RESEARCH PAPER

Changes in the Meibomian Gland Function, LID Wiper Region and LID Parallel Conjunctival Folds among Various Types of Contact Lenses Users

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ABSTRACT

Purpose: To assess the meibomian gland function, lid wiper region and Lid Parallel Conjunctival Folds among various types of contact lenses users.

Methodology: This observational cross-sectional study, conducted at Department of Optometry, Sumandeep Vidyapeeth deemed to be university, Vadodara, Gujarat, involved 54 patients with a mean age of 26.537 ± 5.233 years (18-40yrs). Thorough ocular examinations included visual complaints, past ocular history, systemic conditions, and contact lens details. TBUT and TMH tests assessed tear film stability and volume. OSDI, SPEED, and CLDEQ-8 questionnaires evaluated disability and dry eye symptoms. A slit lamp examination assessed the ocular surface, corneal lesions, and anterior chamber. Meibomian gland dysfunction (MGD), lid wiper epitheliopathy (LWE) and Lid Parallel Conjunctival Folds (LIPCOF) grading were also evaluated. Statistical significance was $p < 0.05$, analyzed with SPSS 21.0.

Results: Significantly different MGD and LWE gradings were observed overall between groups ($p<0.0001$). However, there was no significant difference in LIPCOF grading among the three contact lens groups ($p = 0.543$) function and lid wiper epitheliopathy changes. LIPCOF alterations occur in hydrogels, silicone hydrogel, and RGP users. Consider modulus for lens material selection.

Keywords: *Meibomian Gland Dysfunction (MGD), Lid Parallel Conjunctival Folds (LIPCOF), Rigid Gas Permeable lenses, Tear Meniscus Height, and Lid Wiper Epitheliopathy (LWE).*

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1. INTRODUCTION:

Around 150 million contact lens (CL) wearer's worldwide experience dry eye and discomfort[1]. Contact lenses improve life quality by correcting vision, providing better peripheral vision, and aiding in sports.[2]. Discontinuation is often due to dry eyes and discomfort[2]. Hydrogels with lower water content provide better comfort due to higher hydration. Silicone hydrogels, known for superior oxygen permeability, are widely used[4],[5]. Meibomian gland dysfunction (MGD) leads to dryness and discomfort[8], [9]. Lid Parallel Conjunctival Folds (LIPCOF) and Lid wiper epitheliopathy (LWE) indicate mechanical forces increased in symptomatic lens wearers[10]. LIPCOF represent prominent bulbar conjunctival folds and are linked to ocular surface friction[11]. LWE, observed

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alterations in the lid margin epithelium, indicate ocular surface trauma during eye movements.[12, 13]

2. **METHODOLOGY**:

