Saudi Journal of Ophthalmology (2015) 29, 249–254

Original Article

Corneal collagen crosslinking for progressive keratoconus in Saudi Arabia: One-year controlled clinical trial analysis

Ashbala Khattak [a,*]; Fouad R. Nakhli [b,1]; Haider R. Cheema [c]

Abstract

Aims: To determine the short-term efficacy of corneal collagen crosslinking (CXL) treatment in patients with progressive Keratoconus (KCN) in comparison with no treatment.
Settings and design: This controlled clinical trial study was carried out at a tertiary eye hospital, Eastern Province, Saudi Arabia.
Methods and material: A prospective controlled clinical study of patients being treated for Keratoconus at a tertiary eye care hospital in the Eastern province of Saudi Arabia. 51 eyes of 43 patients with progressive KCN who received corneal collagen crosslinking (treatment group) and 50 eyes of 34 patients with KCN and no treatment (control group) were included in our study. A one year clinical data were collected preoperatively as well as at 1, 3, 6 and 12 months postoperatively for the treatment group patients. A baseline and 1 year clinical data were collected for the control group patients. The short-term efficacy of the treatment in preventing progression of KCN in comparison with no treatment was analysed at one year.
Results: At one year after crosslinking, there was significant flattening of the average keratometry by 0.61 D ($p = 0.001$) [95% CI: 0.25, 0.97] compared to 0.40 D ($p = 0.210$) steepening in the control group; difference between treatment and control was 1.01 D ($p = 0.006$) [95%CI: 0.29, 1.72]. Pachymetry in treatment group thinned by 20.21 μm ($p < 0.0001$) [95% CI: 12.77, 27.66] compared to 0.32 μm ($p = 0.912$) in the control group. Visual acuity remained stable at the preoperative level of 20/30 ($p = 0.397$) in the treatment group and 20/40 ($p = 0.553$) in the control group at one year.
Conclusions: Corneal CXL is an effective treatment for halting the progression of KCN as shown by reduced keratometry and stability of vision.

Keywords: Collagen crosslinking, Keratoconus, Riboflavin, Ultraviolet A, Ectasia

http://dx.doi.org/10.1016/j.sjopt.2015.02.005

Introduction

Keratoconus (KCN) is a progressive degenerative disease of the cornea, usually bilateral, however asymmetric.[1] It affects mostly young patients, and an early age of onset is a negative prognostic factor for corneal transplantation.[2] There are several treatment options available, depending on the stage of KCN. However, none of these options restore vision to a near normal vision. Recently, there has been a major breakthrough in blocking the progression of the disease in the form of corneal collagen crosslinking with Riboflavin and Ultraviolet A (UVA) light.[3,4] This treatment when offered to patients with progressive KCN and, treated

Received 26 August 2014; received in revised form 16 February 2015; accepted 25 February 2015; available online 16 March 2015.

[a] Dhahran Eyes Specialist Hospital, P.O. Box: 39455, Dhahran, Eastern Province 31942, Saudi Arabia
[b] Optometry and Investigation Services, Dhahran Eye Specialist Hospital (DESH), P.O. Box: 39455, Dhahran, Eastern Province 31942, Saudi Arabia
[c] Royal College of Surgeons in Ireland, Dublin, Ireland

* Corresponding author. Tel.: +966 38911828x285 (work), mobile: +966 536474733.
e-mail addresses: ashbalakhattak@gmail.com (A. Khattak), fouadraja@hotmail.com (F.R. Nakhli), drrac@hotmail.com (H.R. Cheema).
[1] Tel.: +966 38911828x414/124 (work), mobile: +966 542406808.

Peer review under responsibility of Saudi Ophthalmological Society, King Saud University

Production and hosting by Elsevier

Access this article online:
www.saudiophthaljournal.com
www.sciencedirect.com

early, can dramatically improve the outcome of KCN, especially in younger patients.

KCN is a very common corneal ectasia in Saudi Arabia and accounts for high percentage of corneal transplants in Saudi Arabia.[5] No controlled studies have been conducted reporting results of corneal collagen crosslinking with Riboflavin and UVA in patients with KCN in Saudi Arabia. The aim of this prospective controlled study was to report our results of collagen crosslinking treatment in comparison with no treatment over a period of one year in Saudi population with KCN.

