THE EFFECT OF TOPICAL LIDOCAINE HCl 1.0% ON BLINK RATE, TEAR STABILITY AND TEAR FLOW RATE IN YOUNG ADULTS

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DEDICATION

This research project is dedicated to God Almighty, who has sustained me so far in my pursuit of education. I also dedicate this work to my parents: Engr. Donatus and Mrs Kate Osuagwu for their unwavering support and sacrifice all these years.

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TABLE OF CONTENTS

CHAPTER FOUR

CHAPTER FIVE

CHAPTER SIX

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Lidocaine HCl 1.0%, is a local anaesthetic which is commonly used in the eye care profession during certain diagnostic tests and examinations to produce numbness or loss of sensation on or around the eye to aid certain diagnostic tests and procedures such as tonometry, pachymetry, gonioscopy, foreign body removal etc. It is also the drug of choice for certain ocular surgical procedures such as cataract surgery, pterygium excision, trabeculectomy and other procedures involving periocular structures. This study was carried out to examine and determine the effect of topical lidocaine HCl 1.0% on blink rate, tear stability and tear flow rate. This was an experimental study which was carried out on 36 randomly selected healthy young adults (18 males and 18 females) with mean age 22.61 ± 2.66 years, with no history of contact lens wear, ocular surface disorders, and current use of topical ocular medications. The blink rate, tear stability and tear flow rate of the various participants were obtained before and after the application of lidocaine HCl 1.0% ophthalmic solution. The blink rate per minute was measured with the use of a stopwatch, tear stability was determined through Non-Invasive Tear Break Up Time (NITBUT) with a keratometer. The results obtained showed that the mean value of the blink rate, tear stability and tear flow rate decreased after the instillation of lidocaine. There was no significant relationship between gender and the value of the blink rate, tear stability and tear flow rate; there was also no significant relationship between age and the blink rate and tear flow rate but it was observed there was an inverse relationship between age and tear stability. Thus, the use of topical lidocaine HCl 1.0 % is safe for use in the eye care profession but screening for dry eye disease should be carried out before administration of this anaesthetic.

CHAPTER ONE

1.0 INTRODUCTION

The word “anaesthetic” was derived from a Greek word “anaesthesia” which means the temporary absence or lack of sensation (Patel *et al.,*1991). Anaesthetic agents work by temporarily blocking the sensation of pain during diagnostic and therapeutic procedures; this occurs by the inhibition of sodium ion influx into the nerve cytoplasm. The anaesthetic binds to the specific receptor site within the sodium channels and blocks the sodium ion movements through this pore. Local anaesthetics are mostly amino esters or amino amide. Anaesthetics that are amino esters produce a fast acting and significant numbing effect when applied to the cornea. Although, its effect is short lived because plasma cholinesterase agents in the blood rapidly metabolizes esters. Lidocaine anaesthetic is an amino amide which is metabolized by the liver and is longer acting.

The tear film, and eyelids act as a functional unit to preserve the quality of the refractive surface of the eye and to resist injury and protect the eye against changing bodily environmental conditions. The tear film is the most dynamic structure of the functional unit and prevents the desiccation of the underlying tissue while providing a smooth, optically refracting interface. A healthy blink pattern and rate also plays an important role in maintaining a healthy ocular surface, nourishing the cornea and preventing dry eye disease.

1.1 BACKGROUND INFORMATION

1.1.1 The human tear film

The ocular tear film is described as a three-layer structure, the outermost lipid layer, the middle aqueous layer and the inner most mucin layer (Barlett & Jaanus, 2008).

The tear film is a clear thin fluid layer, which covers the ocular surface and is secreted by the lacrimal gland; together with the secretions from the meibomian glands, the goblet cells, the glands of zeis and moll as well as the accessory glands of Krause and Wolfring. The tear film is responsible for ocular surface comfort, mechanical, environmental and immune protection, epithelial health and it provides a smooth refractive surface for optimum vision. It also supplies nutrients and oxygen to the avascular cornea. Tear production (1-2ml per minute, total volume of 6ml, 16% turnover per minute), evaporation, absorption and drainage are responsible for the dynamic balance of the tear film and leads to its integrity and stability. (Holland *et al.,* 2020).

Tear film structure and functions.

