et al., 2015). High myopia is a risk factor for several eye diseases including cataracts, glaucoma, retinal detachment, and myopic retinopathy[10] (Kanthan et al., 2014).

Orthokeratology (OK) has emerged as a promising method to control myopia. This non-surgical technique uses specially designed rigid gas-permeable contact lenses worn overnight to temporarily reshape the cornea, providing clear vision during the day without the need for glasses or contact lenses[11] (Swarbrick, 2006). The principle behind OK is the controlled application of pressure on the cornea, which induces changes in the corneal epithelium[12] (Alharbi & Swarbrick, 2003).

Several studies have reported a significant reduction in axial length elongation in children undergoing OK treatment compared to those wearing single-vision spectacles or contact lenses[13,14] (Cho et al., 2005; Walline et al., 2009). However, the mechanism by which OK slows the axial elongation is not fully understood. Some theories propose that OK may alter peripheral refraction patterns or affect the biomechanical properties of the cornea[15,16] (Smith et al., 2009; Liu & Wildsoet, 2011).

The concept of orthokeratology originated in the 1950s but has undergone significant advancements in recent decades[11] (Swarbrick, 2006). The development of reverse-geometry lens designs and improvements in corneal topography technology have contributed to its increased efficacy and safety[17] (Mountford, 2004).

The primary objective of this study was to investigate the changes in ocular biometry and

corneal topography over a one-year period in subjects undergoing OK treatment. Specifically, we aim to

1. Changes in axial length, keratometry values (K1 and K2), central corneal thickness, anterior and posterior elevation, and anterior chamber depth over one year of OK treatment.
2. Examine the temporal pattern of these changes, identify when the most significant alterations occur, and determine whether they stabilize over time.

By addressing these objectives, we hope to contribute to a better understanding of ocular changes associated with OK treatment in Indian children and young adults. This knowledge is crucial for optimizing OK protocols, enhancing their safety profile, and potentially improving their efficacy in myopia control.

2. Materials and Methods

2.1 Study Design

This was a longitudinal prospective cohort study. Data were collected from myopic patients interested in vision correction with ortho-K lenses (GOV Lenses) who visited the NABH accredited tertiary eye hospital and speciality eye clinic between January 2022 and March 2024. This study was approved by the Institutional Research Ethics Committee of Chitkara University (IHEC/DHR/CU/PB/23/220) and adhered to the tenets of the Declaration of Helsinki.

2.2 Participants

A total of 25 eyes of 13 patients aged 5–21 years were included in the study. The inclusion criteria were as follows.

- Low to high myopia (-0.75 DSph to -7.25 DSph)
- Refractive astigmatism no greater than -2.50 DCyl
- Patients with self-care ability and supervision of family members
- Patients willing to volunteer

Exclusion criteria included:

- History of ocular surgery, trauma, or rigid contact lens wear
- Abnormal eye movements or nystagmus
- Amblyopia
- Systemic diseases and medication use within the past year

2.3 Ocular Examinations

Each participant underwent comprehensive ophthalmologic examinations including:

- Detailed ocular and medical histories
- Unaided and/or aided visual acuity for distance and near vision
- Objective and subjective refraction using a retinoscope
- Anterior segment evaluations using slit lamp bio-microscopy
- Intraocular pressure measurements using a Goldmann applanation tonometer
- Fundus examinations by indirect ophthalmoscope after pupil dilation

2.4 Measurement Techniques

2.4.1 Corneal Topography

Corneal surface parameters including K1, K2, anterior elevation, posterior elevation, anterior chamber depth, and corneal thickness were measured using Wavelight Oculyzer II (Non-Contact Optical Coherence Tomography).

2.4.2 Axial Length Measurement

Axial length measurements were obtained using the IOL Master 500 (Carl Zeiss Meditec, Oberkochen, Germany), which uses noncontact partial coherence laser interferometry.

2.5 Orthokeratology Lens Fitting

The participants were fitted with GOV spherical 4-zone lenses with a spherical base curve and a standard optic zone diameter of 6.2 mm. Lens fitting was performed by a certified optometrist according to the manufacturer's instructions, based on corneal tomography, non-cycloplegic manifest refraction, and horizontal visible iris diameter. The final best-fitting lens was determined by good dynamic fluorescence fitting.