This was an observational cross-sectional study that was conducted at Department of Optometry, Sumandeep Vidyapeeth deemed to be university, Vadodara, Gujarat between the time period of July 2024 to September 2024. Patients who had been using various contact lenses for a duration of 8-10hrs/day ranging from a minimum of 6 months to a maximum of 5 years were included in the study. After getting the approval from the Sumandeep Vidyapeeth Institutional Ethical Clearance Committee (SVIEC) to conduct the study, in the beginning the comprehensive ocular examination was done followed by ocular history, encompassing visual complaints like blurring, diminished vision or loss of vision, along with ocular discomfort such as redness, irritation, pain etc. Associated complaints relevant to the chief issues were noted, alongside the past use of spectacles and contact lenses and previous ocular consultations, diagnoses and treatments. Traumatic or surgical history and systemic conditions like diabetes, hypertension and autoimmune disorders were considered. Regarding contact lenses, inquiries include past usage, current wear, age of lenses, reasons for discontinuation, issues with prior and current lenses, desire for change and duration of use. Details about the wearing schedule, replacement frequency, lens material and cleaning solution were noted. Objective and subjective refraction assessment were conducted. Preliminary examinations like tear film breakup time (TBUT) and tear meniscus height (TMH) and meibomian gland dysfunction (MGD) evaluations were performed using fluorescein and lissamine green dyes, in addition to Schirmer's test-1 for lacrimal secretion assessment. Total tear secretion is the sum of basal and reflex secretion, where topical anesthesia was not used[14]. TBUT assesses tear film stability; normally between 15 and 45 seconds. Over 20 seconds is insignificant; under 10 seconds suggests instability. Consistent breakups in one area may indicate corneal epithelium issues than tear deficiency. TBUT severity range in seconds: Normal: 11.8±6.4, Mild/Moderate: 6.1±4.9 Severe: 2.7±1.513. The TMH (Tear Meniscus Height) test was performed to measure the tear meniscus formed on the lower lid margins that gave a useful guide to tear volume. This was a straight-forward procedure which requires a slit lamp. Caution against excessive illumination to prevent tear prisms from drying. Patients completed the OSDI (Ocular Surface Disease Index), SPEED (Standard Patient Evaluation of Eye Dryness Questionnaire), and CLDEQ-8 (Contact Lens Dry Eye Questionnaire) questionnaires. OSDI covers frequency and general ocular symptoms (light sensitivity, grittiness, pain or soreness, blurred and poor vision), activity limitations (reading, night driving), and environmental triggers (wind, humidity, air conditioning). Scored from 0 to 100, higher scores indicate greater disability from normal[15]. The SPEED questionnaire comprises four questions. Evaluating dry eye symptoms frequency and severity over various time frames. At the visit, the past five days and the last three months. Scores were assigned to dryness/grittiness/scratchiness, soreness/irritation, burning/watering and eye fatigue, resulting in scores from 0 to 28. Normal subjects average a score of 2.2 for mild dry eye.5.0, moderate dry eye 6.6, and severe disease 9.6[15]. The CLDEQ-8 questionnaire, tailored for contact lens wearers, gauges discomfort, dryness, blurred vision and desire to remove lenses, with a total score up to 37 points. Slit lamp examination involved positioning the patient comfortably, using red-light fixation and employing binoculars testing with diffuse, optic section and conical beam techniques to assess ocular surface, corneal lesions, lens pathology, and anterior chamber characteristics in both eyes sequentially[16]. Meibomian gland dysfunction was evaluated by observing the type of secretion from the gland [17, 18]. Lid-wiper epitheliopathy is evaluated by instilling one drop of Lissamine green dye, wait one minute, and instill a second drop of the same Lissamine green dye, wait for 3 minutes. Evert the eyelid and evaluate the lid margin for LWE[19, 20]. LIPCOF grading score was calculated by adding together the nasal LIPCOF grade and temporal LIPCOF Grade [21]. The grading system of MGD, Lid wiper epitheliopathy and LIPCOF is shown in **Table. 1, Table. 2 and Table. 3** respectively.

3. RESULT:

A total of 54 patients were included in this study. The mean grade was compared between three groups for 36 eyes. The mean age of patients studied was 26.537 ± 5.233 (18-40 years) included in the study. The average duration of CL usage was 8-10 hours/day. The significant difference overall between the three groups for the MGD grading ($p<0.0001$). Similarly, overall, there is a significant difference between groups for the LWE grading ($p<0.0001$). However, there is no significant difference for the LIPCOF grading between three groups of contact lenses ($p = 0.543$). The comparison is shown graphically in **Fig. 1**.