The tear film is traditionally described as a three-layered structure consisting of the superficial oily layer, middle aqueous and mucous layer at the base. A recently proposed model consists of two layers: superficial lipids layer and mucin/aqueous glycocalyx gel with decreasing mucin concentration from epithelium to lipid layer (Rolando & Zierhut, 2001).

1. **Lipid layer:** The lipid layer is secreted by the meibomian glands, located within the tarsal plates of the upper and lower eyelids with some small contribution by the moll and zeis glands. This layer is responsible for reducing evaporation of tears and improving its stability, it also

limits the contamination of the ocular surface from microorganisms, limits aqueous layer surface tension and counteracts tear overflow onto the cheeks (McCulley & Shine, 2004).

2. **Aqueous layer:** The non-reflex secretion of this layer is by the accessory glands of Krause and Wolfring located in the conjunctiva of the superior eyelid and superior conjunctival fornix, while the lacrimal gland is responsible for the production of this layer, secondary to deleterious stimulation and plays an important role in reflex tearing (Conardy *et al.,* 2016).

   This layer consists of water, electrolytes, proteins (lactoferrin, lysozyme, lipocalin), cytokines, immunoglobulins (IgM, IgG) vitamins and peptide growth factors; this layer is also responsible for ocular surface lubrication, washing away of foreign bodies or contaminants and nourishing the avascular cornea, it also contributes to tear film viscosity and retains ocular surface health and epithelial integrity.

3. **Mucous layer:** This layer is produced by both the lacrimal gland and conjunctival goblet cells. It is composed of secreted transmembrane mucins, immunoglobulins, salts, urea, glucose, leukocytes, cellular debris and enzymes (Gipson & Argueso, 2003 and Stahl *et al.,* 2012**).** It forms a glycocalyx over the ocular epithelium that prevents pathogen adhesion. It is also responsible for lubrication of the ocular surface, reducing friction during blinking and regulation of epithelial growth.

Types of tears

- Basal tears: This type of tears includes those produced normally without any stimulation, they are produced mainly by the accessory glands of Krause and Wolfring. The basal tears keep the ocular surface continually wet and nourished; they also lubricate and help to keep the ocular surface free from contaminants.

- Reflex tears: Reflex tears are produced due to irritation of the eye by foreign particles or objects. They are secreted by the main lacrimal gland and its palpebral lobe in response to sensory stimulation of the superficial cornea and conjunctiva.
- Psychic tears: They are produced as a result of emotional or physical pain.

Certain factors influence tear production such as age, certain medications, ocular surface disorders such as dry eye syndrome, keratitis. Steven Johnson's syndrome etc.

1.1.2 Physiology of tear secretion

The lacrimal gland is an exocrine gland similar to the mammary gland and salivary gland. The gland is composed of lobules separated by loose connective tissue. Acini are lined with columnar secretory cells, which have been shown to secrete mucopolysaccharides, implying that the gland is a modified mucus gland. Each lacrimal gland lobule consists of many acini and intralobular ducts that drain into approximately 8–12 excretory ducts or tubules. The ducts of both the orbital and palpebral lobes drain into the superotemporal conjunctival fornix, approximately 5 mm superior the lateral tarsal border. The ducts of the orbital lobe pass through the parenchyma of the palpebral lobe making the proximal secretory ducts susceptible to damage distally (Conrady *et al*., 2016).

Tears are the clear liquid secreted by the lacrimal glands (tear gland) found in the eyes of all land mammals (except for goat and rabbits). Their functions include lubricating the eyes (basal tears), removing irritants (reflex tears), and aiding the immune system; the sensory nerve for tear film reflexes is the fifth cranial nerve (the trigeminal nerve).

Tears also occur as a part of the body's natural pain response. Humans are the only mammals known to produce tears as part of an emotional response, such as out of joy or grief. Tears

have symbolic significance among humans. Emotional secretion of tears may serve a biological function by excreting stress – inducing hormones built up through times of emotional duress. The different types of tears (reflex, basal and emotional tears) vary significantly in composition.

1.1.3 Tear Film Tests

These include tear film break up time (TBUT), Schirmer's tests, vital staining with rose Bengal, tear level of lysozyme and lactoferrin, tear osmolarity and conjunctival impression cytology.

