



## COMPARISON BETWEEN LATHE-CUT AND CAST-MOLDING SOFT CONTACT LENS MANUFACTURING TECHNIQUES ON OCULAR SURFACE INTEGRITY: A DOUBLE-BLIND RANDOMIZED CONTROL TRIAL

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### ABSTRACT

**Background:** Soft contact lenses are widely used for vision correction due to their comfort and optical performance. The manufacturing technique—whether lathe-cut or cast-molded—can significantly affect lens properties, including surface smoothness, hydration, and oxygen transmissibility. These factors may influence ocular surface health and long-term wearability.

**Objective:** To compare the impact of lathe-cut versus cast-molding soft contact lens manufacturing techniques on ocular surface integrity among first-time lens users.

**Methods:** This double-blind randomized control trial included 70 healthy participants aged 15–35 years with no prior history of contact lens wear, ocular disease, or systemic conditions affecting the eye. This study was conducted in Eye 2 Eye Optometrists, Lahore and ophthalmology department Fuji Foundation hospital Lahore. Participants were randomly assigned to receive either lathe-cut or cast-molded soft contact lenses. Baseline assessments included visual acuity, refractive error, corneal curvature, tear film breakup time (TBUT), Schirmer's test, and Ocular Surface Disease Index (OSDI) scores. Follow-up evaluations were conducted at 3 and 6 months. Statistical analysis was performed using Chi-square tests and paired t-tests; significance was set at  $p < 0.05$ .

**Results:** Among the 70 participants, 27 (38.6%) were male and 43 (61.4%) were female. While both groups showed significant intra-group improvements in TBUT and Schirmer scores over the 6-month period ( $p = 0.001$ ), cast-molded lenses demonstrated a more consistent improvement in tear film stability and tear production. Normal OSDI scores were observed in 62.9% of the lathe-cut group and 51.4% of the cast-molded group; however, this difference was not statistically significant ( $p = 0.334$ ).

**Conclusion:** Both lathe-cut and cast-molded soft contact lenses are effective in maintaining ocular surface integrity and improving tear film stability in first-time users. While lathe-cut lenses showed slightly higher rates of subjective comfort, cast-molded lenses provided more consistent improvements in

objective tear metrics. These findings support the continued clinical relevance of both manufacturing techniques, with a need for patient-specific material and design selection to optimize outcomes.

## **1-Introduction**

Contact lenses are specialized devices used for medical purposes intended for correcting vision impairments as well as manage particular conditions affecting the ocular surface. They are designed to fit directly on the eye's surface, offering an alternative to traditional glasses or surgical interventions. Contact lenses can be used for various purposes, including improving visual acuity, refractive errors corrections and addressing specific eye conditions like dry eye or irregular corneas. Additionally, contact lenses may be customized to meet individual needs, including specialty lenses for medical or cosmetic reasons. By conforming closely to the eye, contact lenses provide a wider field of vision than spectacles and can enhance comfort and convenience for users. (Morgan et al., 2021). Globally, approximately 140 million individuals, with around 40.9 million in the United States alone, rely on use of contact lenses to address refractive errors. The market is experiencing significant growth and is expected to surpass \$19 billion by 2024 (Moreddu et al., 2019). Contact lenses (CLs) are frequently employed to correct ametropia, such as myopia, hyperopia, and astigmatism. These lenses have a significant impact on the ocular environment because they are placed directly on the outer surface of the eye and are far thicker than the normal tear film. Their presence modifies the dynamics of the tear film, influencing the way tears disperse and fragment on the cornea's surface and possibly causing modifications in corneal moisture. Numerous elements of ocular health, including as preserving moisture balance, guaranteeing sufficient oxygen delivery to the cornea, and general comfort during usage, can be impacted by this interaction between the contact lens and the eye (Moro et al., 2018). Contact lenses, often thicker

than the tear film, directly interact with the eye's external surface, impacting the ocular environment. They are widely preferred over traditional eyeglasses due to their ability to conform to the eye's curvature, offering a broader field of view and reduced vision distortion (Sahabudeen et al., 2021). Contact lenses are popular for both cosmetic and vision correction purposes, making the industry highly profitable (Alam et al., 2021). Recent advancements in contact lens materials have enhanced their durability, functionality, and multipurpose use, while also introducing features like health monitoring and drug delivery (Vincent & Fadel, 2019).