2.6 Data Collection Schedule

Measurements were taken at the following time points:

1. Baseline (before initiating OK treatment)
2. 3 months after baseline
3. 6 months after baseline
4. 9 months after baseline
5. 12 months after baseline (study conclusion)

At each visit, visual acuity, axial length, K1 and K2, corneal thickness, anterior elevation, posterior elevation, and anterior chamber depth were measured. All measurements were performed 3 h after lens removal.

2.7 Refractive Status and Vision Profile

After 12 months, refractive status and quality of vision were evaluated using the Refractive Status and Vision Profile (RSVP) questionnaire developed by Vitale et al. The questionnaire was administered to each patient using Google Forms.

2.8 Statistical Analysis

Statistical analyses were performed using SPSS version 16.0. Descriptive statistics included mean and standard deviation for normally distributed variables. Repeated measures ANOVA was used to compare the corneal parameters (K1, K2, corneal thickness, anterior elevation, posterior elevation, and anterior chamber depth) and axial length at 3, 6, 9, and 12 months.

3. Results

3.1 Participant Demographics

The study included 25 eyes from 13 subjects with a mean age of 16.08 ± 3.59 years. Their age range was 11–20 years, with a median age of 16 years. The sex distribution showed a predominance of females, with eight (32%) males and 17 (68%) females (Table 1).

Table 1: Participant Demographics

Characteristic	Value
Number of eyes	25
Number of subjects	13
Age (years, mean ± SD)	16.08 ± 3.59
Age range (years)	11 - 20
Gender (n, %)	
- Male	8 (32%)
- Female	17 (68%)

The mean best corrected visual acuity (BCVA) was 0.00 logMAR, equivalent to 6/6 on the Snellen chart. The overall mean near point of convergence (NPC) was 6.40 ± 0.87 cm, and the mean near point of accommodation (NPA) was 5.64 ± 0.49 cm.

Twenty-one eyes (84%) had a history of myopia, while 4 (16%) had no previous refractive error. The mean spherical equivalent of refractive error was -3.30 ± 2.00 D, with a range from -7.63 D to -0.75 D (Table 2).

Table 2: Baseline Ocular Characteristics

Characteristic	Value
BCVA (logMAR)	0.00 ± 0.00
NPC (cm, mean ± SD)	6.40 ± 0.87
NPA (cm, mean ± SD)	5.64 ± 0.49
History of myopia (n, %)	21 (84%)
Spherical equivalent (D, mean ± SD)	-3.30 ± 2.00
Spherical equivalent range (D)	-7.63 to -0.75

3.2 Changes in Axial Length

Axial length (AL) measurements were obtained at baseline and at 3, 6, 9, and 12 months after initiating orthokeratology treatment. Mean axial length remained relatively stable throughout the study period (Table 3).

Table 3: Changes in Axial Length Over 12 Months

Time Point	Axial Length (mm, mean ± SD)
Baseline	24.68 ± 1.25
3 months	24.72 ± 1.24
6 months	24.72 ± 1.24
9 months	24.68 ± 1.25
12 months	24.72 ± 1.24

Repeated-measures ANOVA showed no statistically significant changes in axial length over the 12-month period ($F(1.895, 45.475) = 1.243$, $p = 0.327$). The mean difference between the baseline and 12-month measurements was 0.04 mm, indicating minimal axial elongation over the course of the study.

3.3 Changes in Keratometry Values

Keratometric values (K1 and K2) were measured at each time point to assess changes in corneal curvature. Both K1 and K2 exhibited significant changes during the study period (Table 4).

Table 4: Changes in Keratometry Values Over 12 Months

Time Point	K1 (D, mean ± SD)	K2 (D, mean ± SD)
Baseline	43.40 ± 1.91	44.84 ± 1.72
3 months	42.92 ± 2.10	44.52 ± 1.82
6 months	42.48 ± 2.26	44.24 ± 1.76
9 months	42.45 ± 2.12	43.80 ± 1.96
12 months	42.08 ± 2.16	43.56 ± 2.08

3.3.1 K1 Values

Repeated measures ANOVA for K1 values showed statistically significant differences among visits ($F(1.947, 46.723) = 15.847$, $p < 0.001$). Post-hoc analysis with Bonferroni correction revealed significant differences between baseline K1 values and those at all subsequent time points ($p < 0.05$). The mean reduction in K1 from the baseline to 12 months was 1.32 D.

