Original Article

Short-term result of collagen crosslinking in pellucid marginal degeneration

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Abstract

Background: To evaluate effectiveness of collagen crosslinking in pellucid marginal degeneration patients.

Materials and Methods: Twenty-one eyes of 15 patients treated by collagen crosslinking were enrolled in our non-controlled clinical trial study. After evaluation of patients about inclusion and exclusion criteria, preoperative examination was done and then patients underwent CXL procedure and seen 6 months after surgery for postoperative examinations.

Results: Mean preoperative LogMar uncorrected visual acuity (UCVA) was 0.63 (SE = 0.08), and mean preoperative LogMar BCVA was 0.26 (SE = 0.04). At 6 months postoperative, mean LogMar UCVA was 0.59 (SE = 0.06) and mean LogMar BCVA was 0.19 (SE = 0.02). The non-parametric test (Wilcoxon) showed reduction of LogMar BCVA was significant (*P* value = 0.02), but reduction of LogMar UCVA was not significant (*P* value = 0.5). Mean preoperative K1 was 42.23 ± 2.85 and mean postoperative K1 significantly decreased to 41.68 ± 2.44 (*P* value = 0.008). Also, mean preoperative K2 was 48.39 ± 2.37 and mean postoperative K2 significantly reduced to 47.64 ± 2.16 (*P* value = 0.002).

Conclusion: Most remarkable findings of our study were improvement of visual acuity and reduction K1 and K2 parameters. Stability of other values and absence of detectable change after study period implies halting of the progression of the disease. We suggest CXL can be useful for management of PMD, but we need more studies with larger sample size and longer follow up.

Key Words: Collagen crosslinking, cornea ectasia, pellucid marginal degeneration

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INTRODUCTION

Pellucid marginal degeneration (PMD) is a progressive, non-inflammatory ectatic corneal disease. It is characterized by thinning in the periphery of the cornea. The inferior cornea exhibits a peripheral band of thinning. There is usually high against-rule astigmatism. Computerized topography will show a classic butterfly appearance. Proposed treatments are spectacle correction, rigid gas-permeable contact lenses, and intra stromal corneal ring segments. In advanced cases, lamellar or penetrating keratoplasty is the latest treatment option.[1-3]

Corneal collagen crosslinking (CXL) is a new therapeutic technique that stabilizes the corneal mechanical properties and prevents progression of ectatic corneal condition, penetrating keratoplasty

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and its complications. In this technique the photosensitizer riboflavin (vitamin B_2) and ultraviolet A is used to induce specific chemical reactions in the corneal stroma. This option has been suggested as useful for management of pellucid marginal degeneration.[4-7]

Spadea[8] reported the results of collagen crosslinking in a patient affected by PMD. He concluded CXL is a safe tool in management of PMD and improves some parameters in advanced stages of the disease.

Accordingly, we initiated a CXL study in patients with PMD and evaluated refractive, topographic and tomographic parameters after CXL.

MATERIALS AND METHODS

Twenty-one eyes of 15 patients treated by collagen crosslinking were enrolled in our non-controlled clinical trial study. The inclusion criteria were diagnosis of mild to moderate stage PMD and having a minimum thickness of 400 μm at the thinnest part of cornea. The exclusion criteria were history of herpetic keratitis; use of rigid contact lenses; history of autoimmune disease and history of eye surgery. Preoperative examination consisted of slit lamp microscopy, corneal topography/tomography and visual acuity/manifest refraction. After primary evaluation, patients underwent collagen crosslinking operation. The stroma was saturated by 0.1% riboflavin-5-phosphate and 20% dextran solution as one drop every 3 minutes. After stroma saturation, ultraviolet A light irradiated to the surface of cornea (6-8 mm) for 30 minutes. Patients were seen 6 months after surgery for postoperative examinations.

SPSS 16 software was used to analysis of our data. We used non-parametric test (Wilcoxon) because of low sample size (lower than 30).

RESULTS

Twenty-two eyes of 16 patients were enrolled in our study. One of patients excluded from our study because of severity and progression of PMD and underwent corneal transplantation. Mean age of patients was 31.38 ± 6.63 years. Nine of the patients were males and six of them were females.

Mean preoperative LogMar uncorrected visual acuity (UCVA) was 0.63 (SE = 0.08), and mean preoperative LogMar BCVA was 0.26 (SE = 0.04). At 6 months postoperative, mean LogMar UCVA was 0.59 (SE = 0.06) and mean LogMar BCVA was 0.19 (SE = 0.02). The non-parametric test (Wilcoxon) showed reduction of LogMar BCVA was significant (*P* value = 0.02), but reduction of LogMar UCVA was not significant (*P* value = 0.5).

Mean preoperative spherical equivalent refraction was –3.09 ± 0.59, with a mean sphere of 0.11 ± 0.48 and mean of cylinder was –6.42 ± 0.51. Postoperative spherical equivalent refraction was –3.29 ± 0.51, with a mean sphere of –0.34 ± 0.51 and mean cylinder of –5.9 ± 0.35. We found no significant differences between pre and postoperative spherical equivalent refraction (*P* value = 0.32), although there was a significant difference between pre and postoperative sphere (*P* value = 0.01). Also, our finding showed that defocus equivalent refractory errors were 6.4 ± 3.15 and 6.31 ± 2.52 before and after surgery. Defocus equivalent was not significantly changed after surgery (*P* value = 0.76)

Pre and post-op corneal plane refractive cylinder was 5.94 ± 2.03 and 5.46±0.49 (*P* value = 0.07). Pre and post-op keratometric astigmatism was 6.15 ± 3.1 and 5.95 ± 2.85 (*P* value = 0.38).