Subjects and methods

The study was conducted at a tertiary care ophthalmic hospital in Eastern Province of Saudi Arabia. It was approved by institutional review board of the hospital. The inclusion criteria for the treatment group was diagnosis of KCN, with either subjective worsening of vision or at least one diopter steepening of the cornea on keratometry over a period of one year and, the thinnest corneal pachymetry of more than 400 μm. The exclusion criteria were patients with previous intracorneal segments placement, severe dry-eye, and corneal pachymetry less than 400 μm, central corneal scar or no subjective or objective progression of KCN. The matched control group patients were randomly selected from our medical records, patients who had been diagnosed with KCN but did not undergo any intervention for treatment of KCN during their follow-up in the clinic. These patients were historic controls and did not undergo any treatment as CXL was not readily available as treatment modality in the past.

A full ocular assessment, including the measurement of pre-operative Visual acuity, Refraction and, Specular Microscopy (Konan Medical, Inc., Hyogo, Japan), was carried out for all patients undergoing corneal collagen crosslinking. Best Corrected Visual Acuity (BCVA), refraction and Pentacam measurements were repeated at every subsequent visit.

Collagen crosslinking technique

An informed consent was obtained from all patients undergoing the procedure. The eye to be treated was prepped with Iodine and topical anesthesia. A lid speculum was used. An 8 mm zone was treated with an 8 mm sponge soaked in 20% alcohol for 20 s followed by rigorous irrigation to wash out any residual alcohol. The epithelium was removed with cellulose sponges. Pachymetry was performed after epithelium removal to ascertain that it was more than 400 μm. A 3.0 ml single use isotonic solution of Riboflavin (>0.1%) with $Dextran_{500}$ (20%) (LightMed Corporation, New Taipei City, Taiwan), was instilled in the eye every 4 min and Balanced Salt Solution (BSS) every two minutes for a total of 30 min. Pachymetry was obtained at the end of 30 min to make sure the corneal thickness was still more than 400 microns before the UVA light application. UVA light from VEGA CBM-X-Linker (Costruzione Strumenti Oftalmici, or CSO, Italy) with cropped light beam of 9 mm diameter was applied for 30 min with 3 mW/cm^2 energy. Riboflavin drops and BSS were continued in the same manner during UVA irradiation. At the end of procedure, a bandage contact lens was applied. The patient was instructed to use antibiotic Vigamox (Alcon, Dallas Fort Worth, USA) and steroid eye drops, Vexol (Allergan, Irvine California, USA) four times a day for a week following the procedure. The steroid drops were gradually tapered over 1 month and antibiotics were discontinued after one week. Patients were followed in clinic at post-op day one, 1 week, 1 month, 3 months, 6 months and then one year after the procedure.

Statistical analysis

Independent *t*-test for parametric data, and one way repeated-measure ANOVA were performed with SPSS statistical software (version 17.0.1, IBM Corp., Somers, NY, USA) to compare groups and trends. $p < 0.05$ was

Table 1. Topographic and refractive changes over 1, 3, 6, and 12 months from baseline in treatment group.

Parameter	Pre-treatment Mean ± SD	Post-treatment			
		Post treatment interval	Difference value from baseline	95% confidence interval	*p*-value
Average keratometry K_{av}	47.35 ± 3.81	1 month	0.74	0.23, 1.26	0.006
		3 months	−0.53	−1.06, 0.01	0.054
		6 months	−0.73	−1.17, −0.29	0.002
		12 months	−0.61	−0.97, −0.25	0.001
Maximum keratometry K_{max}	55.03 ± 7.39	1 month	1.11	−0.18, 2.40	0.091
		3 months	−0.61	−1.94, 0.72	0.362
		6 months	−1.39	−2.29, −0.49	0.003
		12 months	−0.54	−1.73, 0.66	0.371
Asphericity Q value	−0.82 ± 0.53	1 month	−0.157	−0.25, −0.06	0.001
		3 months	−0.018	−0.10, 0.06	0.654
		6 months	0.07	−0.01, 0.15	0.080
		12 months	0.093	0.004, 0.18	0.042
Pachymetry thinnest (μm)	460.53 ± 27.80	1 month	−38.69	−49.25, −28.13	<0.001
		3 months	−32.03	−39.32, −24.74	<0.001
		6 months	−21.12	−28.68, −13.55	<0.001
		12 months	−20.21	−27.66, −12.77	<0.001
Spherical equivalent (D)	−3.37 ± 3.32	1 month	0.49	−3.26, 4.24	0.794
		3 months	0.30	−0.63, 1.23	0.516
		6 months	−0.14	−1.11, 0.83	0.769
		12 months	0.02	−0.55, 0.60	0.935
Best Corrected Visual Acuity (Decimal)	0.63 ± 0.26	1 month	0.08	−0.27, 0.42	0.663
		3 months	0.142	−0.02, 0.27	0.028
		6 months	0.010	−0.07, 0.09	0.790
		12 months	0.029	−0.04, 0.10	0.397