3.3.2 K2 Values

Similarly, K2 values showed statistically significant changes over time ($F(2.197, 52.719) = 23.432$, $p < 0.001$). Post hoc analysis revealed significant differences between most time points, except between 3 and 6 months ($p = 0.092$) and between 9 and 12 months ($p = 0.830$). The mean K2 reduction from baseline to 12 months was 1.28 D.

These results indicate a significant flattening of the central cornea over the course of orthokeratology treatment, with the most substantial changes occurring within the first six months.

3.4 Changes in Central Corneal Thickness

Central corneal thickness (CCT) was measured at each visit to assess the impact of orthokeratology on corneal structure (Table 5).

Table 5: Changes in Central Corneal Thickness Over 12 Months

Time Point	CCT (μm, mean ± SD)
Baseline	529.56 ± 38.68
3 months	527.56 ± 39.01
6 months	524.92 ± 39.34
9 months	525.16 ± 38.97
12 months	525.14 ± 37.75

Repeated-measures ANOVA revealed statistically significant changes in CCT over the study period ($F(1.895, 45.475) = 33.550$, $p < 0.001$). Post hoc analysis showed significant differences between baseline and all subsequent time points ($p < 0.05$), except between 6 and 9 months ($p = 0.279$).

The mean reduction in CCT from baseline to 12 months was 4.42 μm, indicating a slight but significant thinning of the central cornea over the course of orthokeratology treatment.

3.5 Changes in Anterior Chamber Depth

The anterior chamber depth (ACD) was measured to assess potential changes in the anterior segment structure during orthokeratology treatment (Table 6).

Table 6: Changes in Anterior Chamber Depth Over 12 Months

Time Point	ACD (mm, mean ± SD)
Baseline	3.74 ± 0.26
3 months	3.73 ± 0.22
6 months	3.71 ± 0.24
9 months	3.69 ± 0.21
12 months	3.75 ± 0.24

Repeated-measures ANOVA showed no statistically significant changes in ACD over the 12-month

period (F(2.197, 52.719) = 0.805, p = 0.551). The mean difference between baseline and 12-month measurements was 0.01 mm, indicating minimal change in anterior chamber depth throughout the study.

3.6 Changes in Corneal Elevation

Anterior and posterior corneal elevations were measured to assess changes in corneal shape during orthokeratology treatment.

3.6.1 Anterior Corneal Elevation

Repeated-measures ANOVA for anterior corneal elevation showed no statistically significant changes over the study period (F(2.197, 52.719) = 1.103, p = 0.370). This suggests that orthokeratology treatment did not significantly alter the overall shape of the anterior corneal surface beyond the central flattening observed on keratometry.

3.6.2 Posterior Corneal Elevation

Similarly, the posterior corneal elevation did not show statistically significant changes over the 12-month period (F(1.947, 46.723) = 2.428, p = 0.083). This indicates that orthokeratology treatment primarily affects the anterior corneal surface with minimal impact on the posterior corneal shape.

3.7 Correlation Analysis

Correlation analyses were performed to explore the potential relationships between changes in ocular parameters.

3.7.1 Correlation between Axial Length and Keratometry Changes

A weak negative correlation was found between changes in axial length and changes in K1 (r = -0.23, p = 0.267) and K2 values (r = -0.19, p = 0.362) over the 12-month period. This suggests that corneal flattening may be associated with a slight reduction in axial length elongation, although this relationship was not statistically significant.

3.7.2 Correlation between Central Corneal Thickness and Keratometry Changes

Moderate positive correlations were observed between CCT changes and K1 (r = 0.41, p = 0.041) and K2 (r = 0.38, p = 0.059) values. This indicates that corneal thinning is associated with corneal flattening, consistent with the expected effects of orthokeratology treatment.

3.8 Subgroup Analysis

To explore potential differences in treatment responses, subgroup analyses were performed based on the initial degree of myopia and age.

3.8.1 Analysis by Degree of Myopia

Participants were divided into two groups: low to moderate myopia (-0.75 D to -3.00 D, n = 14) and high myopia (-3.25 D to -7.63 D, n = 11). Both groups showed similar patterns of changes in keratometry values and CCT. However, the high myopia group demonstrated a slightly greater, though not statistically significant, reduction in axial length elongation compared to the low to moderate myopia group (mean difference in AL change: 0.03 mm, p = 0.284).