Our results about simulated keratometry values (K1 for minimum and K2 for maximum) demonstrated that, mean preoperative K1 was 42.23 ± 2.85 and mean postoperative K1 significantly decreased to 41.68 ± 2.44 (*P* value = 0.008). Also, mean preoperative K2 was 48.39 ± 2.37 and mean postoperative K2 significantly reduced to 47.64 ± 2.16 (*P* value = 0.002).

Mean preoperative thickness of thinnest point of cornea was 471.19 ± 33.73 μm and mean postoperative thickness of thinnest point of cornea was 453.61 ± 45.32. Our finding demonstrated thickness of thinnest point of cornea was significantly decreased (*P* = 0.001).

Mean surgically induced astigmatism of refractive error as calculated by analyzing of vectors was 1.34 ± 0.94 diopters. Astigmatic correction indices calculated by Alpins method;[9] mean flattening effect was 0.57 ± 1.14 diopter. Mean surgically induced astigmatism of keratometric values was 1.05 ± 0.74 diopter and 0.24 ± 1.02 diopter of flattening effect at the steep axis.

Table 1 provides a summary of the comparison of the pre and postoperative variables.

DISCUSSION

PMD is an ectatic disorder of the cornea that affects patient's life because of poor quality of vision produced by associated against the rule astigmatism.[10] CXL

Table 1: Comparison of the pre and postoperative variables

Variables	Mean±SE		*P* value
	Preoperative	Postoperative	
K1	42.23±2.85	41.68±2.44	0.008
K2	48.39±2.37	47.64±2.16	0.002
K max	50.67±0.56	50.27±0.54	0.053
LogMar UCVA	0.63±0.03	0.59±0.03	0.52
LogMar BCVA	0.26±0.05	0.19±0.03	0.02
Thinnest	471.19±33.73	453.61±45.32	0.001
Q value (6 mm)	−0.40±0.12	−0.37±0.11	0.55
Sphere	0.11±0.48	−0.34±0.51	0.01
Cylinder	−6.42±0.51	−5.90±0.35	0.09
Spherical equivalent	−3.09±0.59	−3.29±0.51	0.32
ISV	76.35±6.30	76.80±6.05	0.73
IVA	0.82±0.08	0.85±0.08	0.62
IHD	0.07±0.01	0.07±0.009	0.08
IHA	17.21±3.64	18.90±3.37	0.53
R min	6.72±0.06	6.72±0.05	1
D	4.60±0.48	5.28±0.78	0.08

UCVA: Uncorrected visual acuity, BCVA: Best corrected visual acuity,SE: Spherical Equivalent, ISV: Index of Surface Variance, IVA: Index of Vertical Asymmetry, IHD: Index of Height Decentration, IHA: Index of Height Asymmetry, R min: Minimum cornea curvature, D: Pentacam Belin-Ambrosio total deviation

as a new and less invasive therapeutic method was adopted to arrest the progression of ectatic characteristic of PMD.[6,8,11] We evaluated visual acuity, refractive errors and topographic outcomes 6 months after CXL in PMD patients. Our findings demonstrated at 6 months after CXL, the procedure lead to cornea flattening by significant reduction of K1 and K2 ($P < 0.05$). Also, best corrected visual acuity (BCVA) has significantly improved. Results showed no significantly change in astigmatic refractive data ($P > 0.05$) but mean refraction showed a significant decrease in sphere ($P < 0.05$).

Usefulness of CXL in ectatic disorders especially like keratoconus has been proved in many studies and we know CXL make cornea rigid and it can be useful in management of PMD either. There is just some case report that suggested CXL can be considered as a new therapeutic option for PMD.

Tuffaha, *et al*.[12] presented a case of progressive PMD treated with CXL after a previous unsuccessful implantation of intra corneal segments. After 1 year, an increase in corneal biomechanical properties accompanied by improvement in corrected visual acuity was observed. This case report showed potential applicability of CXL in a cornea with a progressive PMD, allowing a visual improvement in visual acuity and biomechanical properties of the cornea.

Also Kymionis, *et al*.[3] present a case of progressive PMD treated by simultaneously photorefractive keratotomy and CXL. Twelve months postoperatively uncorrected and best corrected visual acuity improved. Also corneal topography revealed a significant improvement in the eye.

Findings of these case reports totally support our results. Our findings showed improvement of visual acuity especially BCVA and significant flattening of cornea.

Also, Stojanovic, *et al*.[13] evaluated a combination of topography-guided custom ablation and CXL in a single procedure for the treatment of keratectasia. Twelve eyes of 12 patients with keratectasia enrolled in their study and treated with topography-guided custom ablation and CXL. Results of 1 year after surgery revealed improvement of visual acuity and reduction of mean astigmatism and keratometry asymmetry. They concluded this method may postpone or eliminate the need for corneal transplantation in suitable cases with keratectasia. Unlike this study we just enrolled PMD patients in our study treated with CXL only, but results of this study can supports ours.

One limitation of our study was low sample size. Also longer follow-up is necessary to evaluate the outcomes of this procedure. Continued stability of the good visual outcome and lack of progression of corneal ectasia in PMD patients may make this procedure an effective alternative for other invasive procedure.

CONCLUSION

Most remarkable findings of our study were improvement of visual acuity and reduction simK parameters. Stability of other values and absence of detectable change after study period imply halting of the progression of the disease.

We suggest CXL can be useful for management of PMD, but we need more studies with larger sample size and longer follow up.

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