

# **Safety, Efficacy and Pachymetry Variation During and Following Collagen Cross Linking in thin Keratoconic Corneas with Different Protocols.**

**Mukesh Taneja<sup>1,2</sup>**  
**Pravin K. Vaddavalli<sup>1</sup>**  
**Bhupesh Bagga<sup>1</sup>**

- <sup>1</sup>. L V Prasad Eye Institute, Hyderabad**
- <sup>2</sup>. Ophthalmic Biophysics Center, BPEI, Miami**

**The authors have no financial interest to disclose.**

# Introduction

**Stability of Progression in Keratoconus with CXL with Dresden Protocol is well documented for corneal thickness  $> 400 \mu$**  (Wollensak et al : AJO 2003, Paolo et al : Ophthalmology 2009)

**What about Patients with Corneal Thickness  $< 400 \mu$**

- Significant number of Patients
- Progressive Keratoconus
- Corneal minimum Thickness  $< 400\mu$
- Especially in young (10-20 years) age group

# PURPOSE

**To study central corneal pachymetry variations, safety and efficacy during and following collagen cross linking (CXL) treatment using different protocols for Keratoconus patients with thin corneas.**

**Collagen cross linking was done in 28 eyes of patients with:**

- **Progressive keratoconus with thin corneas**
- **Corneal thinnest pachymetry below 425 microns**
- **Follow up : 6 to 12 months and beyond**
  
- **Different protocols of Collagen Cross Linking were used:**
- **CXL Protocols (conventional and accelerated flash)**
- **(With and without epithelium on)**
- **Riboflavin solutions (isotonic and hypoosmolar)**
- **With and without dextran**
- **With different methods of riboflavin soak.**

**Intraoperative Central Corneal Thickness (CCT) measurements using ultrasound pachymetry were performed per-operatively during the procedure.**



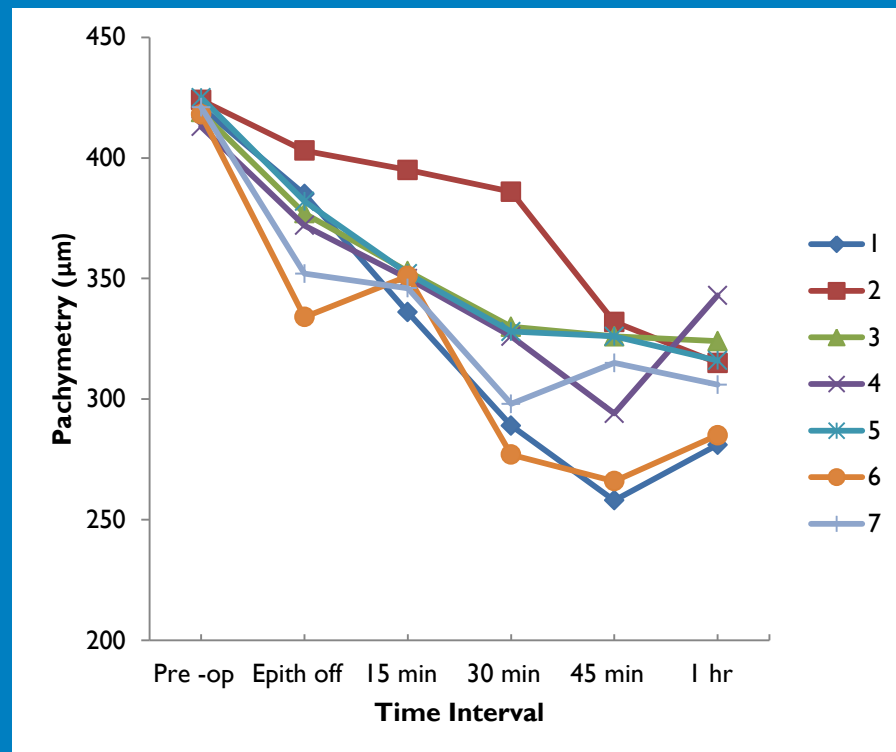
**Intra –Op Pachymetry in CXL**

# RESULTS

- We found a significant intra-op pachymetry variation ranging from 248 $\mu$  to 632 $\mu$  in all the protocols except transepithelial CXL
- This correlated well with transient corneal oedema seen in 4 patients
- Efficacy of the CXL procedure was seen to be maintained in all the protocols at six months but was equivocal in transepithelial CXL and when corneal thickness increased beyond 600 $\mu$  intraoperatively
- No significant complications were seen other than corneal haze which was seen in all patients and transient corneal oedema in 4 patients that resolved with time
- Two patients developed sterile corneal infiltrates that resolved over two weeks.