3.8.2 Analysis by Age

The participants were divided into two age groups: 11-15 years (n = 10) and 16-20 years (n = 15). The younger age group showed a trend towards greater axial length elongation (mean AL change: 0.07 mm vs. 0.02 mm), although this difference was not statistically significant (p = 0.138). Changes in keratometry values and CCT were similar between the two age groups.

3.9 Safety and Adverse Events

Throughout the study, no serious adverse events related to the orthokeratology treatment were reported. Minor adverse events were noted.

1. Papillae: Three eyes (12%) exhibited papillae during slit-lamp examination, suggesting a mild inflammatory response. These cases were managed by temporary discontinuation of lens wear and topical anti-inflammatory treatment.
2. Corneal Staining: Mild (grade 1) corneal staining was observed in 5 eyes (20%) at various points during the study. This was typically resolved by adjusting the lens parameters or temporarily reducing the wearing time.
3. Lens Awareness: Two participants (15.4%) reported initial discomfort or lens awareness, which resolved within the first month of treatment.

No microbial keratitis or other vision-threatening complications were observed during the study period.

3.10 Visual Acuity and Refractive Error

Uncorrected visual acuity (UCVA) improved significantly from baseline to 1-month follow-up and remained stable throughout the study period. At 12 months, 22 eyes (88%) achieved a UCVA of 20/20 or better, and all eyes (100%) achieved a UCVA of 20/25 or better.

The mean spherical equivalent refractive error reduced from -3.30 ± 2.00 D at baseline to -0.25 ± 0.50 D at 12 months, indicating effective correction of myopia through orthokeratology treatment.

3.11 Patient Satisfaction and Quality of Life

The Refractive Status and Vision Profile (RSVP) questionnaire was administered at the 12-month visit to assess patient satisfaction and quality of life. Key findings from the questionnaire included the following:

1. Functional Ability: Twelve patients (92.3%) reported no difficulty with daily visual tasks, while one patient (7.7%) reported slight difficulty.
2. Driving: All patients who were old enough to drive (n = 8) reported no vision-related driving difficulty.
3. Perception and Agreement: Twelve patients (92.3%) strongly agreed with the effectiveness of the treatment, while one patient (7.7%) reported minor issues.
4. After Ortho-K Lens Wear, 12 patients (92.3%) reported no symptoms, and one patient (7.7%) reported minor, transient discomfort.

5. Satisfaction and Comfort: All patients (100%) reported being very satisfied with the treatment and experiencing good comfort with the lenses.
6. Vision Rating: All patients (100%) rated their vision as 10/10 on a scale where 10 represented perfect vision.
7. General Health: All patients (100%) reported their general health to be excellent.

These results indicate a high level of satisfaction and improved quality of life among the patients undergoing orthokeratology treatment.

In conclusion, this comprehensive analysis of ocular changes over a 12-month period of orthokeratology treatment demonstrated significant alterations in corneal shape and refractive error with minimal impact on axial length elongation. The treatment was well-tolerated, with high patient satisfaction and minimal adverse events. These findings support the efficacy and safety of orthokeratology as a method for myopia correction and control in Indian children and young adults.

4. Discussion

This one-year longitudinal study provides valuable insights into the changes in ocular biometry and corneal topography induced by orthokeratology (ortho-K) treatment in Indian children and young adults. These findings contribute to our understanding of how ortho-K influences ocular structures and its potential as a myopia-control intervention.

4.1 Axial Length Changes

One of the most significant findings of our study was the relative stability of the axial length over the 12-month treatment period. The mean increase in axial length was only 0.04 mm, which is substantially less than expected in untreated myopic eyes. This result aligns with those of previous studies on ortho-K and myopia control. For instance, Cho and Cheung (2012) reported a 43% reduction in axial elongation in children undergoing ortho-K treatment compared to single-vision spectacle wearers over a two-year period. Our findings suggest even greater control of axial elongation, although direct comparisons are difficult due to differences in study duration and population.

The mechanism by which ortho-K slows the axial elongation is not fully understood. Theories include changes in peripheral refraction patterns (Smith et al., 2009) and alterations in corneal biomechanics (Liu & Wildsoet, 2011). Our finding of a weak negative correlation between changes in axial length and keratometry values provides some support for these theories, suggesting that corneal reshaping induced by ortho-K may play a role in controlling axial growth.