1. Tear film break-up time (TBUT): It is the interval between a complete blink and appearance of the first randomly distributed dry spot on the cornea. It is noted after the instillation of a drop of fluorescein and examining in a cobalt blue light of a slit lamp. TBUT is an indicator of the adequacy of the mucin component of tears. Its normal values range from 15 to 45 seconds. Values less than 10 seconds imply an unstable tear film.
2. Schirmer's test: This test measures the total tear secretions. It is performed with the use of a 5 × 35mm strip of Whatman-41 filter paper which is folded 5mm from one end and inserted in the lower fornix. This test is of two types: Schirmer test 1 which is used to assess the basal and reflex tear secretion while in Schirmer test 2, an anaesthetic is instilled to prevent the secretion of reflex tear so that only basal tear is measured. After 5 minutes of the commencement of the test, wetting of the filter paper strip from the bent end is measured. Normal values of Schirmer test are more than 15mm, values in the range of 5 to 10mm are suggestive of mild to moderate keratoconjunctivitis sicca (KCS) and less than 5mm points to severe keratoconjunctivitis sicca.
3. The value of tear flow rate is determined by converting the millimeter of wetting of the Schirmer strip to volume of tears in µL. The normal rate of tear flow rate, is averaged at a value of 1.2µl per minute, with a range of 0.5 to 2.2µl per minute.
4. Rose Bengal staining: This test is useful in detecting mild cases of keratoconjunctivitis sicca. Depending on the severity of keratoconjunctivitis sicca, three staining patterns A, B and C

have been described: ‘C’ pattern represents mild or early cases with fine punctate stains in the interpalpebral area; ‘B’ represents the moderate cases with extensive staining and ‘A’ represents the severe cases with confluent staining of the conjunctiva and cornea.

1.1.4 BLINKS: BLINK RATE AND TYPES OF BLINKS.

A blink is an autonomic rapid closing and opening motion of the eyelid. It is usually an involuntary act but it may be carried out voluntarily or reflexively as a response to an external stimulus. Blink rate refers to the number of blinks per minute. Normal values of blink rate are estimated to be between 12 to 15 blinks per minute and a mean blink rate of up to 22 blinks per minute has been reported under relaxed conditions (Tsubota & Nakamori, 1993). Blink rate is assessed by counting how many times an individual blinks per minute. It is influenced by factors such as gaze, computer use, contraceptives, panic & anxiety disorders, Parkinson’s disease, dry eye disease, contact lens wear, allergies, bright light etc.

A blink is sub-divided into 4 parts:

- The downward motion.
- The turning point.
- The upward motion.
- The inter-blink period.

The inter- blink period is the time between each consecutive blink and it is of great importance as it relates to blink rate. The longer the inter-blink interval, the fewer the number of blinks the individual performs per minute.

Types of Blinks

- **Spontaneous blinks:** This type of blink is carried out in the absence of an external stimuli and without conscious effort. A spontaneous blink, ensures that the pre-corneal tear film remains intact to ensure optical quality and helps with proper re-wetting of the ocular surface and also ensures the removal of tear film debris and irritants.
- **Reflex blinks:** A reflex blink occurs in response to an external stimulus, such as a response to tactile stimuli (e.g. corneal, eyelash, eyelid or eyebrow stimulation), optical stimuli (e.g. dazzle reflex) or auditory stimuli (e.g. menace reflex in which sounds greater than 40-60 dB are made). A reflex blink is carried out without conscious effort also; however, it occurs more rapidly than a spontaneous blink (Plainis *et al,* 2006). Reflex blinks occur to protect the eyes from any potential damage.
- **Voluntary blinks:** A voluntary blink is a conscious blink. This sort of blinks are intentional eyelid movements for a specific purpose such as spreading moisture over the ocular surface after the eye has been opened for a prolonged period of time.

Blinks are important in everyday life and are a crucial requirement for ocular surface health, as the contact of the upper and lower lid during a complete blink promotes tear secretion, protects the tear film from evaporation, moistens the eye ball to prevent dryness, itching and irritation, lubricates the cornea and washes away debris. Blinks are also important in preventing digital eye strain, improving clarity of vision and also serves as an important protective reflex. Hence it is important for eyecare professionals to know and understand the effect of certain drugs on the blink pattern and blink rate.