There are three different kinds of contact lenses: soft, rigid, or hard, and hybrid, which combines elements of both rigid and soft designs (Moreddu et al., 2019). Most contact lenses are made of hydrogels, silicone-based polymers, or a combination of these materials. While hydrogels are prized for their capacity to hold moisture and offer comfort, silicone-based polymers are recognized for their high oxygen permeability, which facilitates easier breathing for the cornea. Manufacturers are able to produce lenses that meet a variety of ocular needs and preferences by combining these components to provide improved oxygen transfer and superior hydration. These materials are selected for their ability to meet several critical requirements. One of the most important properties is gas permeability, which allows the lenses to permit oxygen to reach the cornea, thereby maintaining its health and comfort. High water content is another crucial feature, as it helps to keep the lenses moist, reducing dryness and enhancing wearer comfort. Surface wettability is vital for maintaining a stable tear film and preventing irritation. The lenses must also possess adequate mechanical strength to withstand daily wear

and resist deformation. High optical transmittance ensures that light passes through the lenses effectively, providing clear vision. Finally, biocompatibility is essential to ensure that the lens materials do not cause adverse reactions with the eye's tissues, allowing for prolonged and comfortable use (Shaker et al., 2019). Although glass was initially used for contact lenses in the 1800s, polymer-based lenses made from polymethyl methacrylate (PMMA) were developed in the early 1930 (Corbett et al., 2019).

RGPs, designed to correct vision, were made in various styles including different toric techniques. A major issue with PMMA lenses is their lack of oxygen permeability due to the limited mobility of polymer chains, which lessens the flow of oxygen and water to the eye. After many years PMMA was introduced with silicon acrylate that combines the oxygen permeability of silicon with PMMA manufacturing. (Dean & Ball, 2019). When silicone acrylates were introduced, the production of PMMA became more affordable and silicone's oxygen permeability was coupled to create the first RGP material. (Moreddu et al., 2019)

Boston RPG materials developed and began with silylomethacrylate-based polymers that have improved wettability. These include the inclusion of methacrylic acid and the modification of the conventional TRIS structure to include an itaconate ester. Originally, RGPs were made in two forms as: corneal or scleral lenses, diameters ranges between 7-12 mm and more than 18 mm. In last ten years, the market has been driven by therapies to produce stiff lenses with intermediate size. These days, stiff lenses are utilized as miniscleral lenses, which have a diameter of 15.0 to 18.0 mm, and corneoscleral lenses, which have a diameter of 12.0 to 15.0 mm. (Moreddu et al., 2019)

Soft contact lenses are crafted from polymer hydrogels, which feature high water content that enhances their flexibility compared to rigid lenses. Typically, these lenses measure

approximately 14.5 mm in diameter, making them 2-3 mm larger than the cornea. This design allows them to function exclusively as corneal lenses, covering the entire corneal surface. Soft lenses come in two primary material types: hydrogels and silicone hydrogels. Hydrogel lenses are characterized by their low oxygen permeability (low-Dk materials), while silicone hydrogels offer higher oxygen permeability (high-Dk materials), making them suitable for extended wear and improved comfort (Moreddu et al., 2019). Because of its exceptional flexibility and oxygen permeability, soft contact lenses easily adapt to the natural shapes of the wearer's eyes. Different replacement schedules, such as weekly, monthly, or daily, are offered for these lenses to accommodate personal preferences and requirements. Poly (hydroxyethyl methacrylate), or PHEMA, was the first material used to make soft contact lenses. It is made by polymerizing HEMA monomers. Up to 40% of the water can be retained by PHEMA, making it comfortable to wear. N-vinyl pyrrolidone (NVP) and methyl methacrylate (MMA) were copolymerized with HEMA to boost the water content and improve the performance of these lenses. This breakthrough led to lenses that are more comfortable overall, have better oxygen permeability, and retain moisture better. However, hydrogel materials have limited water content because oxygen is primarily transported through water channels. The introduction of HEMA copolymers like NVP and the copolymerization of MAA and NVP addressed this limitation, though the addition of MAA increased sensitivity to heat, pH, and tonicity changes. Combining glyceryl methacrylate (GMA) with HEMA resulted in a polymer with high wettability (Piskalns et al., 2007).

