

“A Prospective Comparative Study Determining Corneal Parameter Changes in Normal Pregnancy and Pregnancy Induced Hypertension”

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Abstract

INTRODUCTION

Pregnancy and Pregnancy induced hypertension are associated with a myriad of ocular changes involving the corneal curvature, corneal thickness and corneal sensitivity. This study aims at assessing these changes throughout the gestational period and comparing these changes between the two groups

METHODS

A total of 60 pregnant women aged between 21-35yrs of age, 30 in normotensive group and 30 in PIH group coming for ANC check-up at OBG OPD of SSIMS and RC were recruited in the study. This is a prospective observational study carried out over a period of 2 years. This follow up study included 2 visits, first at second trimester of pregnancy (>20 weeks) and second visit in the third trimester (between 32 to 36 weeks). At each visit – visual acuity, slit lamp examination, corneal curvature, corneal thickness, corneal sensitivity and dilated funduscopy was done.

RESULTS

It was noted that in normotensive pregnant women there was a raise in corneal curvature and thickness and no change in the corneal sensitivity from second to third trimester during pregnancy. In PIH group there was a raise in the corneal curvature, thickness and no change in the corneal sensitivity from second to third trimester during pregnancy. Comparison between two groups revealed raised mean CCT in PIH group compared to normotensive pregnant women. The results were found to be statistically significant.

CONCLUSION

CCT showed an increasing trend towards 3rd trimester of pregnancy in both normal pregnancy and PIH but the change was exaggerated in the PIH group compared to normal pregnancy. The changes in corneal thickness during pregnancy and PIH makes it a relative contraindication for refractive surgeries. New Contact lens prescription during normal pregnancy and PIH should be deferred due to temporary changes in central corneal thickness, corneal curvature.

Key words

PIH, CCT

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I. Introduction

Pregnancy is often associated with ocular changes, it may be associated with development of new ocular conditions or can even exacerbate pre-existing conditions. The ocular effects of pregnancy may be physiological or pathological or can be modifications of pre-existing conditions. Gestational hypertension is characterized by blood pressure of 140/90mm hg or more after 20 weeks of gestation with-out proteinuria. Pre-eclampsia is characterized by increased blood pressure with proteinuria after 20 weeks associated with coagulation abnormality and liver dysfunction and Eclampsia is characterized by increased blood pressure with proteinuria after 20 weeks associated with convulsion. (1) Keratometry studies have shown increased values in central corneal thicknesses in the second and third trimesters of pregnancy which are most likely due to water retention, and usually returns to the normal value with delivery (4) The curvature of cornea increases during pregnancy (5) The curvature returns to normal after cessation of breast feeding. The most probable etiology of this increase in curvature is development of corneal oedema under hormonal influence. Corneal sensitivity has

been reported to decrease during pregnancy. The decrease in sensitivity is due to corneal oedema that develops during pregnancy (6) These changes produce temporary refractive changes during pregnancy and need special attention for refractive eye surgery. The surgery may be postponed to ensure refractive stability Although ocular changes in women with Pregnancy induced hypertension have been investigated in many studies, there remains a need for further studies to determine ocular disorders that emerge in PIH (13) There have been found to be conflicting results in the data obtained from studies conducted on PIH patients for other purposes. The aim of this study was to investigate the possible effect of PIH on CORNEAL PARAMETERS during pregnancy and thereby contribute to literature.

II. Aims And Objectives

1. To determine changes in corneal parameters during normal pregnancy and pregnancy induced hypertension
2. Comparison between the corneal changes in normal pregnancy and pregnancy induced hypertension

METHOD OF STUDY

We conducted a comparative prospective study on normotensive women and women with PIH coming for ANC check-up in OBG OPD at a tertiary care centre for a period of 2 years. The women aged between 21 and 35yrs of age, in their second trimester (>20 weeks) were selected according to the inclusion Criteria.

Follow up visit – third trimester (at 32 to 36 weeks)

The study group comprised 60 pregnant women – 30 normotensives and 30 with PIH.

Inclusion criteria:

- Normotensive pregnant women between 21-35yrs of age, >20 weeks of gestation
- Women with PIH between 21-35yrs of age, >20 weeks of gestation

Exclusion criteria:

- Pregnant women with essential hypertension or hypertension <20 weeks gestation.
- Pregnancies complicated with pre-existing diabetes mellitus, primary renal disease and collagen vascular diseases, liver disorder.
- Pregnant women with history of ocular trauma or ocular surgery
- Pregnant women who are not willing to give consent.
- Pregnant women who have undergone LASIK surgery

TEST DONE AT EACH VISIT-

1. Visual acuity both for distance and near (Snellen’s visual acuity chart for distance and near)
2. CORNEAL CURVATURE BY:
 - a. Keratometry by Bosch and Lomb Keratometer