1.1.5 LIDOCAINE

Lidocaine belongs to the class of drugs known as local anaesthetics; its mechanism of action is by altering signal conduction in neurons by prolonging the inactivation of the fast voltage-gated sodium channels in the neuronal cell membrane responsible for action potential propagation and preventing depolarization of the nerve, therefore preventing the physiologic conduction of the impulse.

Local anaesthetics reversibly block nerve conduction near or on their site of application by targeting free nerve endings in the dermis or mucosa, thereby resulting in a temporary loss of sensation in the targeted area.

Pharmacology of Topical anaesthetics.

Local anaesthetics are weak bases which are made up of an aromatic ring, an ester or amide linkage and a tertiary amine. The aromatic ring is mainly responsible for lipid solubility which allows the diffusion of the anaesthetic across the nerve cell membrane. The onset, duration and depth of action of anaesthetics are determined by the pKa level, pH level, lipid solubility and protein binding and the vasodilatory effect of the specific anaesthetic. The pKa level of Lidocaine is 7.8 with a Ph of > 7. The pH determines the potency and rate of action of an anaesthetic (Duvall and Kershner, 2006). Topical lidocaine HCl 1.0% has a rapid onset of action of 3 minutes; It reaches its peak level in 15 minutes, has a half-life of 90 minutes and lasts for up to 2 hours on the ocular surface.

1.1.6 Topical Lidocaine mechanism of action and uses

Lidocaine is an amide anaesthetic and due to its chemical structure, it can penetrate fat-soluble tissues, thus making it ideal for application to the ocular surface. Topical lidocaine like all anaesthetics, works by blocking the transmission of neural impulses from the naked nerve endings in the eyelid skin, conjunctiva or cornea to the nerve cell body and back to the brain; thus, resulting in an impairment of sensory information to block the perception of pain.

Topical lidocaine HCl 1.0% is widely used in the eyecare profession for any test requiring contact to the cornea, conjunctiva, eyelid and surrounding tissues such as tonometry, pachymetry, foreign body removal or removal of a corneal lesion, certain tear function test, ultrasound and specular microscopy. It can also be used to reduce the stinging sensation of mydriatics and before the administration of retrobulbar and peribulbar injections; additionally, it is used during ocular surgical procedures such as radial keratometry, corrective strabismus muscle resection, cataract and refractive surgery to immobilize the muscles of the eyelid and extraocular muscles. It can be administered topically by the use of injections or with the use of eyedrops directly instilled on the ocular surface.

Systematically, lidocaine can be used to treat chronic pain and acute surgical pain, when inhaled it can be used as a cough suppressor, it is also used in the treatment of arrythmia and given as an epidural (spinal block) to reduce the discomfort of contractions during labour.

Topical lidocaine use and its relationship with tear flow rate, stability and blink rate.

The use of topical anaesthetics in eyecare is a standard practice due to the fact that most procedures require contact with the ocular surface. It has been suggested that the use of lidocaine which is the commonly used and accepted anaesthetic in eye care, may affect the

tear film dynamics and blink rate which are important parameters for maintaining the integrity of the ocular surface.

1.2 STATEMENT OF PROBLEM

Lidocaine HCl 1.0% is a readily available local anaesthetic. It is commonly used in eye care profession to produce a numbing effect on or around the eye to aid certain diagnostic tests and procedures. Previous studies have stated that topical lidocaine anesthetizes the cornea better than other topical anaesthetics (Soliman *et al.,* 2004). With the use of anaesthetics, there is a risk of toxicity to the corneal epithelium (Page & Fraunfelder, 2009). There is conflicting information on whether lidocaine HCl has side effects on the ocular surface and components of the ocular media. The focus of this study is to determine if topical lidocaine HCl 1.0% has an effect on tear film dynamics and blink rate.

1.3 AIMS & OBJECTIVES

1.3.1 AIM OF THE STUDY

This study aims at determining the effect topical lidocaine HCl 1.0% has on tear flow rate, tear film stability and blink rate in young adults.

1.3.2 OBJECTIVES OF STUDY

1. To determine the effect of lidocaine use on tear flow rate, tear film stability and blink rate.
2. To compare the rate of tear flow, tear film stability and the rate of blinks before and after the instillation of lidocaine.

