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Research Article

Early Results of Pediatric Crosslinking Therapy

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Abstract

Purpuse: To assess the the clinical results of collagen crosslinking in pediatric patients.

Methods: This prospective study included 17 eyes of 11patients uder 18 years old who had diagnosed progressive keratoconus. Uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA) using Snellen chart, corneal topography were evaluated. The corneal epithelium off method used and 0.1% Riboflavin mixed with 20% dextran solution applicated during 3 minute intervals for 30 minutes. Ultraviolet A irradiation with 18 mW/cm^2 light power was administered for 5 minutes.

Results: All patients completed the 12-month follow-up. The increase in visual acuity at 6^{th} and 12^{th} month was statistically significant. No reduction in visual acuity and no worsening of K value was observed in any of the patients.

Conclusions: The results of this study indicate that riboflavin and ultraviolet-A induced corneal CXL is a promising therapeutic option for progressing keratoconus in pediatric population.

Keywords: *Corneal Collagen Cross-Linking; Keratoconus; Pediatric Keratoconus*

Introduction

Keratoconus is non-inflammatory, progressive degeneration of the cornea. It is characterized by often asymmetric- bilateral involvement with irregular astigmatism and low visual acuity that coincides with thinning and protrusion of the cornea [1,2]. Decreased function of stromal enzyme inhibitors and developing collagen crosslink anomalies are implicated by genetic predisposition and repetitive micro trauma. The incidence in the general population is approximately 1 in 2000 and unfortunately, penetrating keratoplasty is required in approximately 20% of patients who are not prevented from progression [3]. Keratoconus is usually prone to progression around puberty and early adulthood [4]. Especially in patients who have vernal conjunctivitis and are constantly rubbing their eyes, the risk of this progression is much higher [5,6]. Therefore, treatment should be applied to halting the disease especially at risky age and patient groups where progression of keratoconus is detected. Otherwise, there will be no other treatment options other than penetrating keratoplasty with acute hydrops and scar development, with the increase of the protrusion ofthe corneal apex and the attainment of critical levels of corneal thinning. For this purpose, in the early stages of the disease corneal cross-linking (CXL) treatment is performed [7,8]. Collegen cross-linking with ultraviolet –A light and riboflavin increases the rigidity of the corneal collagen and its resistance to keratectasia by photopolymerization of the corneal stromal fibers [9]. This treatment strategy has been shown to reduce the need for penetrating keratoplasty [10].

Material and Method

This prospective, interventional study was approved by the institutional review board and was conducted in strict adherence to the tenets of the Declaration of Helsinki. 17 eyes of 11patients under 18 years old who had diagnosed keratoconus at the Haydarpaşa Numune Trainning and Research Hospital underwent riboflavin-ultraviolet A-induced CXL. Uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA) using Snellen chart, corneal topography were evaluated at baseline and at 3, 6 and 12 months. The inclusion criteria were thinnest pachymetry of more than 400 μm, absence of corneal opacities, absence of concurrent corneal infections and no history of herpetic keratitis, absence of severe vernal keratoconjunctivitis and severe dry eyes, absence of autoimmune disease, no history of previous ocular surgery.

The corneal epithelium off method with topical anesthesia has been used while performing the procedure. The epithelium of the central 7 mm of kornea was debrided by blunt metal spatula mechanically all eyes. 0.1% Riboflavin mixed with 20% dextran solution applicated during 3 minute intervals for 30 minutes. Ultraviolet A irradiation with 18 mW/cm^2 light power was administered for 5 minutes. At the end of treatment all eyes were washed with saline solution, ofloxacin and cyclopentolate drops were administered and therapeutic contact lens was applied for 3 days. Patients were discharged with topical levofloxacin to apply 3 times a day for 1 week; fluorometholone 0.2% eyedrops to apply 3 times aday for 2 weeks and lubricating eyedrops to use for 3 months.

Results

Seventeen eyes of 11 patients were included in the study. Six of the patients were male, 5 were females. The mean age of patient was 14.2 ± 2.4 years (12 - 17). All patients completed the 12-month follow-up.

The median baseline UCVA before treatment was 0.33 ± 0.14 Snellen lines (range 0.2 to 0.6). Postoperative 3, 6 and 12 months follow up UCVA was0.36 ± 0.15, 0.38 ± 0.17and 0.4 ± 0.18 respectively(range 0.2 to 0.6). The median baseline BCVA was 0.66 ± 0.18 (range 0.4 to 1.0) and at 3, 6 and 12 months was 0.67 ± 0.17, 0.68 ± 0.17 and 0,69 ± 0.16 respectively (range 0.4 to 1.0). No reduction in visual acuity was observed in any of the patients. The increase in visual acuity at 3th month follow up was not statistically significant ($p > 0.05$) but at 6th and 12th month it was statistically significant ($p < 0.05$).