3. CENTRAL CORNEAL THICKNESS BY:

- a. Pachymetry by Sonoptek Ultrasonic Pachymeter



- 4. CORNEAL SENSATIONS (whips of cotton)
- 5. FUNDOSCOPY

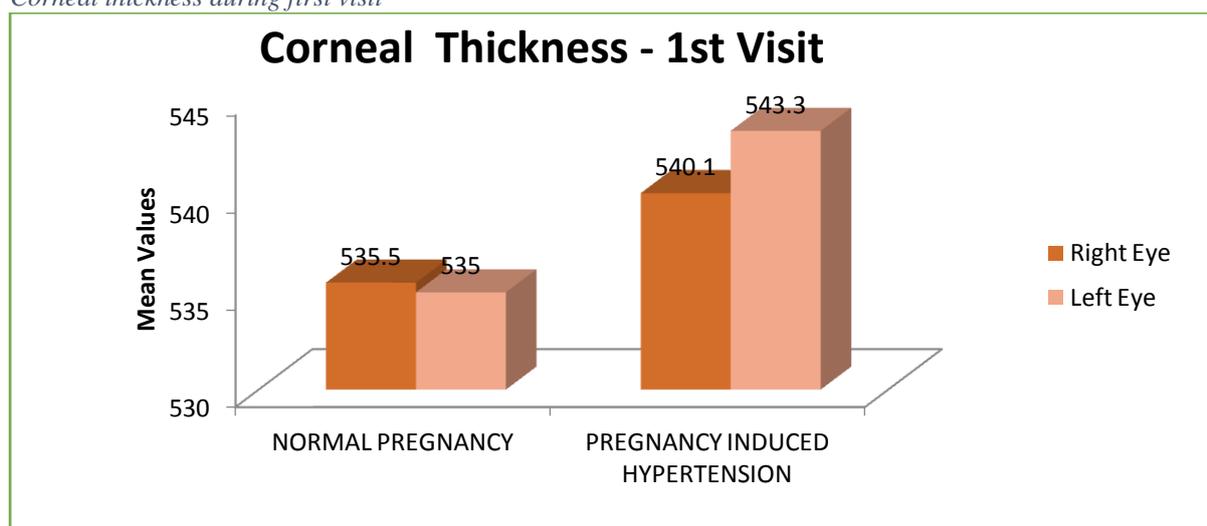
III. Results

CORNEAL THICKNESS DURING FIRST VISIT

Corneal thickness during first visit

Corneal Thickness	1st Visit		Unpaired t test	
	NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION	P Value	Significance
Right Eye	535.5 ± 33.4	540.1 ± 30.2	0.578	Not Sig
Left Eye	535.0 ± 30.3	543.3 ± 33.1	0.319	Not Sig

Corneal thickness during first visit



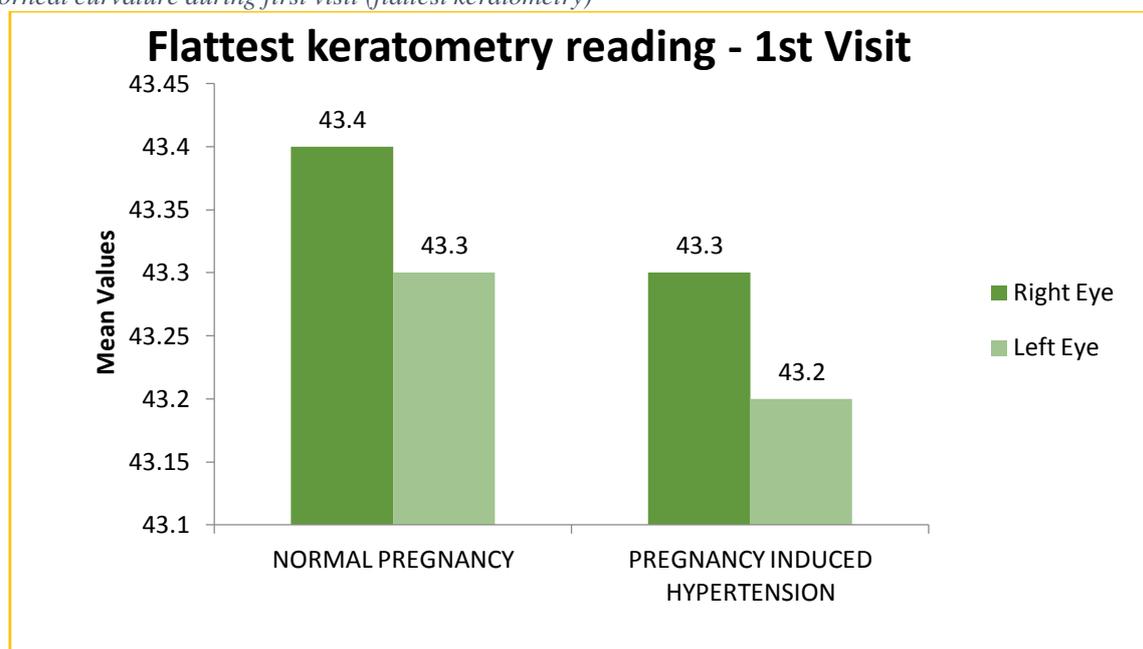
In this study the average corneal thickness during first visit was 535 microns in both eyes in normal pregnancy group, 540 microns in the right eye and 543 microns in the left eye in pregnancy induced hypertension group. The comparison between two groups showed no statistically significant difference

CORNEAL CURVATURE DURING FIRST VISIT

Corneal curvature during first visit (flattest keratometry)

Flattest keratometry reading	1st Visit		Unpaired t test	
	NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION	P Value	Significance
Right Eye	43.4± 0.8	43.3 ± 0.8	0.733	Not Sig
Left Eye	43.3± 0.8	43.2 ± 0.6	0.519	Not Sig

Corneal curvature during first visit (flattest keratometry)



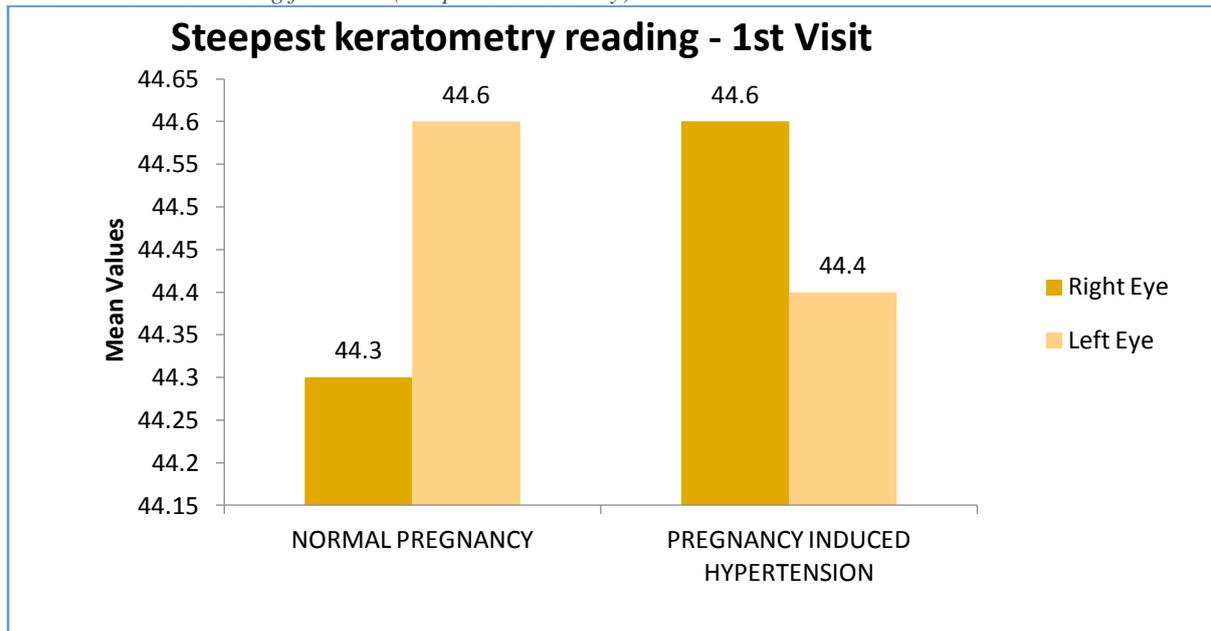
In this study the average of flattest keratometry reading during first visit was 43.4 in the right eye and 43.3 in the left eye in normal pregnancy group, 43.3 in the right eye and 43.2 in the left eye in pregnancy induced hypertension group. The comparison between two groups showed no statistically significant difference