In hybrid contact lenses, a silicone hydrogel-made peripheral fitting zone encircles an RGP-centered optical zone with 14.5 mm diameter, and they combine the comfort of soft lenses for wearers with the improved optics of RGP lenses (Obendorf &

Wilhelm, 2003). The best qualities for a contact lens material are longevity, optical clearance, and capacity for maintain corneal metabolism by supplying enough oxygen to cornea. (Moreddu et al., 2019) Mechanical, optical, and chemical characteristics can be used to categorize contact lens properties. Additionally, contact lenses are described as created with a variety of geometrical qualities in mind (Moreddu et al., 2019). The comfort, fit, and longevity of contact lenses are all determined by their mechanical characteristics. Wettable polymers, whose characteristics vary with the amount of water present, are used to create soft lenses. (Efron & Morgan, 2017). The optical characteristics of contact lenses are essential for achieving optimal visual performance. The refractive index of the polymer and optical transparency are the two most crucial optical characteristics of a CLs (2). A CL's refractive index should ideally match the cornea's. Water can occasionally microphase separate, resulting in zones with distinct refractive indices that reduce hydrogel clarity (Efron & Morgan, 2017).

The primary and most significant refractive surface of a contact lens is its anterior surface when it is being worn. Consequently, to minimize light dispersion and avoid optical distortions, it is crucial to maintain a constant optical surface. Ensuring comfort and efficacy in contact lens wear requires maintaining excellent tear function and a clean, highly wettable lens surface. Tear film integrity and stability are essential for maintaining the quality of vision because they provide a smooth layer of optical material covering the cornea. Wearing contact lenses, however, can upset this delicate equilibrium and change the tear film's structure and content. A shorter tear film breakup time, more evaporation, and less hydration of the lens surface can result from these alterations to the integrity and stability of the tear film. The wearer may experience pain, dryness, and a reduction in visual acuity as a result of these interruptions. Consequently, these changes

may degrade the quality of vision, cause discomfort, and increase the risk of ocular surface issues such as dryness and irritation. Therefore, it is essential to manage and monitor tear film health regularly to ensure optimal visual performance and comfort for contact lens users (Montani & Martino, 2020)). Mechanically, CL wear may have an impact on the health of the cornea and conjunctiva, depending on the features of the lens material or the lens design (Sapkota et al., 2018). Although it's widely accepted that softer materials are more comfortable for the eyes, too-stiff lenses are difficult to work with and stay in place enough on the eye to enable efficient exchange of tears under the lens (Kim et al., 2018)).

The outermost of the eye, known as tear film, is crucial to vision quality. (Serramito et al., 2019) The pre-lens tear film, which is located between the lens and the eyelid, and the post-lens tear film, which is located between the lens and the cornea, are the two distinct layers that are created when a contact lens is placed on the eye. Compared to the first pre-corneal tear film, both of these segments are noticeably thinner. Pre-corneal tear film thickness might vary according on the methods of measurement, but it is typically believed to be between 3 and 11 micrometres. The total stability and performance of the tear film may be significantly impacted by the thinner pre- and post-lens tear films. This stability is necessary to keep eyes comfortable by avoiding dryness and to preserve good vision (Graham & Lin, 2021).

A shorter NITBUT and FTBUT have been significantly linked to a higher likelihood of contact lens dropout within six months. These results indicate that individuals with diminished tear film stability are more prone to discontinuing contact lens use due to discomfort or vision problems (20). Specifically, individuals who discontinued contact lens use after six months had an average baseline pre-corneal NITBUT that was about 5 seconds shorter compared to those who continued using lenses effectively. However, the predictive

accuracy of this measure was moderate aligning with the accuracy levels reported for similar symptom-related outcomes in existing literature (Graham & Lin, 2021).

The plastic materials used to make contact lenses have two different curvatures built into them: the central posterior curve (CPC) and the central anterior curve (CAC). For the sake of comfort, vision correction, and optimal fit, certain curvatures are essential. One of the three main techniques for producing contact lenses is lathe cutting, spin casting, or cast moulding. All of these methods entail meticulously moulding the material of the lenses to attain the appropriate curvatures and optical characteristics, guaranteeing that the lenses effectively correct eyesight while keeping the wearer comfortable (Dean & Ball, 2019)). Three manufacturing methods are lathe cutting, spin casting, and cast molding. A significant drawback of these conventional methods is their limited ability to produce patient-specific customizations, which can affect the precision and comfort of the lenses for individual needs (Childs et al., 2016). Cast molding of a contact lens involves creating two mold halves, each with an optical quality surface (Dean & Ball, 2019)).

By injecting a liquid monomer resin mixture with a photo initiator into the centre of a revolving mould, the spin casting method creates contact lenses with distinct edges. The pre-polymer solution forms a thin layer on the mould walls as it spreads uniformly as the mould rotates. The lens material is then polymerised and solidified by exposure to UV radiation, curing this layer. The lens is taken out of the mould when the curing process is finished, and then it is polished and ground to a perfect finish. Because of its efficiency and speed, this technology is preferred for large-scale production (Bennett & Weissman, 2005).