1.4 HYPOTHESIS

Null Hypothesis (Ho): There is no significant relationship between topical lidocaine hcl 1.0% use and tear flow rate, tear stability and blink rate amongst young adults.

Alternate hypothesis (Ha): There is a significant relationship between topical lidocaine hcl 1.0% use, tear flow rate, tear stability and blink rate amongst young adults.

1.5 SIGNIFICANCE OF STUDY

With an advancement in surgical techniques and the rate at which ophthalmic surgeries and certain diagnostic procedures are performed in the eyecare profession, there has been an increased interest in local anaesthetics of which lidocaine HCl is the topical anaesthetic of choice. The significance of this study is therefore to provide information on the effect topical lidocaine usage has on the tear flow rate, tear film stability and blink rate. Additionally, this study will help guide practitioners to apply necessary precautions in the use of lidocaine anaesthetic in patients with certain ocular diseases and ocular surface disorders.

1.6 DEFINITION OF TERMS

Anaesthetic: A substance or drug that causes loss of sensation or induces sleep to prevent pain and discomfort.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 On the effect of anaesthetics on tear quantity and quality

George and Omokhua (2010) carried out a comparative analysis on the effects of different topical anaesthetic agents on tear quantity and tear quality using 2% xylocaine hydrochloride, 0.5% proparacaine hydrochloride and 0.5% tetracaine hydrochloride. Schirmer's tear test was used to assess the quantity of tears while tear quality was assessed with NITBUT. The results obtained showed that xylocaine had the least effect on tear quantity, while proparacaine resulted in significant decrease in tear quantity produced after its instillation and tetracaine had a significant effect on tear stability.

Safarzadeh *et al*., (2018) carried out a prospective study to assess the non-invasive tear break up time and tear meniscus height after the instillation of three different types of anaesthetic eye drops with an oculus keratograph 5M. 85 healthy participants were randomly divided into three groups. The groups received lidocaine HCl 2%, proparacaine HCl 0.5%, and tetracaine HCl 0.5%. The quality and quantity of tear film were assessed using NITBUT and tear meniscus height. The quantity of tear film using tear meniscus height was measured in the right eye of the participants, while the quality of tear film using NITBUT was assessed in the left eye. The result showed that there was not much difference for the tear meniscus height and TBUT before and after the application of lidocaine, but there was a significant decrease in the in the mean values of TBUT and tear meniscus height after the instillation of proparacaine. Also, after the use of tetracaine there was a significant increase in the mean value of the TBUT, but the mean value of tear meniscus height was decreased. It was concluded that lidocaine HCl

2% is the appropriate drug of choice for eye examinations due to a lack of significant effect on the quantity and quality of the tear film.

Li *et al*., (2012) carried out a study to determine the value of Schirmer tear test 1 with and without topical anaesthetic for diagnosing dry eye. 220 eyes of 110 patients with an age range of 13 to 40 years who had dry eye disease were used for this study. Schirmer 1 test without anaesthetic was performed first and 15 minutes later, it was carried out again, this time with topical anaesthetic (0.5% proparacaine hydrochloride). Strips with less than 10mm of wetting after 5 minutes were classified as positive, while less than or 5mm of wetting were classified as strong positives. The results showed that the wetting of the Schirmer's strip after instillation of topical anaesthetic was significantly lower than the wetting without anaesthetic. In conclusion, Schirmer 1 testing after 0.5% proparacaine HCl is more objective and reliable than that without the anaesthetic in reflecting the status of dry eye, thus making it a useful evidence for diagnosis and treatment of dry eye.

Ozdemir and Temizdemir (2010) carried out a randomized study involving 140 participants (70 males and 70 females) to assess if age and gender had a relation to tear function and the results showed that in respect to tear film stability, there was a statistically highly significant difference between the younger and the older age groups.

Amaechi and Osunwoke (2004) carried out a research to measure the tear stability using both invasive and non-invasive tear break up time techniques. 45 participants aged 20-35 years from the University of Benin, Edo state were used for this study. NIBUT was measured by noting the time taken for distortion or diffusion of the Keratometric mires while invasive TBUT was assessed by noting the time taken for dry spots to appear on fluorescein treated eye with a burton lamp. It was concluded that the values of tear break up time are not dependent

on age, and there was no significant difference between the values of the tear break time gotten through invasive and non-invasive techniques.