**Table / Graph 1: Intraoperative Pachymetry variation in Group 1  
(CXL with Isoosmolar Riboflavin )**

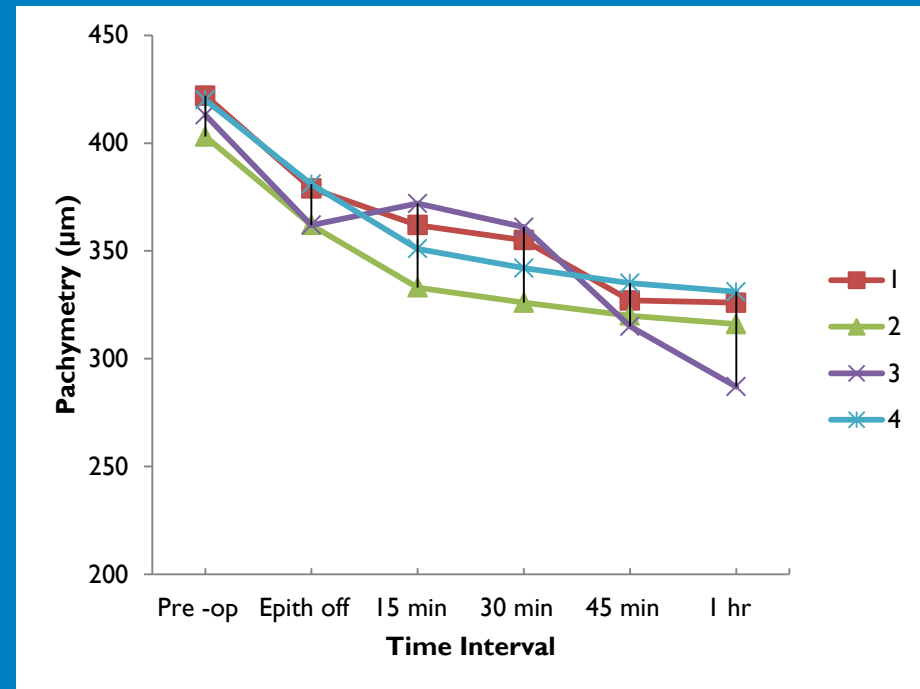
Pt. No.	Age	Eye	Pre - op	Epith off	15 min	30 min	45 min	1 hr
1.	18	OS	421	385	336	289	258	281
2.	14	OS	424	403	421	386	332	315
3.	19	OD	419	377	353	330	326	324
4.	15	OS	413	372	350	326	294	343
5.	17	OD	425	382	352	328	326	316
6.	15	OS	418	334	351	277	266	285
7.	19	OD	421	352	346	298	315	306



Mean preoperative CCT : 420.1μ (range, 413-425μ)  
At the end of CXL procedure 310.0 μ (range, 281-343μ)

**Table / Graph 2: Intraoperative Pachymetry variation in Group 2  
(CXL with Isoosmolar Riboflavin without eye speculum )**

Pt. No.	Age	Eye	Pre - op	Epith off	15 min	30 min	45 min	1 hr
1	14	os	422	379	362	355	327	326
2	18	od	403	362	333	326	320	316
3	22	od	413	362	372	361	315	287
4	17	os	420	381	351	342	335	331