The lathe-cutting method is a more expensive due to lower production and is primarily used for manufacturing customized contact lenses. Most lathe machines are computer-controlled, allowing

for precise, individualized lens production to meet specific requirements. After fabrication, lathe-cut lenses are dehydrated and must be hydrated before use to prevent breaking or tearing. These lenses are generally thicker than those produced by spin casting, which makes them easier to handle and provides better lens movement. However, the lathe-cutting process is time-consuming and labor-intensive, as each lens is crafted individually, making it challenging to replicate consistently (Contact Lens Material and Manufacture Process, 2021).

Reduced dropout rates among contact lens wearers continue to be a major concern for manufacturers and clinicians, despite substantial developments in contact lens materials over the past few decades. Discontinuation of usage of contact lenses is intimately related to the comfort and behaviour of the lenses as well as their impact on the ocular surface. Improving patient satisfaction and adherence to contact lens usage requires addressing these aspects (Ruiz-Alcocer et al., 2018)). Dry eye symptoms are more common in contact lens wearers than in non-wearers, with up to 50% of users reporting some degree of pain. By forming distinct pre- and post-lens tear film layers, contact lenses disturb the natural tear film and cause a number of abnormalities, including tear film instability. These changes add to the higher incidence of dry eye complaints among contact lens wearers (Tyagi et al., 2012).

This study aims to investigate the effects of various soft contact lens manufacturing procedures on ocular surface integrity, which is a therapeutically relevant subject. Both contact lens wearers and eye care professionals will benefit from these discoveries. Our objective is to compare various manufacturing processes in order to support the continuous advancement of contact lens technology as well as the comfort and ocular health of contact lens.

## **Objectives**

- I. To examine the effects of Lathe Cut soft contact lens manufacturing technique on ocular surface integrity.
- II. To examine the effects of Cast Molding soft contact lens manufacturing technique on ocular surface integrity.
- III. To compare the effects of lathe cut versus cast molding soft contact lens manufacturing techniques on the ocular surface integrity

**Material and Methods:**

**Research Design:** Double Blind  
Randomized control trial

**Clinical setting:** The Low Vision and Keratoconus clinic, Eye 2 Eye Optometrists, Lahore and ophthalmology department Fuji Foundation hospital Lahore

**Sample Size:** 
$$\frac{Z^2 p (1-p)}{d^2}$$

n = Sample size

Z = Confidence interval = 95% = 1.96

d = Error = 5% = 0.05%

P = Population value = 0.09

$$n = \frac{(1.96)^2(0.09)(1-0.09)}{(0.05)^2}$$

n = 70(24)

**Sampling Technique:**

Non-Probability purposively convenient sampling technique

**Duration of Study:**

6 months after approval of synopsis

**Selection Criteria:**

**Inclusion Criteria:**

- Individuals who have never worn contact lenses
- Participants aged 15 to 35 years
- Patients without any ocular pathology (Ruiz-Alcocer et al., 2018)

**Exclusion Criteria:**

- Patients with astigmatism greater than 0.75 DC
- Subjects with a history of ocular surgery, eye pathology, or systemic disease
- Patients with poor compliance(Ruiz-Alcocer et al., 2018)

**ETHICAL CONSIDERATIONS**

The research adhered to the ethical guidelines set by the Superior University Lahore committee, ensuring the protection of participants' rights. Key points include:

1. Written informed consent was obtained from all participants (see attached).
2. All information and data were kept confidential.
3. Participant anonymity was maintained throughout the study.
4. Participants were informed that they would gain knowledge about the effects of periocular massage on dry eye disease.
5. It was communicated that there would be no harm or risk to their personal life from participating.
6. Participants were informed they could withdraw from the study at any time.
7. The study's purpose, focusing on evaluating periocular massage's effects on dry eye disease, was clearly stated.
8. Participants were informed that the study would enhance their understanding of dry eye disease.
9. Data was securely stored, with physical data locked and electronic data protected by password.

**Data Collection Procedure:**

After obtaining the ethical approval from the institutional review board (IRB) and informed consent from the subjects, the individuals were divided into two groups (lathe cut & cost molding) by using a double-blind randomized control trial. The subjects were briefed about the study's purpose, procedure, risks, and benefits, and the types of lenses included in the study. A draw was conducted by a third party to ensure that neither the researcher nor the subject knew which group the subject would be assigned to.