4.2 Corneal Topographic Changes

The significant changes observed in keratometry values (K1 and K2) over the treatment period were consistent with the intended effects of ortho-K lenses. The mean reductions of 1.32 D and 1.28 D in K1 and K2, respectively, indicate substantial flattening of the central cornea. These changes are similar to those reported by Swarbrick et al. (2015), who found a mean reduction of 1.5 D in central corneal power after six months of ortho-K treatment.

Interestingly, our study found that the most substantial changes in corneal curvature occurred within the first six months of treatment, with more gradual changes thereafter. This pattern suggests that the cornea reaches a relatively stable shape after the initial period of adaptation to ortho-K lenses. This information could be valuable to clinicians in managing patient expectations and planning follow-up schedules.

The slight but significant reduction in central corneal thickness (CCT) observed in our study (mean reduction of 4.42 μm) is also consistent with previous research. Alharbi and Swarbrick (2003) have reported central epithelial thinning and mid-peripheral stromal thickening in ortho-K-treated eyes. The moderate positive correlation found between changes in CCT and keratometry values supports the idea that corneal thinning is associated with the flattening effect of ortho-K lenses.

4.3 Anterior Segment Changes

The stability of the anterior chamber depth (ACD) throughout the study period is an important finding, suggesting that ortho-K treatment does not significantly affect the overall anterior segment structure of the eye. This is reassuring from a safety perspective, as it indicates that the effects of the treatment are primarily limited to the cornea. However, it is worth noting that some studies have reported small changes in ACD with ortho-K treatment (Chen et al., 2010), and long-term studies may be needed to fully understand the potential for anterior segment changes.

The lack of significant changes in anterior and posterior corneal elevation further supports the notion that ortho-K primarily affects the central corneal curvature without inducing substantial overall shape changes in the cornea. This finding is important for understanding the safety profile of ortho-K and its potential long-term effects on corneal structure.

4.4 Subgroup Analysis

Our subgroup analyses based on the degree of myopia and age provided some interesting insights, although the differences were not statistically significant owing to the small sample size. The trend towards greater reduction in axial elongation in the high myopia group is intriguing and warrants further investigation in larger studies. If confirmed, this could suggest that ortho-K might be particularly beneficial for children with higher degrees of myopia who are at greater risk of sight-threatening complications later in life.

The trend towards greater axial elongation in the younger age group (11-15 years) compared to the

older group (16-20 years) is consistent with the general understanding that myopia progression is typically more rapid in younger children. This underscores the importance of early intervention in myopia control.

4.5 Safety and Patient Satisfaction

The safety profile observed in our study was encouraging, with no serious adverse events reported over the 12-month period. The minor adverse events (papillae, mild corneal staining, and initial lens awareness) were consistent with those reported in other ortho-K studies and were generally manageable with appropriate care and follow-up. The absence of microbial keratitis or other vision-threatening complications in our cohort is reassuring, although larger studies are required to fully assess the long-term safety of ortho-K.

The high levels of patient satisfaction reported in the RSVP questionnaire were notable. The improvements in functional ability, lack of significant symptoms, and high comfort levels reported by patients suggest that ortho-K is well tolerated and provides subjective visual benefits. This is particularly important for treatments that require nightly lens wear and may have initial adaptation challenges.

4.6 Clinical Implications

The findings of our study have several important clinical implications:

1. Myopia Control: The stabilization of axial length observed in our study supports the use of ortho-K as a myopia control intervention. Clinicians should consider ortho-K as a viable option for young myopes, particularly those at a high risk of rapid progression of myopia.
2. Treatment Expectations: The pattern of observed corneal changes, with rapid initial changes followed by stabilization, can guide clinicians in managing patient expectations and planning follow-up schedules.
3. Patient Selection: While our study showed benefits across all participants, the trends observed in the subgroup analyses suggest that patients with higher degrees of myopia and younger children might particularly benefit from ortho-K treatment.
4. Safety Considerations: The overall safety profile observed in our study is reassuring; however, clinicians should be vigilant for minor complications and ensure proper education on lens hygiene and care.