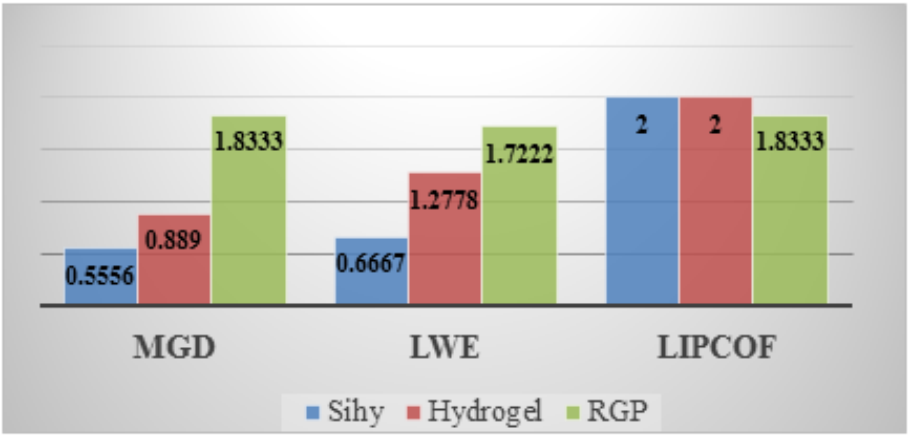

Fig.1: Effect of Contact lens Material on MGD, LWE & LIPCOF

3.1. *Comparing Silicone Hydrogel Contact Lens Material with Grades of MGD, LWE, and LIPCOF:* In this section, silicone hydrogel contact lens materials such as Balafilcon A and Senofilcon C, Senofilcon A, Etaflicon A, Somfilcon A, Comfilcon A, and Fanfilcon A were compared. With each grade of MGD, MGD is higher in Grade 1 than in Grade 2 or Grade 4. LWE is higher in Grade 0 than in Grade 1 or Grade 2. LIPCOF is higher in Grade 1 than in Grade 2. Grade 3. The comparison is shown graphically in **Fig. 2**.

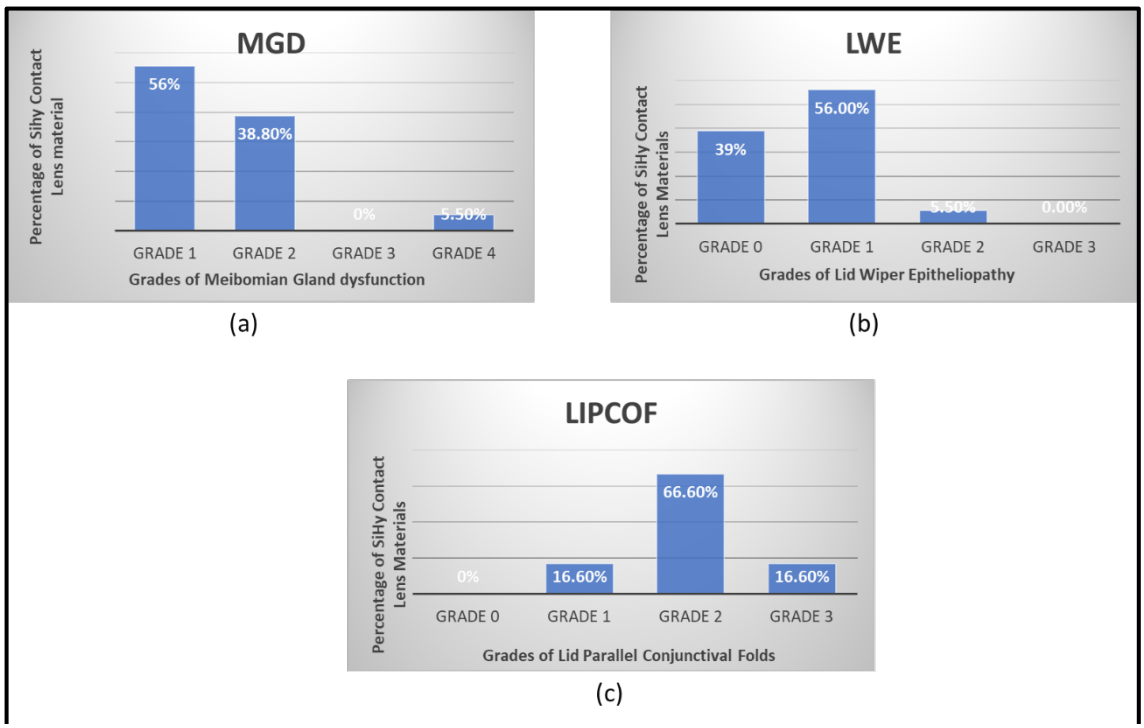

Fig.2: Comparing Silicone Hydrogel contact lens material with grades of MGD, LWE and LIPCOF.

3.2. *Comparing Hydrogel Contact Lens Material with Grades of MGD, LWE, and LIPCOF:* In this section hydrogel contact lens materials such as Hilafilcon A, Omafilcon, and Alphafilcon. When compared with each grade of MGD, it is higher in Grade 1 than in Grade 2. Grade 3. LWE is higher in Grade 1 than in Grade 2. LIPCOF is higher in Grade 1 than in Grade 2 and Grade 3. The comparison is shown graphically in **Fig. 3**.