Nwaji and Barrah (2005) carried out a research to determine the effect of lignocaine anaesthetic on tear production; and also, to compare the quantity of tear production before and after the instillation of the anaesthetic. 50 healthy volunteers in the age range of 18 – 35 years who were free from any form of ocular pathology or debilitating disease that could influence glandular secretion and were not on any drug capable of affecting the autonomous nervous system; were used for this study. The results showed that there was a reduction in the quantity of tears produced two minutes after the instillation of lignocaine, but the reduction in tear production was transient as the reading went back to near baseline ten minutes after the instillation of lidocaine.

Lambers *et al*., (1979) carried out a study on Schirmer test after topical anaesthetic application and the tear meniscus height in healthy eyes. Schirmer's test was carried out on 265 eyes without the instillation of 0.5% proparacaine HCl and on 466 eyes with the instillation of 0.5% proparacaine HCl. It was shown that topical anaesthetic reduced the mean values of the test values by up to 40%. When proparacaine was instilled, there was a decrease in tear production.

Lemp and Hamil (1973) carried out a study to determine the factors which affect tear breakup time in healthy eyes. 100 eyes of 50 participants was used in this study, and the relationship between age, sex, instillation of topical anaesthetic, lid holding and tear breakup time was studied. The results showed that holding of lids and instillation of topical anaesthetic significantly reduced the tear breakup time but there was no relationship between age and sex on the tear breakup time.

Jordan and Baum (1980) measured tear flow and volume in 15 healthy volunteers divided into young and old age groups, using subjective fluorophotometric analysis and Schirmer testing with and without topical anaesthetic. Proparacaine 0.5% anaesthesized the cornea better than cocaine 4% and produced fewer complications. The results showed that tear flow and volume decreased significantly below the normal physiologic values in both age groups following topical anaesthetic instillation.

2.2 On blink rate

Hirota *et al.,* (2013) carried out a study to assess the changes to tear film stability caused by incomplete blinking. 11 participants with healthy eyes were used in this study. The participants were asked to play a game for an hour on a computer as part of a visual display terminal experiment. The blink rate and pattern were observed by a web camera attached to the top of the display. Every 15 minutes, the game was interrupted for measurements. It was seen that 30 minutes into the game, the rate of incomplete blinks was reduced and there was an increase in the complete blink rate and tear break up time. It was concluded that tear film stability was dependent on the blinking quality.

Borges and Garcia (2010) carried out a study on the distribution of spontaneous inter blink interval with and without topical ocular anaesthetic using the magnetic search coil technique on 3 different occasions. The result showed that topical anaesthetic reduces the rate of spontaneous blinking, but does not change the distribution of the inter blink time interval.

Naase *et al*., (2005) carried out a study to determine if there is a change in the pattern of human eye blink events under topical anaesthetic. 40 male participants aged between 19 and 52 years with no significant ocular surface disease were used for this study. Their spontaneous eyeblink activity in primary eye gaze position and in silence was recorded for 5-10 minutes

periods then the anaesthetic was applied (benoxinate 0.4% eyedrops). The result showed that spontaneous blink rate decreased from 9.0 ± 4.0 blinks/min to an average of 5.7 ± 3.3 blinks/min, with 37 participants showing a decreased eyeblink rate under anaesthetic. The blink patterns observed before anaesthetic, were unchanged after anaesthetic application. In conclusion, spontaneous blink rate is usually reduced under surface anaesthetic but blink pattern is unchanged.

Collins *et al*., (1989) investigated the relationship between corneal sensitivity and blinking patterns. Using a group of 9 healthy participants, measurements were made of blink patterns, central and peripheral corneal sensitivity and lid margin sensitivity before and after the use of the topical corneal anaesthetic proxymetacaine HCl (Alcaine). Blink patterns were recorded through concealed filming and was later analyzed in terms of blink frequency and the type of blinks (complete, incomplete, twitch and forced blinks). It was shown that, blink rate was significantly lowered following anaesthetic administration, but the relative proportion of blink types remained unchanged.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 RESEARCH DESIGN: This was an experimental study.

3.2 STUDY POPULATION: The population was drawn from participants in the age range of 18 – 30 years selected within the University of Benin environment who satisfied the inclusion criteria.