CORNEAL CURVATURE DURING FIRST VISIT

Corneal curvature during first visit (steepest keratometry)

Steepest keratometry reading	1st Visit		Unpaired t test	
	NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION	P Value	Significance
Right Eye	44.3 ± 0.7	44.6 ± 0.7	0.612	Not Sig
Left Eye	44.6 ± 0.8	44.4± 0.6	0.176	Not Sig

Corneal curvature during first visit (steepest keratometry)



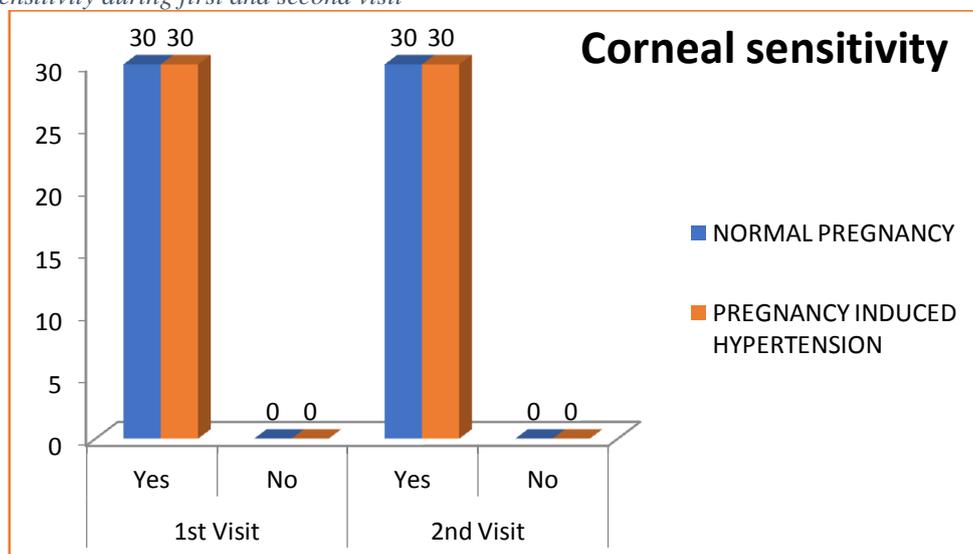
In this study the average of steepest keratometry reading during first visit was 44.3 in the right eye and 44.6 in the left eye in normal pregnancy group, 44.6 in the right eye and 44.4 in the left eye in pregnancy induced hypertension group. The comparison between two groups showed no statistically significant difference

CORNEAL SENSITIVITY DURING FIRST AND SECOND VISIT

Corneal sensitivity during first and second visit

Corneal sensitivity		NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION
1st Visit	Yes	30	30
	No	0	0
2nd Visit	Yes	30	30
	No	0	0

Corneal sensitivity during first and second visit



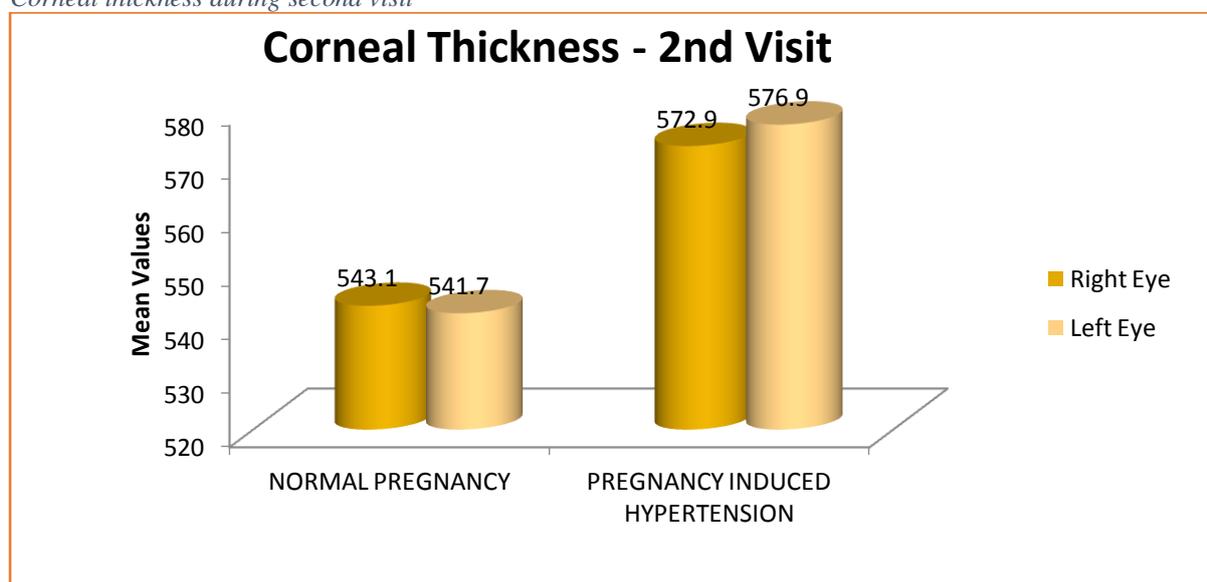
In this study the corneal sensitivity was found to be similar in both the groups during first and second visit

CORNEAL THICKNESS DURING SECOND VISIT

Corneal thickness during second visit

Corneal Thickness	2nd Visit		Unpaired t test	
	NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION	P Value	Significance
Right Eye	543.1 ± 31.6	572.9 ± 34.4	0.001	Highly Sig
Left Eye	541.7 ± 29.5	576.9 ± 36.8	0.001	Highly Sig

