

Rigid Gas Permeable Contact Lens Can Reduce the Progression of Myopia?

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Abstract

Introduction: Myopia is a global issue though prevalence varies from country to country but a huge number of people suffer from complications of myopia. It is a multifactorial disorder and there is no known way to prevent the development of myopia, but lots of research is ongoing to prevent the progression of myopia and RGP contact lens is one of the debatable issues to halt the progression.

Methods: It was a prospective analytic study done at Green Eye Hospital, Dhanmondi, Dhaka, Bangladesh. The study was conducted from January 2018 to December 2019 total two-year period. There were 160 patients enrolled in the study, they were divided into two groups. In Group: A, 80 patients those who were using RGP contact lens and the patients were selected by non-random purposive sampling method, on the other hand, group: B had 80 patients those were selected by quota sampling to match with the group: A patient by demographically. Data were collected thrice, first at entry point, second after one-year and third after two-year.

Results: Data was normally distributed so we did Independent "t" test, chi-squared and ANOVA with the help of Statistical Package for the Social Sciences (SPSS) version 22.

All the demographic variables were non-significant. Mean and SD of refractive error at entry point was 3.6813 ± 1.9172 and 3.7281 ± 1.9658 respectively ($P: 0.8788$ 95% CI -0.6532 to 0.5595). After two-year it was 3.9031 ± 2.3076 and 5.0031 ± 2.4673 respectively ($P: 0.0041$ CI -1.845992 to -0.354008).

Conclusion: RGP contact lens can reduce the progression of myopia. And it is the time to increase optometric services in country-wide.

Keywords: Myopia progression, RGP contact lens, Spectacle

Introduction

Myopia is an emerging public issue in South Asia. The prevalence of school myopia is progressive in recent decade is 80 – 90% at school level [1]. It was assumed that in 2010 prevalence of myopia was 28 but in 2050 prevalence will be 50 [2,3]. The economic costs of myopia are also high. In Singapore, the mean annual direct cost of myopia for each Singaporean school children aged 7–9 years was estimated to be US\$148 [4]. In the United States of America total cost per annum is between USD 3.9 to USD 7.2 billion [5].

In the United States, the National Health and Nutrition Examination Survey (NHANES) reported the annual direct cost of correcting distance vision impairment due to refractive errors to be between US\$3.9 and US\$7.2 billion. In the United States of America total cost per annum is between USD 3.9 to USD 7.2 billion [5].

Myopia is a multifactorial disorder. The world is becoming virtual. Our children, also aged people are now spending more time on Visual Display Terminal (VDT) and Covid-19 will increase this habit more in near future. It is assumed that prevalence of myopia will be 50 in the of 2050, But now the calculation may be change due to Covid-19 pandemic which increases the use of VDT by people and more chance myopia. Many study shows that use of VDT is directly proportional to progression of myopia.

Study from Bourne (2004), the prevalence of Myopia in Bangladesh is 23.8. In Pakistan (Shah 2008) is 36.5 and in India is 31.0 (Raju 2004) [6]. Refractive error mainly treated by optometrists, in most of the developed countries and some developing countries but in Bangladesh the optometry is not flourish adequately, so it is treated by ophthalmologist with few exception, eye hospitals run by NGO has the optometrists and refractive error treated by them. On the other hand, issues regarding the causes and prevention of myopia have only gained interest among ophthalmologists in the recent decade worldwide [7].

Still, spectacle is the best treatment option of myopia. In addition to that, to get rid of spectacle many people use soft contact lens and Lasik also, but they have no role to arrest the progression of myopia. Scientists are work on it, to arrest the progression of myopia but no single one is the permanent solution.

Several treatment option is using to halt the progression of myopia among them

1. Alteration of pattern of spectacle wear [8,9]
2. Bifocals and multifocal Lens [8]
3. Atropine and pirenzepine eye drops [10]
4. Ocular hypotensive [11]
5. Orthokeratology [12]
6. Contact lens

There are two randomized trial “Effect of RGP contact lens on axial myopia”, and both shows that it doesn’t halt the axial progression [13]. But what is role of RGP on cornea. Many study shows it has some role to prevent the progression of myopia when it is curvature myopia [14,15]. The Contact Lens-Myopia Treatment Study (CL-MTS) was organized to determine whether RGP lenses would reduce the progression of myopia in school children. When a patient uses RGP contact lens, there is a tear film layer in between the RGP lens and cornea so the curvature of RGP contact lens acts as corneal

surface and in each blink there is a friction of corneal epithelium with the tear film. The tear film behind the lens is in pressure than normal so it causes smoothness of corneal surface. So there is chance of correction of astigmatism.