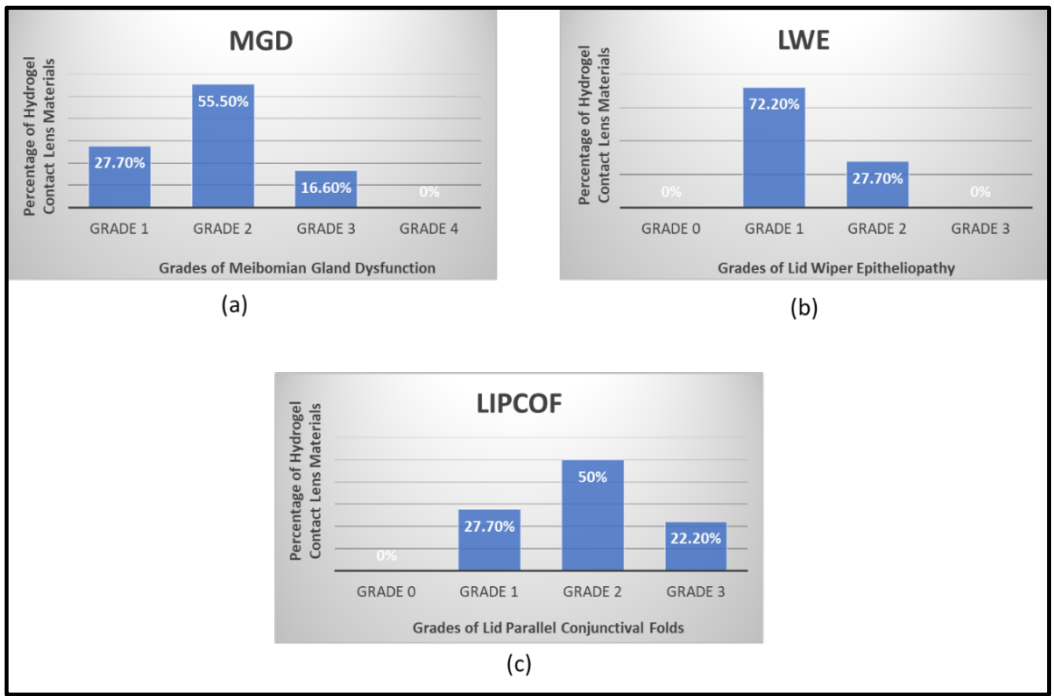

Fig. 3: Comparing Hydrogel Contact lens material with grades of MGD, LWE, LIPCOF

3.3. *Comparing RGP lens material with grades of MGD, LWE, and LIPCOF:* In this section, RGP Contact lens materials such as Fluroperm 92, 90, and Hexafocon-B were compared with each other grade of MGD. MGD is higher in Grade 1 than in Grade 2 and Grade 3. LWE is higher in Grade 2, than in Grade 1, Grade 3, and Grade 0. LIPCOF is higher in Grade 2 than in Grade 1. Grade 3 and Grade 0. The comparison is shown graphically in **Fig. 4**.