Corneal thickness during second visit



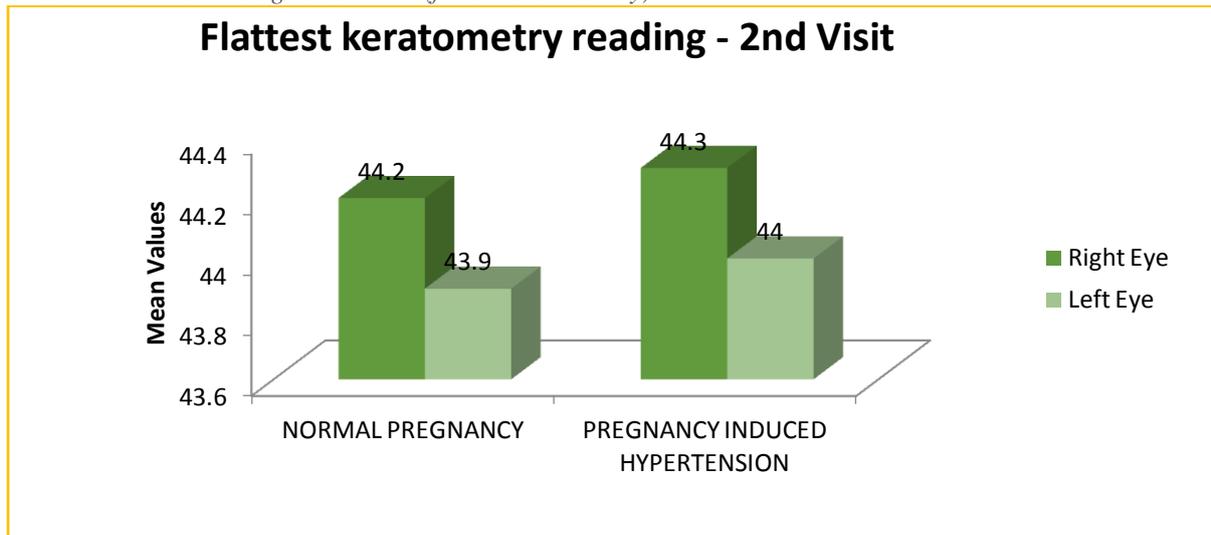
In this study the average corneal thickness during second visit was 543.1 microns in the right eye and 541.7 microns in the left eye in normal pregnancy group, 572.9 microns in the right eye and 576.9 microns in the left eye in pregnancy induced hypertension group. The comparison between two groups showed highly statistically significant difference

CORNEAL CURVATURE DURING SECOND VISIT

Corneal curvature during second visit (flattest keratometry)

Flattest keratometry reading	2nd Visit		Unpaired t test	
	NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION	P Value	Significance
Right Eye	44.2 ± 0.7	44.3 ± 0.7	0.784	Not Sig
Left Eye	43.9 ± 0.8	44.0 ± 0.5	0.381	Not Sig

Corneal curvature during second visit (flattest keratometry)



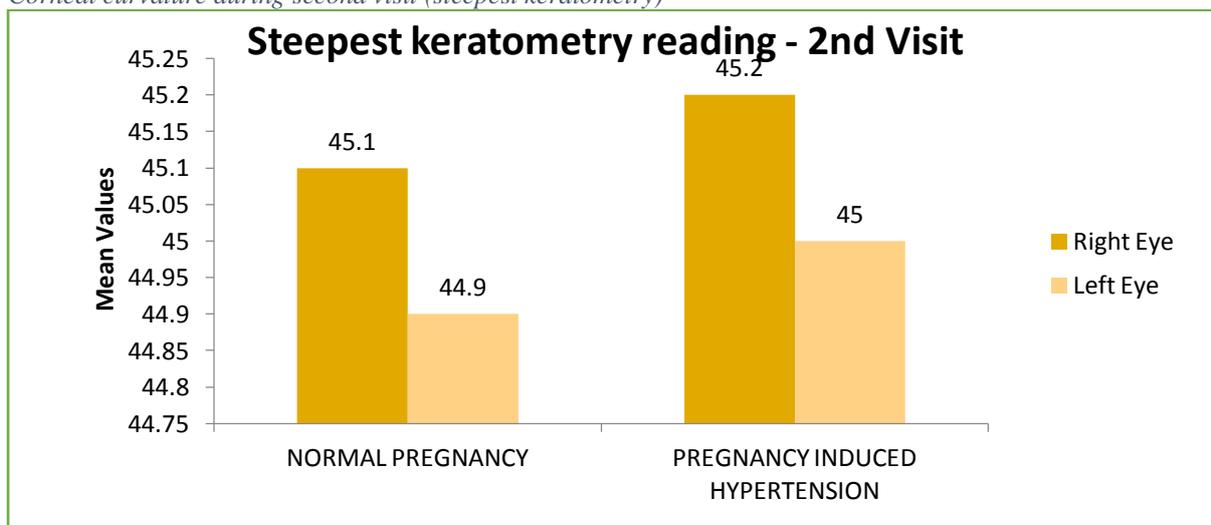
In this study the average of flattest keratometry reading during second visit was 44.2 in the right eye and 43.9 in the left eye in normal pregnancy group, 44.3 in the right eye and 44 in the left eye in pregnancy induced hypertension group. The comparison between two groups showed no statistically significant difference

CORNEAL CURVATURE DURING SECOND VISIT

Corneal curvature during second visit (steepest keratometry)

Steepest keratometry reading	2nd Visit		Unpaired t test	
	NORMAL PREGNANCY	PREGNANCY INDUCED HYPERTENSION	P Value	Significance
Right Eye	45.1 ± 0.7	45.2 ± 0.7	0.928	Not Sig
Left Eye	44.9 ± 0.8	45.0 ± 0.4	0.573	Not Sig

Corneal curvature during second visit (steepest keratometry)