On the other hand, soft contact lens has no role to halt myopia progression. In addition to that there is “myopia creep” [16]. So in our study, we show that RGP contact lens has positive effects on corneal astigmatism when cylinder is ≥ 2.0 D. Gas permeable contact lens first introduced in world market in late 1970. It is newer technology than soft contact lens. There is silicon material in RGP lens which makes it more flexible and more oxygen transmission [17].

Materials of RGP contact lens are classified according to their “Dk” value, which is a measure of their oxygen permeability. Materials with a high Dk transmit more oxygen to the eye than those with a low Dk value: Low Dk is < 12 . Medium Dk is 15-30. High Dk is 31-60. Super Dk is 61-100. In our study we used 90 Dk [18].

Methods

It was a prospective analytic study conducted at Green Eye Hospital, Dhaka, Bangladesh over a period of two-year from Jan 2018 to Dec 2019. The patient was divided into two groups. In Group: A, all 80 patient used RGP contact lens (Dk 90) for correction of their myopia. Group: B comprises 80 patients who used spectacle for correction of their myopia. Patients were selected with some inclusion and exclusion criteria.

Inclusion Criteria Were

Patient is ≥ 13 years older but ≤ 25 -year-older.

Patient must have cylinder power which is ≥ 2.0 D

No gender discrimination was there but girls are more comfort with contact lens than boys

Both axial and curvature myopia were included

Exclusion Criteria Were

Any other pathology of the eye including pathological myopia was excluded from study

Patient with index myopia was excluded from the study. (Though it is rare in this age group)

Irregular astigmatism was excluded from the study

Follow-up of the patient was done at every year with manual retinoscope and keratometric reading with automated keratometer and after subjective refraction spectacle was prescribe.

For the purpose of the study we try to maintain homogeneity of the two groups. We select 80 patients for RGP user by purposive method it was due to number of RGP lens user not enough in Bangladesh. But the spectacle user was selected by quota sampling to homogeneity of the two groups because progression of myopia depends of many factors such as, Gender, Age, Height, Weight, Urban or Rural, Monthly gross income of the family, Grade of study, Time of study: Hour/week (Including textbook and hard copy of any other books) [19]. Outdoor activities hour/week, Screen time hour/week, (Including TV, Mobile, Desktop, Laptop), History of parental myopia [20,21].

All the patients were follow-up every year but they were instructed

come earlier if any visual problem at there before schedule follow-up. Spectacle users were advised to were their glass whole day except sleeping and bathing time. Contact lens user were need to adjust their lens, and they were advised, wearing the lens one hour first day and subsequently increase the wearing time one hour per day and after 16 days they use it 16 hours and this is the maximum wearing time. They were also advised to remove the lens for 1 to 2 hour at day time when they take rest. But never sleep at night with the contact lens, they have to put it out before sleep. If sleep, overnight, with contact lens they have to avoid contact lens for 24-hour.

Fitting of RGP contact lens is not science only it is an art also because it is not only depending on the refractive error of the person, in addition to that diameter of the lens and base curve is vital issue. The assessment of RGP lens fit involves the evaluation of both static and dynamic criteria. The ideal RGP fit should show the following characteristics.

Centration

The lens should remain centred over the pupil in primary gaze and maintain reasonable centration with each blink. The goal of RGP lens centration is to ensure that the visual axis remains within the back optic zone diameter (BOZD) for as long as possible to optimise visual acuity. The lens should also remain on the cornea during all positions of gaze to minimise conjunctival staining from the periphery of the lens onto the limbal conjunctiva.

Unlike soft lenses, RGP lenses should be smaller than the corneal diameter. They should have a total diameter of at least 1.4 mm less than the horizontal visible iris diameter (HVID) to facilitate tear

exchange under the lens and help optimise the alignment of the lens fit.