Visual acuity was measured by using a Log MAR chart. Objective measurements of the subject's refractive error were taken by using auto refractometer and retinoscopy. Best-corrected visual acuity was determined by performing subjective refraction. The

curvature of the corneal anterior surface was measured by using a Keratometer. To check the tear film stability, Tear film breakup time (TBUT) and the Schirmer test were performed before fitting the soft contact lens. The subject was fitted with a contact lens. The TBUT and Schirmer tests were repeated after three and six months of wearing contact lenses. Questions were asked to patients by using an Ocular surface disease index questionnaire (OSDI) and the scores were recorded.(Ruiz-Alcocer et al., 2018)

**Data Analysis:**

Data were collected through the Performa/Questionnaire designed specifically for this study. Data were analyzed on Statically Package for Social Science (SPSS) version 26. The repeated measures ANNOVA test was applied to see the improvements statistically in TBUT and Schirmer test between the Lathe cut and Cast molding contact lens manufacturing techniques.

**Results**

The study comprised seventy patients (27 males, 43 females). They were all young and healthy individuals between the ages 18 and 45 years. The subjects were equally distributed in lathe cut and cast molding soft contact lens manufacturing techniques groups (35-35) by a double blind randomized control trial. The Tear film breakup time (TBUT) and Schirmer test were performed on patients on each visit (Baseline, three months and six months) and the results were recorded. The results were then compared. That is (Base line with first visit, Baseline with second visit, and first visit with the second visit, and the difference in the results were recorded.

Regarding the Ocular surface disease index (OSDI) score, forty (57.14%) were found normal, while thirty (42.86%) individuals were found in mild category. The comparison indicates that OSDI score improves and becomes normal for more patients (62.91%) after using lathe cut contact lens manufacturing technique compared to cast molding technique as (51.4%).

Both the lathe cutting and cast molding groups showed statistically significant improvements in tear film stability (TBUT) over time. The cast molding group showed a more pronounced and consistent improvement across both follow-up periods. The cast molding group showed a statistically significant increase in tear production from baseline to 6 months, while the lathe cutting group did not show significant changes in tear production. Overall, the cast molding group demonstrated better outcomes in both tear film stability and tear production compared to the lathe cutting group. This suggests that the intervention or condition applied in the cast molding group was more effective in improving these aspects of ocular health over the 6-month period.

**Demographic Characteristics**

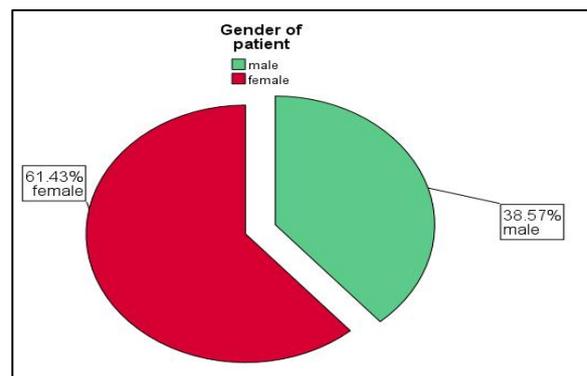


Figure-I: Graphical distribution with respect to gender

Out of 81 patients 62(76.54%) were male while 19 (23.46%) were female (fig-I)

Out of 70 patients 27(38.57%) were male while 43(61.43%) were female. This indicates that there are more female patients (61.43%) compared to male patients (38.57%). (fig-I)

**Graphical distribution of age**

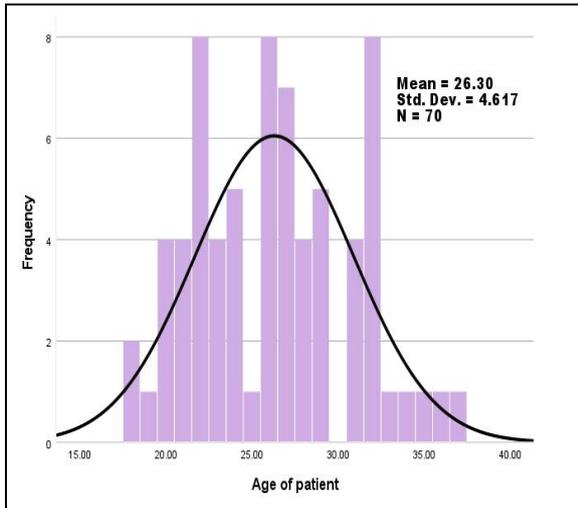


Figure-II: Graphical distribution with respect to age

The age distribution of the 70 patients is centered around 26.30 years, with most patients being between 20 and 30 years old. The data follows a roughly normal distribution with a standard deviation of 4.617 years.