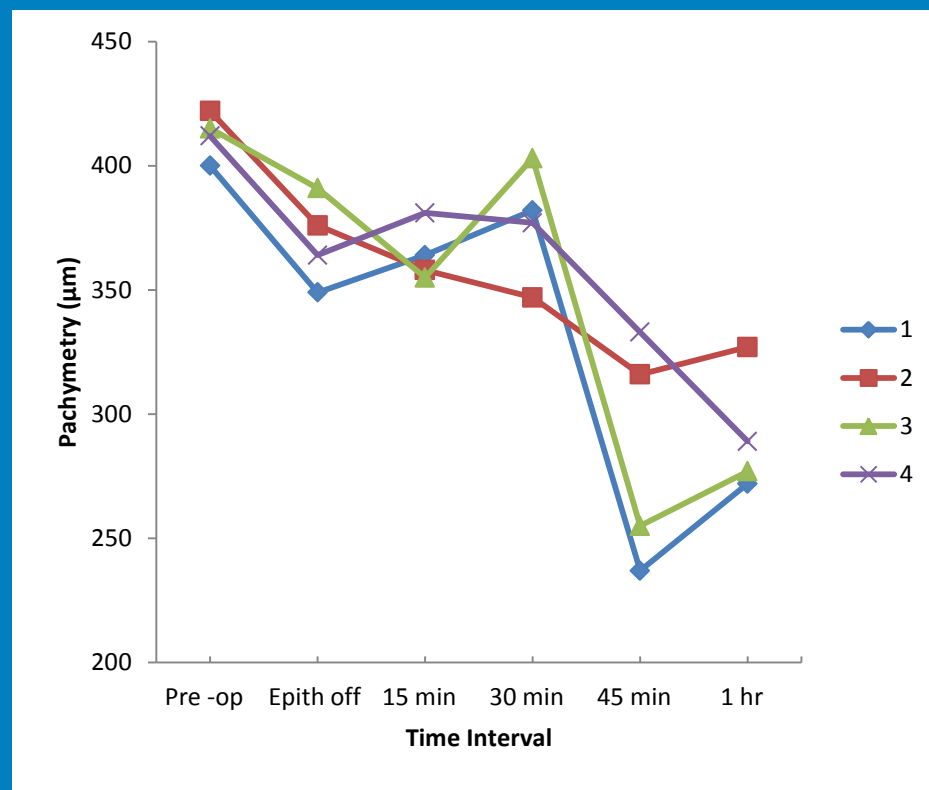
**Mean preoperative CCT: 414.5 μ (range, 403- 422μ)**

**At the end of CXL procedure: 315.0μ (range, 287-331μ)**

Tahzib et al : Ophthalmology, 2010  
(recommended not to use eye speculum)

## Table / Graph 3: Intraoperative Pachymetry variation in Group 3 (CXL with Hypo-osmolar Riboflavin )

Pt. No.	Age	Eye	Pre-op	Epith off	15 min	30 min	45 min	1 hr
1.	26	OS	400	349	364	382	237	272
2.	13	OS	422	376	358	347	316	327
3.	16	OS	415	391	355	403	255	277
4.	28	OS	412	364	381	377	333	289



Mean preoperative CCT : 412.3  $\mu$  (range, 400-422 $\mu$ )