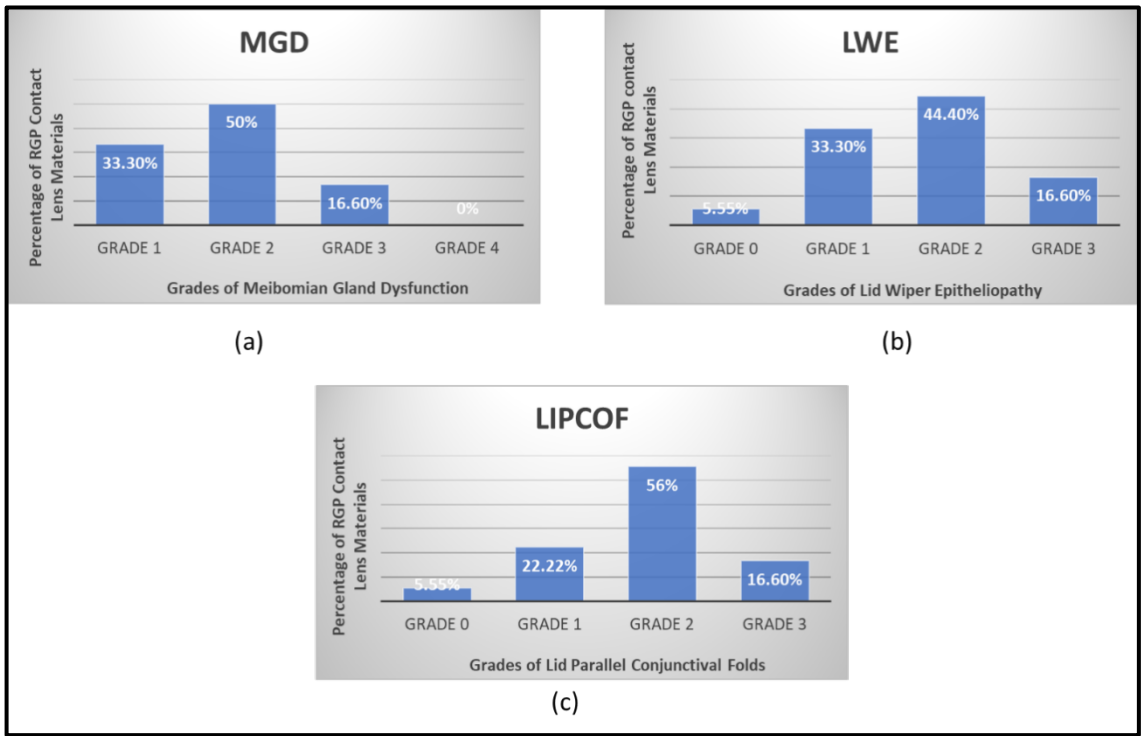

Fig. 4: Comparing RGP lens material with grades of MGD, LWE, LIPCOF

3.4. *Comparison between the duration of CL wear in years with MGD, LWE, and LIPCOF:* There was no statistical difference seen between MGD, LWE, and LIPCOF in the patient who was using a silicone hydrogel contact lens for 1 year. Whereas the patient who were using silicone hydrogel contact lens since 2 years, there has been statistically significant seen in LWE (p = 0.000) and MGD (p = 0.006). The patient who was using silicone hydrogel contact lens material since 3 years there was statistically significant seen in MGD (p = 0.005), LWE (p = 0.00), and LIPCOF (p = 0.016), as well as who was using them since MGD (p = 0.038) and LWE (p = 0.032) showed statistically significant results after four years. & LIPCOF (p = 0.020), as shown in **Table. 2.** There was no statistical difference seen between MGD, LWE, and LIPCOF in the patients who were using hydrogel contact lenses for 1 year. The patient who was using hydrogel contact lens for 2 years, there was a statistical difference seen in MGD (p = 0.025). The patient who was using hydrogel contact lenses for 3 years, there was a statistical difference seen in MGD (p = 0.025), LWE (p = 0.00), and LIPCOF (p = 0.042), as shown in **Table. 3.** There was no statistical difference seen between MGD, LWE, and LIPCOF in the patients who were using RGP contact lenses for 2 years. Whereas, there was a statistical significant difference seen in LWE (p = 0.057) in patients who were using RGP contact lens for 3 years, and the patients who were using RGP contact lenses for 4 years, there was a statistically significant difference seen in MGD (p = 0.020), LWE (p = 0.057), and LIPCOF (p = 0.057). The comparison is shown in **Table 4.**

Table 1: MGD grading[22]

Stage	MGD	Symptoms
1	Minimally Altered expressibility And Secretion Quality	None
2	Mildly Altered expressibility And Secretion Quality	Mild
3	Moderate expressibility and secretion quality	Moderate
4	Severe expressibility and secretion quality	Marked

Table 2: LWE grading[23]

LWE Grade	Symptoms
0	None
1	Mild
2	Moderate
3	Severe

Table 3: LIPCOF grading[24]

Number of folds	LIPCOF Grade
No Conjunctival Folds	0
One Permanent And Clear Parallel Fold	1
Two Permanent And Clear Parallel Folds (Normally <0.2mm)	2
More Than Two Permanent And Clear Parallel Folds (Normally <0.2mm)	3

Table 4: Comparison between Duration of Silicon hydrogel, hydrogel and RGP CL wear in years with MGD, LWE & LIPCOF respectively.