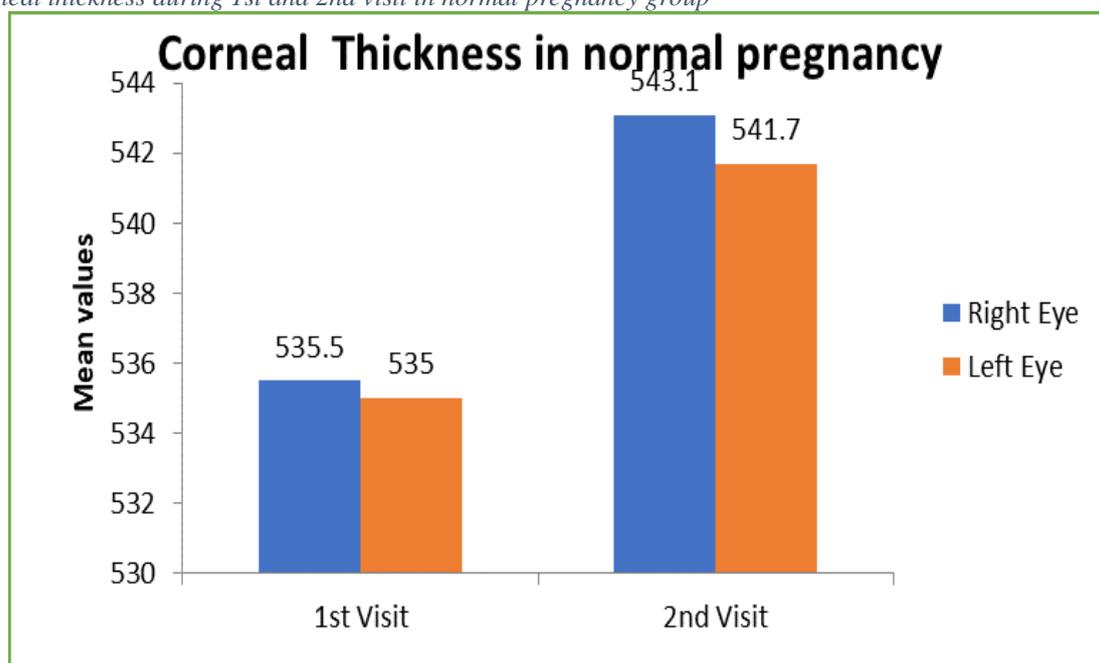
In this study the average of steepest keratometry reading during second visit was 45.1 in the right eye and 44.9 in the left eye in normal pregnancy group, 45.2 in the right eye and 45 in the left eye in pregnancy induced hypertension group. The comparison between two groups showed no statistically significant difference

CORNEAL THICKNESS DURING FIRST AND SECOND VISIT IN NORMAL PREGNANCY GROUP

Corneal thickness during 1st and 2nd visit in normal pregnancy group

NORMAL PREGNANCY					
Corneal Thickness	1st Visit	2nd Visit	Mean difference	P Value (Paired t Test)	Significance
Right Eye	535.5± 33.4	543.1 ± 31.6	-7.567	'0.001	Highly Sig
Left Eye	535.0 ± 30.3	541.7± 29.5	-6.633	'0.001	Highly Sig

Corneal thickness during 1st and 2nd visit in normal pregnancy group



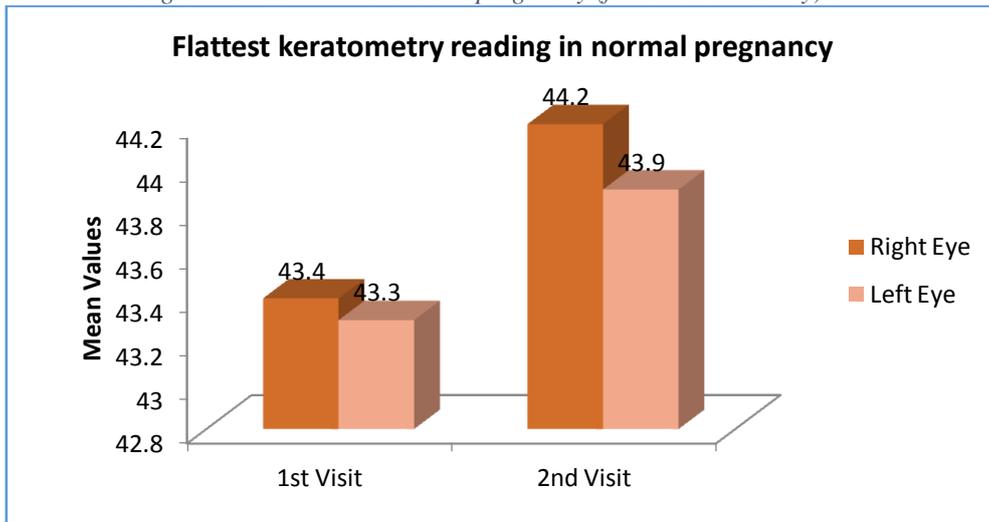
In this study there has been an INCREASING trend in the corneal thickness noted from second to third trimester of pregnancy in normal pregnancy group

CORNEAL CURVATURE DURING FIRST AND SECOND VISIT IN THE NORMAL PREGNANCY GROUP

Corneal curvature during 1st and 2nd visit in normal pregnancy (flattest keratometry)

NORMAL PREGNANCY					
Flattest keratometry reading	1st Visit	2nd Visit	Mean difference	P Value (Paired t Test)	Significance
Right Eye	43.4± 0.8	44.2± 0.7	-0.842	'0.001	Highly Sig
Left Eye	43.3± 0.8	43.9 ± 0.8	-0.583	'0.001	Highly Sig

Corneal curvature during 1st and 2nd visit in normal pregnancy (flattest keratometry)