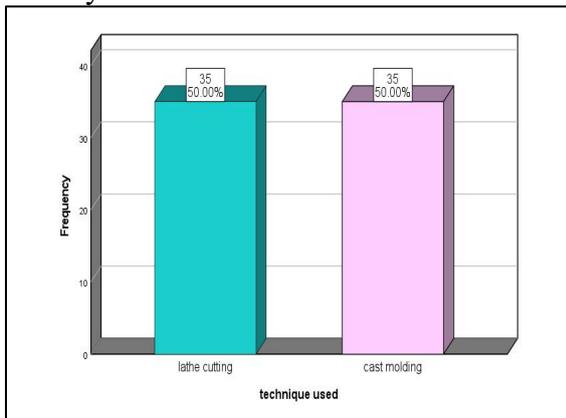


Figure-III: Graphical distribution with respect to hypertension

Figure-III: Graphical distribution with respect to technique used  
The chart indicates that there is an equal preference or application of the two techniques, lathe cutting and cast molding, with both being used 35 times each, making up 50% of the total instances.

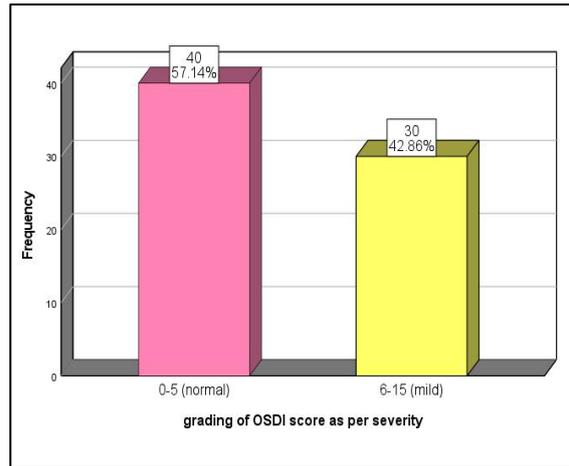


Figure-IV: Graphical distribution with respect to diabetes

a) As regard to risk factors, diabetes mellitus was found in 55(67.90%) patients while 26(32.10%) were non diabetic (fig-IV)

Figure-IV: Graphical distribution with respect to Grading of OSDI as per severity

As regard to Grading of OSDI as per severity, normal was found in 40(57.14%) patients while 30(42.86%) were in mild category (fig-IV)

### INFERENCIAL STATISTICS:

Table-1: Comparison of the effects of contact lens manufacturing technique on ocular surface integrity.

		GROUP		p-values
		Lathe cutting	Cast molding	
Grading of OSDI score as per severity	0-5 (normal)	22(62.9%)	18(51.4%)	0.334
	6-15 (mild)	13(37.1%)	17(48.6%)	
	Total	35(100%)	35(100%)	

The comparison indicates that the grading of OSDI scores improves (becomes normal) for more patients as (62.9%) after using the lathe cutting contact lens manufacturing technique compared to cast molding as (51.4%). This suggests that the choice of technique significantly impacts the severity of OSDI scores among patients, despite

there being no significant difference in overall severity.

**Table 2: Comparison of the between Effects of Contact Lens Manufacturing Techniques on Schirmer Test Results at Baseline, First, and Second Follow-up**

Time Point	LATHE CUTTING	CAST MOLDING	P-VALUE BETWEEN SUBJECT	
<b>TBUT</b>	BASELINE	1.0±0.00	1.0857±.28403	0.079
	FIRST FOLLOWUP (3 MONTH)	1.2000±.40584	1.2286±.42604	0.775
	SECOND FOLLOWUP (6 MONTH)	1.6000±.49705	1.6286±.64561	0.836
<b>P-VALUE SUBJECT WITHIN</b>		0.001	0.001	
<b>(SCHIRMER)</b>	BASELINE	1.0000±0.00	1.0286±.16903	0.321
	FIRST FOLLOWUP (3 MONTH)	1.0000±0.00	1.0286±.16903	0.321
	SECOND FOLLOWUP (6 MONTH)	1.0857±.28403	1.1429±.35504	0.460
<b>P-VALUE SUBJECT WITHIN</b>		0.001	0.001	

The data shows no statistically significant differences between lathe cutting and cast molding techniques at any time point for both TBUT and Schirmer test scores (p-values > 0.05). However, there is a statistically significant improvement within subjects over time for both techniques (p-value = 0.001), indicating that both methods lead to significant improvements in TBUT and Schirmer scores over the course of 6 months.