Lens movement is one of the key characteristics of an ideal RGP fit. The lens should move around 1 to 1.5mm with each blink. The movement should be smooth and unobstructed in vertical plane, indicating a near alignment fit. An immobile lens causes tears to stagnate beneath its surface, leading to corneal staining and distortion, while a lens with excessive movement causes patient discomfort.

A narrow band of edge clearance at the periphery is required to enable adequate tear exchange and facilitate lens removal. The alignment of the back surface with the cornea allows the force of the lens to be distributed across the maximum bearing surface of the cornea. However, slight apical clearance and an area of light corneal touch in the mid-periphery will enhance lens centration. Excessive touch can lead to tear stagnation, staining and/or distortion, while points of excessive clearance lead to an unstable lens fit in terms of centration, comfort and vision.

After a one-hour training session, children wearing RGP lenses had learned to handle the lenses and care for them without parental assistance.

Statistical analysis was done by using Statistical Package for the Social Sciences (SPSS) version 22. Demographic data were analysed by Independent “t” and chi-squared test. Progression of myopia was analysed by Analysis of Variance (ANOVA) due to more than two sets of data.

Results

Table 1: Shows Demographic profile of both groups

	Group: A	Group: B	
Age	Mean: 18.46 SD: 3.40	Mean: 18.14 SD: 3.42	P: 0.5471 (95% CI-0.74 to 1.39) ^Q
Gender	Male: 15 Female: 65	Male: 17 Female: 63	P: .692633 ^Q
Height	Mean: 158.43 SD: 8.54	Mean: 160.15 SD: 9.16	P: 0.2211 (95% CI -4.4855 to 1.0455) ^Q
Weight	Mean: 61.34 SD: 11.43	Mean: 64.08 SD: 13.86	P: 0.1745 (95% CI -6.7071 to 1.2271) ^Q
Monthly income	Mean: 51518.46 SD: 12220.15	Mean: 48797.17 SD: 10780.85	P: 0.1373 (95% CI -877.2197 to 6319.7997) ^Q
Time of study	Mean: 29.24 SD: 11.78	Mean: 27.84 SD: 13.94	P: 0.4937 (95% CI -2.6302 to 5.4302) ^Q
Outdoor activities	Mean: 4.675 SD: 1.893	Mean: 4.338 SD: 1.911	P: 0.2642 (95% CI -0.25698 to 0.93098) ^Q
Screen time	Mean: 9.35 SD: 5.22	Mean: 8.74 SD: 4.70	P: 0.4385 (95% CI -0.9411 to 2.1611) ^Q
parental myopia	Yes: 22 No 58	Yes: 17 No 63	P: 357222 ^Q
Refractive error at entry point	Mean: 3.6813 SD: 1.9172	Mean: 3.7281 SD: 1.9658	P: 0.8788 (95% CI -0.6532 to 0.5595) ^Q

Note: ^Q: Independent “t” test. ^Q: Chi-squared test

Table 2: Shows changes of refractive error between the groups within 2-year

One-way ANOVA among Group: A			
SD ±Mean	SD ±Mean	SD ±Mean	
At the entry	After 1 year	After 2 year	
3.6813 ± 1.9172	3.7563 ± 2.0837	3.9031 ± 2.3076	The f-ratio value is 0.22912. The p-value is .795409. The result is not significant at p < .05

One-way ANOVA among Group: B			
At the entry	After 1 year	After 2 year	
3.7281± 1.9658	4.2875 ± 2.1609	5.0031±2.4673	The f-ratio value is 6.70422. The p-value is .001472. The result is significant at p < .05

Discussion

Control of myopia progression with RGP contact lens is still a debate among the eye care professional. Many study shows that it has some role on Myopia control and vice versa study at there but in case of axial myopia it has no role to arrest the progression of axial length of the globe but in curvature myopia has some role or not is still controversial. Orthokeratology is now an establish treatment of mild to moderate myopia in South-East Asia, mainly South Korea, Japan and China. Hong Kong [22]. Prevalence of myopia is highest in South-East Asia [23]. Overnight wearing of RGP contact lens it acts to flattening the cornea.

In our study, in Group: A, 80 patients were included who uses RGP contact lens minimum 8 hours in day and Group: B, also have 80 patients, who uses spectacle. Both the groups were followed up for two years.