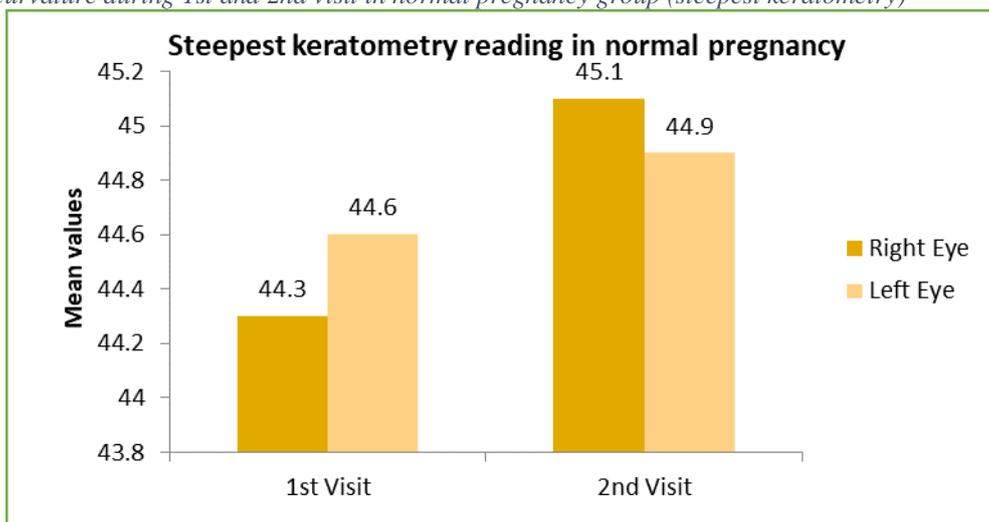
In this study there has been an INCREASE in the flattest keratometry reading from second to third trimester of pregnancy in the normal pregnancy group

CORNEAL CURVATURE DURING FIRST AND SECOND VISIT IN THE NORMAL PREGNANCY GROUP

Corneal curvature during 1st and 2nd visit in normal pregnancy group (steepest keratometry)

NORMAL PREGNANCY					
Steepest keratometry reading	1st Visit	2nd Visit	Mean difference	P Value (Paired t Test)	Significance
Right Eye	44.3 ± 0.7	45.1 ± 0.7	-0.808	0.001	Highly Sig
Left Eye	44.6 ± 0.8	44.9 ± 0.8	-0.275	0.035	Sig

Corneal curvature during 1st and 2nd visit in normal pregnancy group (steepest keratometry)



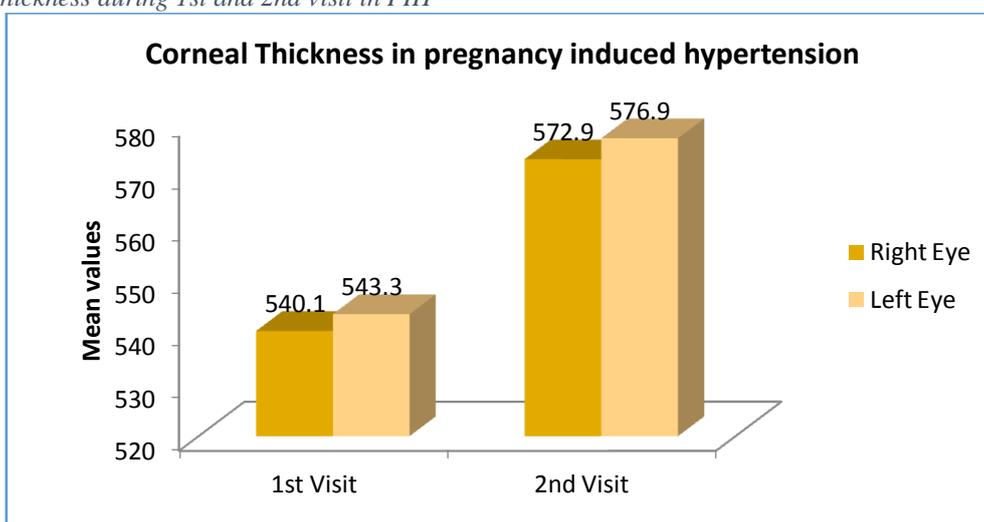
In this study there has been an INCREASE in the steepest keratometry reading from second to third trimester of pregnancy in the normal pregnancy group

CORNEAL THICKNESS DURING FIRST AND SECOND VISIT IN PREGNANCY INDUCED HYPERTENSION

Corneal thickness during 1st and 2nd visit in PIH

PREGNANCY INDUCED HYPERTENSION					
Corneal Thickness	1st Visit	2nd Visit	Mean difference	P Value (Paired t Test)	Significance
Right Eye	540.1 ± 30.2	572.9 ± 34.4	-32.80	0.001	Highly Sig
Left Eye	543.3 ± 33.1	576.9 ± 36.8	-33.60	0.001	Highly Sig

Corneal thickness during 1st and 2nd visit in PIH



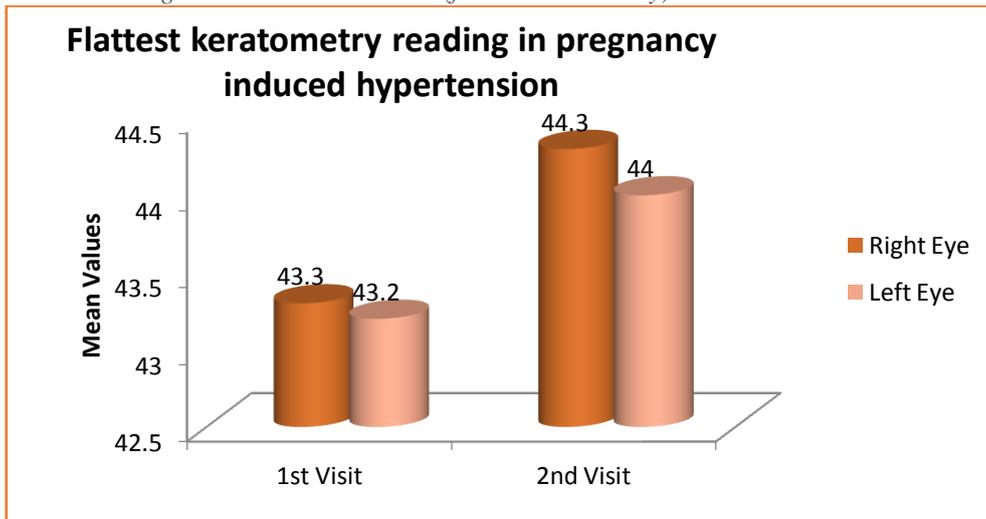
In this study there has been an INCREASING trend in the corneal thickness noted from second to third trimester of pregnancy in pregnancy induced hypertension

CORNEAL CURVATURE DURING FIRST AND SECOND VISIT IN PREGNANCY INDUCED HYPERTENSION

Corneal curvature during 1st and 2nd visit in PIH (flattest keratometry)