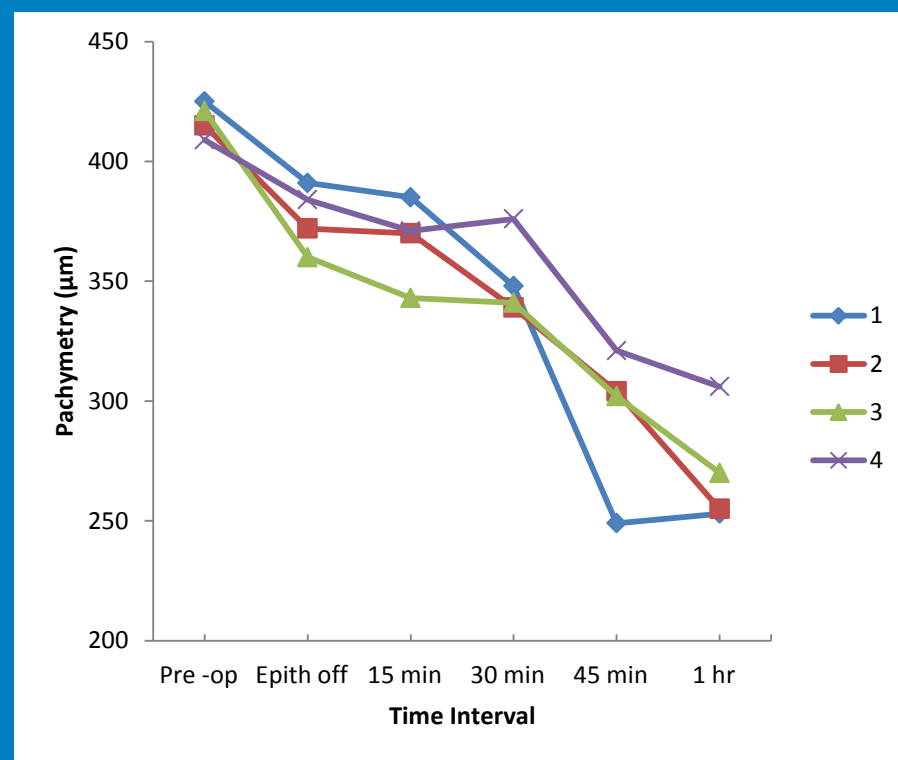
At the end of CXL procedure : 291.3  $\mu$  (range, 272-327 $\mu$ )



# Table / Graph 4: Intraoperative Pachymetry variation in Group 4 (CXL with hypo-osmolar Riboflavin using Vidaaurri's Fluid Ring )



Pt. No.	Age	Eye	Pre-op	Epith off	15 min	30 min	45 min	1 hr
1	25	od	425	391	385	348	249	253
2	15	os	415	372	370	339	304	215
3	14	os	421	360	343	341	302	270
4	22	os	409	384	371	376	321	306



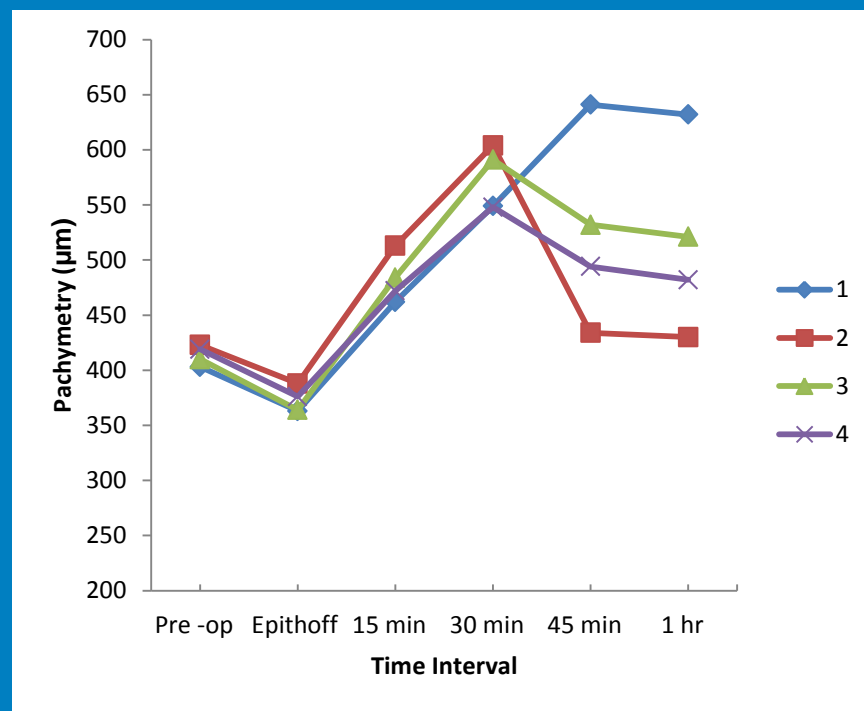
Mean preoperative CCT : 417.5 μ (range, 409- 425μ)

At the end of Procedure : 271.0 μ (range, 253-306μ)

## Table / Graph 5: Intraoperative Pachymetry variation in Group 5 (CXL with 0.5 % Isoosmolar Riboflavin without Dextran using Corneal Shield)