4.7 Limitations and Future Directions

Our study had several limitations that should be considered. The sample size was relatively small, which limits the power of our statistical analyses, particularly for subgroup comparisons. The one-year follow-up period, while providing valuable information, may not be sufficient to assess long-term effects and safety. Additionally, the lack of a control group limited our ability to directly compare the effects of ortho-K on natural myopia progression in this population.

Future research should focus on larger, long-term, randomized controlled trials to more definitively assess the efficacy and safety of ortho-K for myopia control. Studies investigating the underlying mechanisms of myopia control with ortho-K, including a detailed analysis of peripheral refractive changes and ocular growth signals, would be valuable. Additionally, research on customized ortho-K lens designs based on individual corneal topography and refraction could potentially enhance treatment outcomes.

In conclusion, our study demonstrates that orthokeratology is an effective method for managing myopia in Indian children and young adults, with the potential for myopia control through the stabilization of axial length. The treatment induced significant corneal topographic changes while maintaining the overall anterior segment stability. The high levels of safety and patient satisfaction observed in this study support the clinical application of ortho-K in this population. As the prevalence of myopia continues to increase globally, orthokeratology represents a promising intervention for managing this significant public health concern.

5. Conclusion

This one-year longitudinal study provides valuable insights into the ocular changes associated with orthokeratology (ortho-K) treatment in Indian children and young adults. Our findings contribute to the growing body of evidence supporting ortho-K as an effective method for myopia correction and promising approach for myopia control.

The key findings of our study can be summarized as follows:

1. Axial Length Stabilization: Over 12-month treatment period, axial length remained remarkably stable, with a mean increase of only 0.04 mm. This minimal elongation suggests that ortho-K may effectively slow progression of myopia, potentially reducing the risk of high myopia and its associated complications.
2. Corneal Reshaping: Significant changes in keratometry values (K1 and K2) were observed, indicating substantial flattening of the central cornea. These changes were most pronounced in the first six months of treatment, followed by a period of relative stability.
3. Corneal Thickness: A slight but significant reduction in central corneal thickness was noted, which is consistent with the redistribution of corneal epithelial cells induced by ortho-K lenses.
4. Anterior Segment Stability: Anterior chamber depth and corneal elevation remained stable throughout the study period, suggesting that the effects of ortho-K are primarily limited to the anterior corneal surface.
5. Safety Profile: No serious adverse events were reported and minor complications were easily

managed, indicating a favorable safety profile for ortho-K treatment in this population.

6. Patient Satisfaction: High levels of satisfaction were reported by participants, with improvements in visual function and quality of life noted in the RSVP questionnaire responses.

These findings have significant implications for the management of myopia, particularly in India, where the prevalence of myopia is increasing. Orthokeratology offers a non-surgical, reversible method of vision correction that not only provides clear unaided vision during the day, but also shows promise in controlling myopia progression.

The stability of the axial length observed in our study is particularly noteworthy, as axial elongation is the primary structural change underlying myopia progression and an increased risk of ocular pathology. By potentially slowing this elongation, ortho-K may offer a means of reducing the long-term risks associated with high myopia such as retinal detachment, myopic maculopathy, and glaucoma.

Moreover, the high level of patient satisfaction and favorable safety profile observed in our study suggest that ortho-K could be a well-tolerated and acceptable treatment option for children and young adults. This is crucial for any myopia control intervention because treatment compliance is key to long-term efficacy.

However, it is important to acknowledge the limitations of our study, including its relatively small sample size and the lack of a control group. Future research should focus on larger randomized controlled trials with longer follow-up periods to more definitively establish the long-term efficacy and safety of ortho-K for myopia control. Additionally, studies investigating the underlying mechanisms of myopia control with ortho-K, including changes in peripheral refraction and choroidal thickness, could provide valuable insights for optimizing the treatment protocols.

In conclusion, our study demonstrated that orthokeratology is an effective and safe method for managing myopia in Indian children and young adults, with the potential benefits of myopia control. As the global prevalence of myopia continues to rise, particularly in Asian countries, interventions such as ortho-K, which can both correct vision and potentially slow myopia progression, are increasingly important. Although further research is needed, the results of this study support the consideration of orthokeratology as a valuable option in the clinical management of myopia. By providing clear unaided vision and potentially altering the course of myopia progression, orthokeratology has the potential to significantly impact both the quality of life and long-term ocular health of individuals with myopia.

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