PREGNANCY INDUCED HYPERTENSION					
Flattest keratometry reading	1st Visit	2nd Visit	Mean difference	P Value (Paired t Test)	Significance
Right Eye	43.3 ± 0.8	44.3 ± 0.7	-0.96	0.001	Highly Sig
Left Eye	43.2 ± 0.6	44.0 ± 0.5	-0.85	0.001	Highly Sig

Corneal curvature during 1st and 2nd visit in PIH (flattest keratometry)



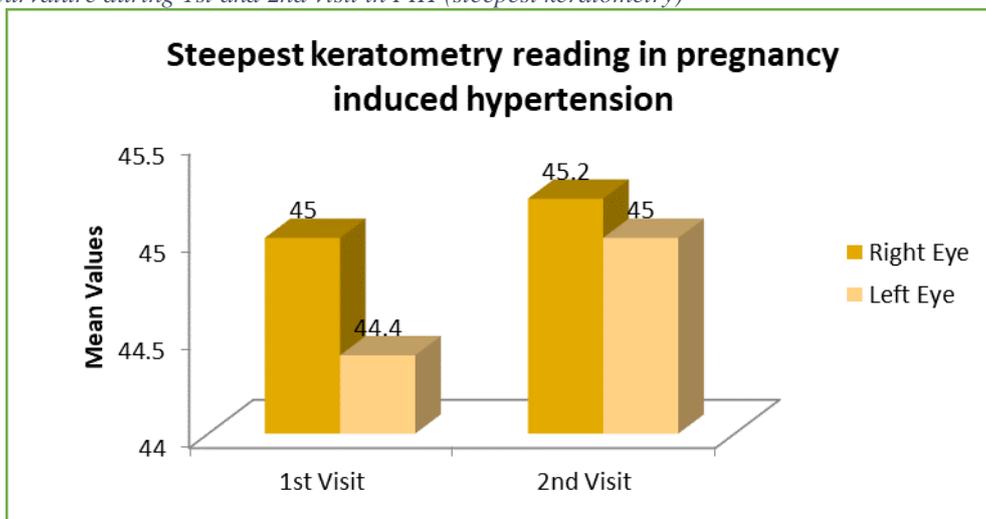
In this study there has been an INCREASE in the flattest keratometry reading from second to third trimester of pregnancy in pregnancy induced hypertension

CORNEAL CURVATURE DURING FIRST AND SECOND VISIT IN PREGNANCY INDUCED HYPERTENSION

Corneal curvature during 1st and 2nd visit in PIH (steepest keratometry)

PREGNANCY INDUCED HYPERTENSION					
Steepest keratometry reading	1st Visit	2nd Visit	Mean difference	P Value (Paired t Test)	Significance
Right Eye	45.0 ± 0.9	45.2 ± 0.7	-0.18	0.24	Sig
Left Eye	44.4 ± 0.6	45.0 ± 0.4	-0.63	0.001	Highly Sig

Corneal curvature during 1st and 2nd visit in PIH (steepest keratometry)

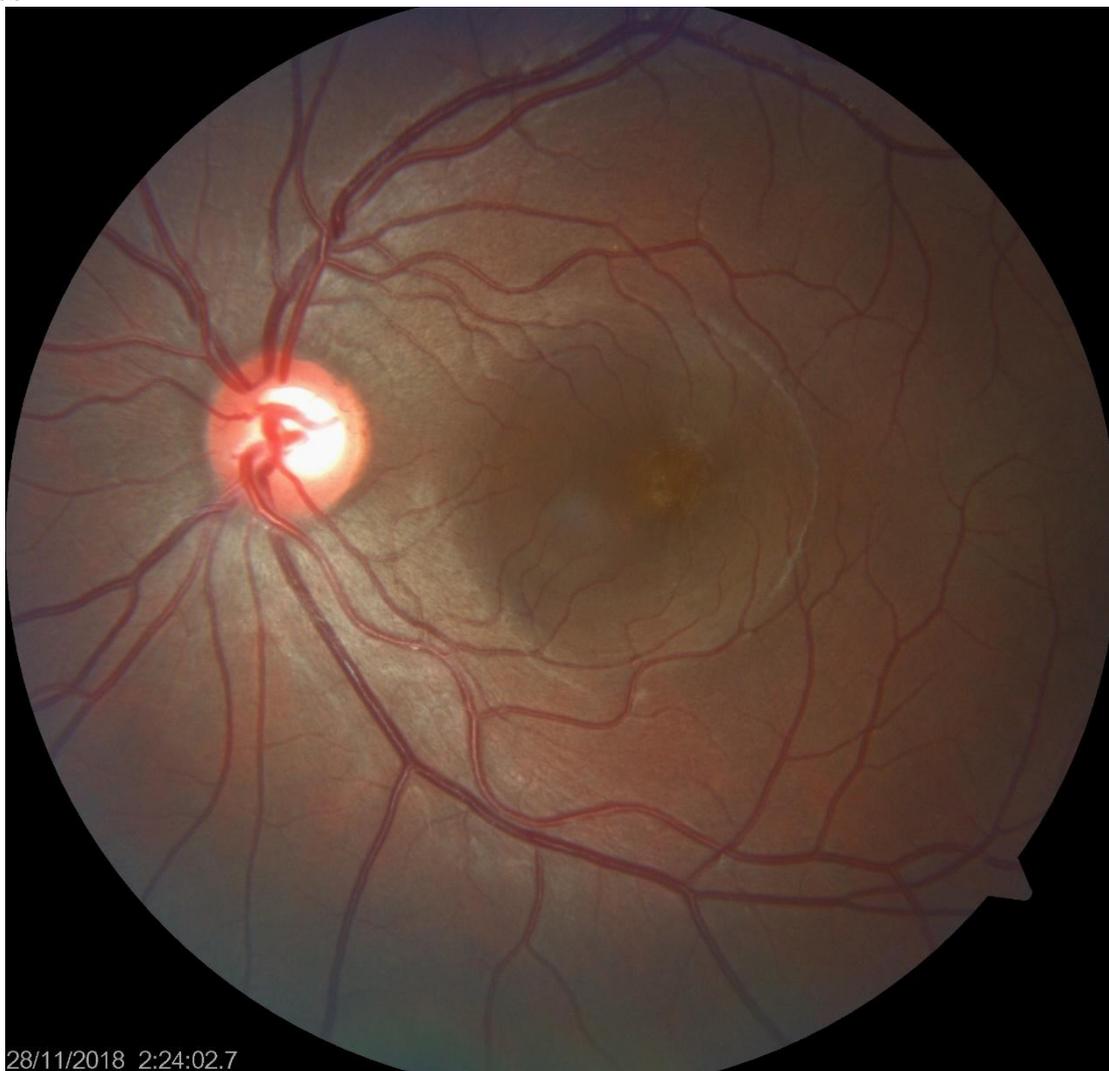


In this study there has been an INCREASE in the steepest keratometry reading from second to third trimester of pregnancy in pregnancy induced hypertension