In demographic profile (Table: 1) Age difference between the two group is insignificant (*Mean and SD of group: A 18.46 ± 3.40 in Group: B, 18.14 ± 3.42. P: 0.5471*). Gender (*P:0.692633*). Height is not significant between the two groups (*Mean and SD of group: A 158.43 ± 8.54 in Group: B 160.15 ± 9.16. P: 0.02211*) Body weight between the two group is also non-significant (*Group: A, 61.34 ± 11.43 Group: B, 64.08 ± 13.86 P: 0.1745*). Monthly income (*in Group: A, 51518.46 ± 12220.15. in Group: B 48797.17 ± 10780.85, p: 0.1373*) which is statistically insignificant. Time of study (*Group: A, 29.24 ± 11.78. Group: B, 27.84 ± 13.94. P: 0.4937*) is non-significant. Outdoor activities between two groups (*Group: A, 4.675 ± 1.893. Group: B, 4.338 ± 1.911. P: 0.2642*) is not significant. Screen time between two groups (*Group: A, 9.35 ± 5.22. Group: B, 8.74 ± 4.70 P: 0.4385*) is also insignificant.

From Table: 2, In Group: A, progression of myopia is 3.6813 ± 1.9172, 3.7563 ± 2.0837 and 3.9031 ± 2.3076 at entry point, after one-year and after two-year. By Analysis of Variance (ANOVA) The f-ratio value is 0.22912. The p-value is .795409. The result is not significant at p < .05. On the other hand, In Group: B, progression of myopia is 3.7281± 1.9658, 4.2875 ± 2.1609 and 5.0031±2.4673 at entry point, after one-year and after two-year. By Analysis of Variance (ANOVA) The f-ratio value is 6.70422. So the result is

significant at p < .05.

In our study, cylinder power of spectacles was used in minus notation. With-the-rule (WTR) astigmatism was defined as cylinder axes from 1°–15° and from 165°–180°, against-the-rule astigmatism as axes 75°–105°, and oblique (OBL) astigmatism as axes 16°–74° and 106°–164° [24-26]. There are many studies which shows RGP contact lens has role to control progression of myopia [2,13-15,27].

But there are also some studies which shows RGP has no role on myopia progression control. There was a randomized clinical trial on 428 Singaporean children by Katz et al, effect of RGP on myopia progression and they concluded that rigid gas permeable lenses did not slow the rate of myopia progression [28].

There are some studies which shows RGP lens is better than soft lens to arrest the progression of myopia. In the Contact Lens and Myopia Progression (CLAMP) Study at Ohio State shows that “The RGP contact lenses did not slow the growth of the eye. However, they did maintain the shape of the cornea, whereas the cornea of the soft contact lens wearers became more curved. This increased corneal curve resulted in more myopia in the group that wore soft contact lenses [29]”.

In our study we, all the variable between the two groups has not significant difference, only group: A was using RGP contact lens and group: B, was using spectacle and two-year follow shows that RGP contact lens has some positive effect to halt the progression of myopia.

Conclusion

It’s a question of debate whether RGP contact lens halt the progression of myopia since it came in to market. In our study, RGP contact lens has some role to reduce the progression myopia than spectacle but not halt the process. But it acts mainly on curvature myopia no role on axial myopia, better for the patient with significant astigmatism.

Limitation of the Study

Our study has some limitations which can be addressed, first, it was a single center-based study and number of sample was not adequate to reflect the population. Second, the study was conducted among

the urban population and economically marginal population didn't include in the study because Green Eye Hospital is a private hospital usually poor people goes to public hospital. In Bangladesh public hospital has a chain of referral system from community clinic to district public hospital and treatment cost near to free at there

Recommendation

Very first we told that the role of RGP to reduced myopia progression is a question of debate so to overcome the drawback of our study we need to randomized controlled trial in a large population which reflect the country population. Study period was two-year but progression of myopia continues up to 20 - 25 year in case of simple myopia and throughout the life in case of pathological myopia, so we have to extend the study period. Lastly, which we mention at introduction that optometrist is not flourish in Bangladesh, only Ophthalmologist giving the service of optometrist, so it is the time to start the course for optometrist at public school as medical school.

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