The median baseline maximum K value was 49.78 ± 2.45, K2 52.63 ± 4.2. Postoperative 3,6 and 12 months median K value was 49.39 ± 5.19, 48.8 ± 4.3 and 48.4 ± 3.96 respectively. No increase in the k value of any patient was found at the end of follow up period, and the decrease in K value measured at 6 and 12 months was statistically significant ($p < 0.05$).

The median baseline coma aberration was 1.26 ± 0.37 and the same as a 3 ad 6. months results. The 12th month coma aberration result was 1.25 ± 0.35 and this decrease of coma aberration was not statistically significant (Friedman p test was used).

		Mean	SD	Min.	Maks.	p
UDVA Snellen	Baseline	0,33	0,14	0,2	0,6	0,013*
	3 Month	0,36	0,15	0,2	0,6	
	6 Month	0,38	0,17	0,2	0,6	
	12 Month	0,4	0,18	0,2	0,6	
UDV Alogmar	Baseline	0,54	0,18	0,2	0,7	0,054*
	3 Month	0,53	0,19	0,2	0,7	
	6 Month	2,22	7,16	0,2	30	
	12 Month	2,19	7,17	0,2	30	
CDVA Snellen	Baseline	0,66	0,18	0,4	1	0,036*
	3 ay	0,67	0,17	0,4	1	
	6 ay	0,68	0,17	0,4	1	
	12 ay	0,69	0,16	0,4	1	
CDV Alogmar	Baseline	0,18	0,12	0	0,4	0,036*
	3 ay	0,17	0,12	0	0,4	
	6 ay	0,16	0,11	0	0,4	
	12 ay	0,15	0,11	0	0,4	
KAvg	Baseline	49,78	5,43	44,1	60,1	0,028*
	3 ay	49,39	5,19	44,1	60,1	
	6. y	48,8	4,3	44,1	56,4	
	12 ay	48,4	3,96	44,1	54,2	
Mean Astigmatism	Baseline	3,41	1,5	1,17	6,1	0,145*
	3 ay	3,28	1,36	1,17	5,23	
	6 ay	3,41	1,5	1,17	6,12	
	12 ay	3,19	1,52	1,17	6,12	
Trefoil	Baseline	0,34	0,07	0,21	0,45	0,392*
	3 ay	0,33	0,09	0,12	0,45	
	6 ay	0,34	0,07	0,21	0,45	
	12 ay	0,34	0,07	0,21	0,40	
Coma	Baseline	1,26	0,37	0,55	1,82	0,572*
	3 ay	1,26	0,37	0,55	1,82	
	6 ay	1,26	0,37	0,55	1,82	
	12 ay	1,12	0,36	0,44	1,8	

**Friedman p*

Discussion

The safety of corneal cross-linking treatment in children has been shown in previous studies studies [11,12]. Kodavoor., *et al*. [13] reported significant haze 14.28% of patients and Soeters., *et al.* [14] reported 3.57% haze after the treatment. We did not detect a major complication in our study.

Cross-linking stabilized the process during 12 and 36 months follow up period when performed with the standart protocol. Kodavoor., *et al*. have reported 3 eyes showing progression during the 12 month follow up [13]. No progression of disease was observed in any of the patients in our study.

We found statistically improvements in UCVA or BCVA 12 months after standart CXL. No reduction in visual acuity was observed in any of the patients and stabilization provided in all of our patients. Kodavoor., *et al*. [13] performed a retrospective study for a duration of 1 year of followup,have reported that improvement in the BCVA was noted in 18 (51.42%) eyes, stabilization in 12 (34.28%), and worsening in five (14.28%) eyes. In this study the mean of preoperative K was 55.11 ± 5.34 D, whereas the mean of postoperative K was reduced to 53.87 ± 4.99 D. In our study the baseline mean of preoperative K value was more flat. Bakshi., *et al*. [13] enrolled 21 children (31 eyes), from three different and independent medical centers, which were followed 23 ± 13.6 months (3 to 48 months). They found a nonsignificant improvement in UCVA and BSCVA and no significant change in K values following CXL, 71 and 77% of treated eyes were found to be stabilized with regards tu UCVA and BCVA respectively.

Keratoconus is usually prone to progression around puberty and early adulthood and the CXL must be performed at the earliest age possible to arrest disease progression in its beginnings.These patients should be kept under close follow up for the earliest signs of progression and CXL should be promptly offered. The introduction of CXL has changed the management of disease in the adult population and it is starting to change the management of pediatric patients and needs especially long term follow up data in the pediatric population.

Conflict of Interest

None of the authors has conflict of interest with the submission.

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