FUNDOSCOPY:

- Group A – 30 – normal fundus
- Group B – 30 – 22- normal fundus
5 -grade 1 hypertensive changes
2 – grade 3 hypertensive changes
1 - CSR

5 - CSR



IV. Discussion

CORNEAL THICKNESS:

Normal pregnancy: In this study the mean central corneal thickness was observed to increase from second to third trimester (approximately 6-8 microns) in the normal pregnancy group. This change was statistically analysed and found to be significant with a p value <0.001

PIH: In this study the mean central corneal thickness was observed to increase from second to third trimester (approximately 30 microns) in pregnancy induced hypertension. This change was statistically analysed and found to be significant with a p value <0.001

COMPARISON:

1st visit: In this study the comparison of central corneal thickness during second trimester between both the groups did not reveal any statistically significant difference.

2nd visit: In this study the comparison of central corneal thickness during third trimester between both the groups revealed a higher value of central corneal thickness in pregnancy induced hypertension (approximately 30 microns) compared to normal pregnancy group which was statistically significant.

Comparison to other studies:

1) In a study by Chao Wang, it was found that CCT was increased during the second and third trimesters of pregnancy⁽⁶⁾, similar observations are made in the current study

2) In a study by KM kuczowski, it was found that there was a measurable increase in corneal thickness in comparison to control group of non-pregnant women⁽⁷⁾ while the current study demonstrated a measurable increase in the corneal thickness from second to third trimester of pregnancy

3) In a study by Garg P, Aggarwal P, it was shown that corneal thickness increases due to oedema which may result in a change in refractive index in cornea⁽⁸⁾, similar observations are made in the current study

4) In a study by Afekhide E. Omoti, it was found that there was measurable increase seen in corneal thickness and decrease in corneal sensitivity.⁽⁹⁾

CORNEAL CURVATURE:

Normal pregnancy and PIH: In this study the mean keratometric values was observed to increase from second to third trimester in the normal pregnancy group. This change was statistically analysed and found to be significant with a p value <0.001

COMPARISON:

1st visit and 2nd visit: In this study the comparison of mean keratometric values during second and third trimester between both the groups did not reveal any statistically significant difference.

Comparison to other studies:

1) In a study by KM kuczowski, it was found that there was an increase in corneal curvature during second and third trimester which resolve postpartum⁽⁷⁾ while in the current study emphasis is thrown on increase in corneal curvature from second to third trimester of pregnancy

2) In a study by Khawla Abu Samra, it was shown that there is statistically significant increase in corneal curvature during second and third trimester which may resolve after delivery or cessation of breast feeding⁽¹⁰⁾ similar to the current study

CORNEAL SENSITIVITY:

In this study the corneal sensitivity was present and preserved through second and third trimesters of pregnancy in both the groups

Comparison to other studies:

1) In a study by Afekhide E. Omoti, it was found that there was measurable increase seen in corneal thickness and decrease in corneal sensitivity⁽⁹⁾ which contradicts the observations of the current study

All the studies mentioned above regarding the changes in corneal parameters have been carried out in the normal pregnancy, where as this current study emphasises on the similar observations being made in pregnancy induced hypertension as well as an exaggeration of the corneal edema (leading to an exaggerated increase in the corneal thickness) in the third trimester of pregnancy compared to normal pregnancy.

V. Conclusion

■ Central corneal thickness showed an increasing trend towards 3rd trimester of pregnancy in both normal pregnancy and pregnancy induced hypertension but the change was exaggerated in the PIH group compared to normal pregnancy

■ The changes in corneal thickness during pregnancy and PIH makes it a relative contraindication for refractive surgeries

■ New Contact lens prescription during normal pregnancy and PIH should be deferred due to temporary changes in central corneal thickness, corneal curvature.

■ Though there was an increase in the corneal curvature in pregnancy and PIH, no statistically significant difference between the two groups was found in this comparative study

Bibliography

- [1]. Kapil A Das , Pooja Jaisal. A Study of Association of Fundus Changes in Pregnancy Induced Hypertension. Int J Med Res Prof. 2016; 2(2):47-50.
- [2]. Efe Y.K., Ugurbas S.C., Alpay A., Ugurbas S.H. The course of corneal and intraocular pressure changes during pregnancy. Can J Ophthalmol J Can d'ophtalmologie. 2012;47(2):150-154
- [3]. Park SB, Lindahl KJ, Temnycky GO, Aquavell JV et al. The effect of pregnancy on corneal curvature. CLAOJ 1992; 18:256-9.
- [4]. Millodot M. The influence of pregnancy on the sensitivity of the cornea. Br J Ophthalmol 1977; 61:646-649.
- [5]. Lupton SJ, Chiu CL, Hodgson L, et al. Changes in Retinal Microvascular Caliber Precede the Clinical Onset of Preeclampsia. Hypertension. 2013; 62(5): 899-904
- [6]. Wang C, Li AL, Pang Y, Lei YQ, Yu L. Changes in intraocular pressure and central corneal thickness during pregnancy: a systematic review and Meta-analysis. Int J Ophthalmol 2017;10(10):1573-1579
- [7]. Kuczowski Km, Looking into the pregnant woman's eye, Hong Kong Med J 2004,10:365

- [8]. Garg P, Aggarwal P, Ocular changes in pregnancy, Nepal J Ophthalmol 2012;4:150-161
- [9]. Afekhide E. Omoti, Joseph M.Waziri Erameh and Valentina W.Okeigbemen, A review of the changes in ophthalmic and visual system in pregnancy, Afr J Reprod Health 2008; 2:185-196
- [10]. Khwala Abu Samra, The eye and visual system in pregnant eye. What to expect? An in-depth review, Oman J Ophthalmol 2013;6:87-91

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