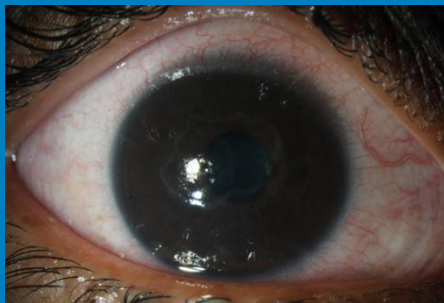


Pt. No.	Age	Eye	Pre -op	Epit hoff	15 min	30 min	45 min	1 hr
1	25	od	403	363	462	549	641	632
2	21	os	423	388	513	604	434	430
3	15	os	410	364	484	591	532	521
4	23	od	419	376	472	548	494	482

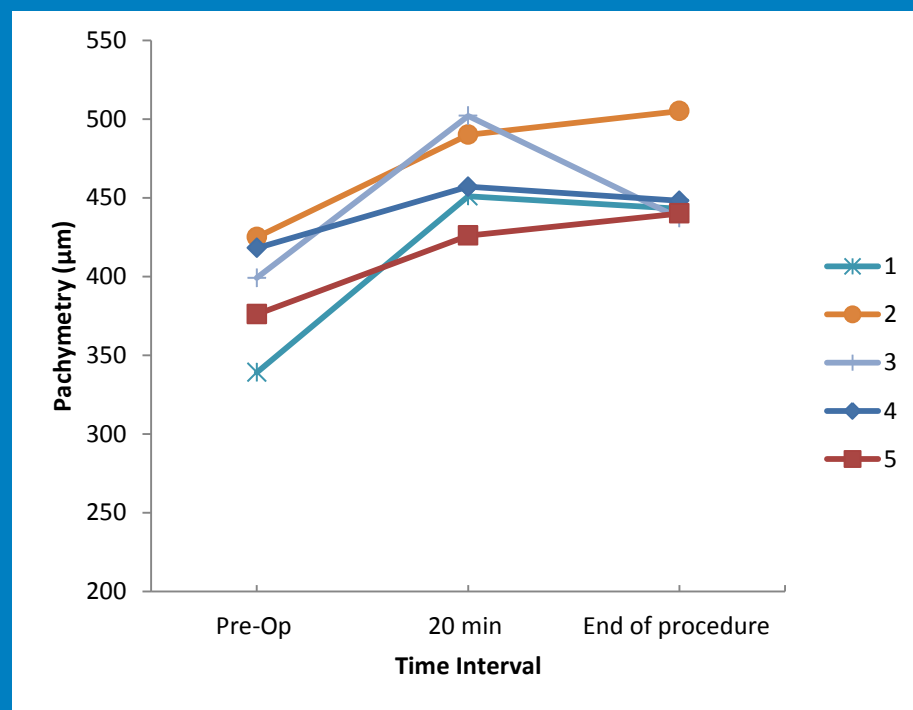


Mean preoperative CCT : 413.7  $\mu$  (range, 403- 423 $\mu$ )  
At the end of Procedure : 516.3  $\mu$  (range, 430 - 632 $\mu$ )

## Table / Graph 6: Intraoperative Pachymetry variation in Group 6 (Transepithelial Flash Cross Linking with Paracel Riboflavin)



Patient No.	Age (years)	Gender	Eye	Pre-Op	20 min	End of procedure
1.	14	F	OD	339	451	443
2.	19	M	OS	425	490	505
3.	18	M	OS	399	502	437
4.	17	F	OS	418	457	448
5.	19	F	OD	376	426	440



Mean preoperative CCT : 391.4  $\mu$  (range, 339- 435 $\mu$ )

At the end of Procedure : 454.6 $\mu$  (range, 437 - 505 $\mu$ )

# CONCLUSION

- **CXL is a relatively safe and effective procedure even in thin keratoconic corneas with modified CXL protocols.**
- **However Intraop pachymetry has a bearing on safety and efficacy of CXL procedure and should be done routinely as an added safety precaution in CXL procedure for all protocols.**