**Table-3: Within Comparison of Lathe Cutting and Cast Molding Techniques on TBUT and Schirmer Test Results at Baseline, 3-Month, and 6-Month Follow-ups**

Parameter	Time point	Lathe Cutting	Cast Molding	p-value repeated measure anova
<b>TBUT</b>	Baseline	1.0±0.00	1.0857±.28403	0.001
	First Followup (3 Month)	1.2000±.40584	1.2286±.42604	
	Second	1.6000±.497	1.6286±.645	

	Followup (6 Month)	05	61	
<b>SCHIRMER TEST</b>	Baseline	1.0000±0.00	1.0286±.16903	0.001
	First Followup (3 Month)	1.0000±0.00	1.0286±.16903	
	Second Followup (6 Month)	1.0857±.28403	1.1429±.35504	

The repeated measures ANOVA analysis indicates that both Lathe Cutting and Cast Molding techniques lead to statistically significant improvements in TBUT and Schirmer test scores over time. The significant p-values (0.001) for both parameters suggest that the improvements are not due to chance, highlighting the effectiveness of both techniques in improving these measures over the course of the study.

**Table-4: Paired wise Comparison of Lathe Cutting and Cast Molding Techniques on TBUT and Schirmer Test Results at Baseline, 3-Month, and 6-Month Follow-ups.**

The data shows results at different time points: Baseline, First Follow-Up (3 months), and Second Follow-Up (6 months).

Groups	LATHE CUTTING		CAST MOLDING	
	Baseline	Second Follow-up (3 Month)	Baseline	Second Follow-up (3 Month)
<b>TBUT</b>	1.0±0.00	1.2000±.40584	1.0857±.28403	1.2286±.42604
	0.006		0.023	
	Baseline	First Follow-up (6 Month)	Baseline	First Follow-up (6 Month)
	1.0±0.00	1.6000±.49705	1.0857±.28403	1.6286±.64561
	0.006		0.001	
	Second Follow-up (6 Month)	First Follow-up (3 Month)	First Follow-up (3 Month)	Second Follow-up (6 Month)
1.6000±.49705*	1.2000±.40584*	1.2286±.42604	1.6286±.64561	
0.001		0.001		

(SHIRMER )	Baseline	First Follow-up (3 Month)	Baseline	First Follow-up (3 Month)
	1.0000±0.00	1.0000±0.00	1.0286±.16903	1.0286±.16903
	1.00		1.00	
	Baseline	Second Follow-up (6 Month)	Baseline	Second Follow-up (6 Month)
	1.0000±0.00	1.0857±.28403	1.0286±.16903	1.1429±.35504
	0.083		0.044	
	First Follow-up (3 Month)	Second Follow-up (6 Month)	First Follow-up (3 Month)	Second Follow-up (6 Month)
	1.0000±0.00	1.0857±.28403	1.0286±.16903	1.1429±.35504
	0.083		0.044	

TBUT: Both the LATHE CUTTING and CAST MOLDING groups showed statistically significant improvements in tear film stability (TBUT) over time. The CAST MOLDING group showed a more pronounced and consistent improvement across both follow-up periods.

Schirmer Test: The CAST MOLDING group showed a statistically significant increase in tear production from baseline to 6 months, while the LATHE CUTTING group did not show significant changes in tear production.

Overall, the CAST MOLDING group demonstrated better outcomes in both tear film stability and tear production compared to the LATHE CUTTING group. This suggests that the intervention or condition applied in the CAST MOLDING group was more effective in improving these aspects of ocular health over the 6-month period.

## 5- DISCUSSION

In the rapidly evolving field of contact lens technology, the quest to enhance user comfort and minimize ocular surface complications remains paramount (Wu, Dave, Carbonneau, & Tran, 2024). As contact lens manufacturers strive to innovate, understanding the nuances of these production methods is crucial. The introduction of new materials and manufacturing techniques is driven by the need to reduce discontinuation rates among

contact lens users (Musgrave & Fang, 2019). A notable trend in recent years has been the increased adoption of daily disposable contact lenses, which have addressed many issues associated with wearing lenses, particularly in maintaining ocular surface health.