Total no. of Years	Silicon Hydrogel			Hydrogel		
	MGD	**LWE**	**LIPCOF**	**MGD**	**LWE**	**LIPCOF**
1	1.000±0.00 p= >0.05	1.000±0.00 p= >0.05	1.000±0.00 p=1.000	1.333±0.00 p=0.423	1.333±0.577 p==0.423	1.000±0.00 p= 0.423
2	1.125±0.64 p=0.006	0.6250±0.517 p= 0.000	2.250±0.707 p= 0.351	1.333±0.516 p= 0.025	1.500±0.5477 p=0.07	2.000±0.632 p=0.363
3	1.600±0.547 p=0.005	0.600±0.57 p=0.001	2.200±0.447 p=0.016	1.333±0.516 p=0.001	1.1667±0.408 p=0.00	2.500±1.048 p=0.042
4	2.6667±0.57	0.6667±0.5	2.333±0.577	1.000±0.	1.000±0.00	2.6667±1.154

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	7 p=0.038	77 p=0.032	p=0.020	00 p=0.233	p=0.233	p=0.315
Total no. of Years	**RGP**					
	MGD		**LWE**		**LIPCOF**	
1	2.333±9.30 p=0.082		1.500±0.836 p=0.064		2.000±0.632 p=0.069	
2	2.000±0.40 p=0.611		1.667±0.408 p=0.363		1.500±0.547 p=0.363	
3	1.000±0.00 p>0.05		1.6667±1.00 p=0.057		2.333±0.577 p=0.080	
4	1.667±0.577 p= 0.020		1.333±1.15 p=0.057		1.333±1.154 p=0.057	

4. DISCUSSION:

There are an estimated million people worldwide who wear contact lenses for refractive error correction. There has been an enormous growth in the number of contact lens wearers, and the number of contact lens wearers is increasing every year. Although lens design and material are getting more advanced, a considerable contact lens. The wearer complains of clinically significant signs and symptoms, including foreign body sensation, redness, and contact lens-related dry eye. As per literature review status, the changes in MGD, LWE & LIPCOF with silicone Hydrogel, Hydrogel Contact Lens, but we haven`t found any research done on RGP lenses. As compared to previous studies, the current study has found that the prolonged use of silicone hydrogel and hydrogel contact lenses do not create major ocular surfaces anomalies, but RGP lenses have shown changes in the ocular surface under normal circumstances.

The previous study conducted by Andrew D. et al. In their study, they have observed the impact of the meibomian gland on successful contact lens users. In the current study, the effect of contact lens materials, i.e., silicone hydrogel, hydrogel, and RGP. There was statistical significance in MGD and LWE [4].

The previous study was conducted by H. Pult and B.H. Riede. In their study, they observed impact of lid parallel conjunctival folds. In the current study of contact lens materials, i.e., silicon hydrogel, hydrogel, and RGP were compared between the duration of CL wears in years showed there was statistical significance in MGD, LWE, and LIPCOF 10. In the current study, the comparison between the generation of silicone hydrogel materials and modulus of elasticity of contact lens material with MGD, LWE, and LIPCOF. There was a statistical significant in LIPCOF in the 1st and 2nd generations of silicone hydrogel material and in the 3rd generation of silicone hydrogel. MGD and LIPCOF are statistically significant in hydrogel contact lens material, i.e., Hilafilcon B, showed a showed a low modulus of elasticity statistically. significant in MGD, LWE, and LIPCOF, and in RGP contact lens material, i.e., hexafocon which is a high modulus of elasticity, showed statistical significance in MGD, LWE, and LIPCOF.

5. CONCLUSION:

The study concluded that the changes in meibomian gland function and lid wiper epitheliopathy occurs more in RGP lens users and LIPCOF changes occur in all three (hydrogels, silicone hydrogels, and RGP) CL users. The current study also concludes that it is important to consider the modulus of elasticity of each contact lens material and also which generation of contact lens material is best suitable for the patient while dispensing the contact lenses. It is recommended that any prolonged contact lens users should have regular follow ups with eye care practitioners to avoid any kind of ocular surface changes caused by contact lenses.

6. SOURCE OF FUNDING:

None.

7. CONFLICT OF INTEREST:

There is no conflict of interest for this study.

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