New contact lens materials are continuously being introduced to the market, with manufacturers focused on reducing lens discontinuation rates by addressing ocular surface complications and enhancing user comfort. The rise in daily disposable contact lenses has notably resolved many issues associated with extended wear, leading to a significant global increase in their use. Recent advancements in lens technology include the development of a new conventional hydrogel lens with a high water content of 78%, aimed at further improving comfort and performance. This innovative hydrogel lens, along with two types of silicone hydrogel lenses, has been evaluated to assess their effects on maintaining ocular surface integrity during wear (Jones et al., 2023).

Regarding ocular surface integrity, our study assessed tear film osmolarity as indicators of dryness and discomfort. The results indicated no significant changes in tear osmolarity across the different lenses. This is encouraging, as it implies that these lenses, including those manufactured by lathe-cut and cast molding techniques, do not exacerbate dry eye symptoms or reduce tear volume in first-time users. Elevated tear film osmolarity is closely associated with the pathophysiology of dry eye disease, and its measurement is considered a valuable diagnostic tool for determining the severity of the condition (Potvin, Makari, & Rapuano, 2015). While it is widely reported that contact lens use can lead to dryness symptoms, various studies have indicated that contact lens wear is typically associated with low to moderate changes in tear osmolarity. This suggests that while contact lenses can induce some degree of dryness, the impact on tear osmolarity may not be as significant as initially presumed (Lemp &

Foulks, 2007; Miller et al., 2004; Nichols & Sinnott, 2006).

In line with prior study, ours revealed no statistically significant differences between lathe cutting and cast molding techniques at any time point for both TBUT and Schirmer test scores ( $p$ -values  $> 0.05$ ). However, there is a statistically significant improvement within subjects over time for both techniques ( $p$ -value = 0.001), indicating that both methods lead to significant improvements in TBUT and Schirmer scores over the course of 6 months. In comparison, a study by K. Gialelis et al. provided a broader overview of dry eye prevalence among contact lens wearers. Their findings indicated that 60% of participants did not experience dry eye, 34% had mild dry eye, 4% had moderate dry eye, and 2% had severe dry eye. This distribution underscores the variability in dry eye symptoms among contact lens users and suggests that while a significant portion of users may experience some level of dry eye, severe cases are relatively rare (Gialelis, Mouzaka, & Chouzouris, 2022).

The continuous introduction of new contact lens materials reflects the industry's dedication to enhancing user comfort and minimizing ocular surface complications. Our study's findings, demonstrated no significant changes in tear osmolarity and no differences in TBUT and Schirmer scores between lathe-cut and cast molding techniques, are promising. They suggest that these lenses do not exacerbate dry eye symptoms, reinforcing the importance of material and manufacturing innovations which were in comparison with previously conducted studies. Furthermore, the observed improvements in TBUT and Schirmer scores over time indicate that both manufacturing methods contribute positively to ocular surface health.

## **CONCLUSION**

Advancements in contact lens materials and manufacturing techniques, including the introduction of high-water content hydrogels, significantly enhance ocular surface health and user comfort. Both lathe-

cut and cast molding methods effectively maintain tear film stability and prevent dry eye symptoms, supporting their continued use and development in modern contact lens technology

## **Recommendations**

To further enhance the comfort and ocular health of contact lens users, it is recommended that manufacturers continue to explore and develop new high water content hydrogel materials, which have demonstrated stability and effectiveness in maintaining tear film integrity.

Both lathe-cut and cast molding techniques should be refined to maximize the benefits observed in tear break-up time (TBUT) and Schirmer test scores.

Additionally, it is crucial to conduct long-term studies to assess the sustained impact of these lenses on ocular surface health.

Emphasizing the adoption of daily disposable lenses could also help mitigate dryness symptoms and improve overall user satisfaction.

## **Limitations**

In evaluating the comparison of lathe-cut versus cast-moulded soft contact lens techniques on ocular surface integrity, several limitations must be acknowledged.

The generalizability of the study's findings may be restricted by sample size in our study.

Variability in contact lens brands and materials used in the lathe-cut and cast-moulded techniques can introduce confounding factors, potentially skewing the results.

Another limitation is the study duration, which may be insufficient to capture long-term effects on ocular surface integrity. Short-term observations might overlook chronic or cumulative impacts of contact lens wear. The reliance on both subjective and objective measures to assess ocular surface integrity could also introduce discrepancies, as subjective patient-reported symptoms might not always align with objective clinical tests.

Environmental factors such as humidity, temperature, and exposure to allergens or

pollutants can also impact the findings, adding another layer of variability.

- Lastly, differences in the experience and skill level of contact lens fitters may lead to inconsistent fitting techniques, which could influence the study's outcomes.

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