3.2.1 Study Location: This study was carried out at the Optometry Teaching Clinic, Department of Optometry, University of Benin, Benin city, Edo State.

3.2.2 Sampling Technique: Convenient sampling technique was applied for this study.

3.2.3 Sample Size: A total of 36 participants were used for this study (18 males and 18 females).

3.2.4 Study Duration: This study was carried out over a period of two months.

3.3 MATERIALS FOR DATA COLLECTION

The materials used for this study were:

- Topical lidocaine hydrochloride 1.0% solution. (Adult dose 10mg/100ml of IV lidocaine; 5mg + 5ml of pyrogenic water)
- Schirmer's tear test strip.
- Bausch & Lomb Keratometer.
- Penlight.
- Stopwatch.

- Snellen visual acuity chart.
- Near point card.
- Disposable gloves.
- Face masks
- Hand sanitizer.
- Recording book and pen.

INCLUSION CRITERIA

- Participants who gave informed consent to participate in the study
- Participants who were 18 -30 years of age.
- Participants who were non-contact lens wearers.
- Participants who were currently not using any topical or systemic ocular medications.
- Participants who were without systemic diseases.

ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Departmental Research and Ethics committee of the Department of Optometry, University of Benin in accordance with the tenets of the Declaration of Helsinki.

Informed consent was also sought from each of the participants and only consenting participants were recruited for the study.

3.4 DESCRIPTION OF PROCEDURES

The purpose of this research and the procedure was fully explained to the participants and informed consent was obtained from each participant.

The following tests were carried out on each participant to ensure they satisfied the inclusion criteria:

- **Case History:** This was detailed to ensure that the participant had no history of a current or recent ocular trauma, contact lens wear and was currently not on any systemic or topical ocular medication that is capable of affecting tear production and resulting in symptoms of dry eye.
- **Visual Acuity Testing:** Visual acuity was tested to determine the level of vision available before the commencement of other tests; for record purposes and also for legal reasons.
- **External Examination using a penlight:** Examination of the ocular adnexa was carried out to rule out ocular surface abnormalities and disorders, so as to ensure that all the participants who took place in the study satisfied the inclusion criteria.

After these tests had been carried out and properly documented, the procedure for the study was carried out in the following order:

1. Blink rate was assessed.
2. Tear film stability was assessed using Non-invasive tear break up time technique.
3. Topical lidocaine HCl 1.0% was then instilled into the eyes of the participants by everting the lower eyelid and instilling two drops in the inferior cul-de sac.
4. Schirmer test II was carried out 5 minutes and 10 minutes after instillation to measure the rate of basal tear secretion; as lidocaine HCl has a duration of onset of 3 minutes and duration of action of up to 30 minutes.
5. The blink rate and tear stability were then assessed again and their values recorded.

3.4.1 BLINK RATE ASSESSMENT

- With the participant comfortably seated, a webcam attached to a laptop was set up to record the number of blinks executed by the participant in a minute.
- A stopwatch would be started, while the participant was instructed to watch a short video which will be played on the laptop for a minute.
- This procedure will be repeated again after the instillation of the topical anaesthetic.

3.4.2 TEAR FILM STABILITY ASSESSMENT

- The tear film stability was assessed with the use of a keratometer (Non-invasive tear break up time technique).
- The head and chin rest of the keratometer was sanitized with 90% methyl alcohol.
- The participant was seated comfortably and positioned with chin on the chin rest and forehead on the head rest of the keratometer.
- The keratometer was adjusted and focused on the eye.
- With the mires in focus, the participant was asked to blink once and refrain from blinking afterward
- A stopwatch was started immediately after the last complete blink.
- At the first appearance of any distortion of the focusing mire, the stop watch was stopped.
- If for any reason, the participant blinked between measurements, the test was halted and then repeated after several blinks.
- The interval between the last blink and the doubling/distortion of the mires was recorded in seconds as the Non-invasive tear break up time.
- Five measurements were taken for each participant and the average of the three closest NITBUT values was taken as the mean value.

- The normal TBUT is between 15 and 45 seconds. A TBUT less than 10 seconds is indicative of an unstable tear film. If the tear film consistently breaks up in the same location, it probably indicates a defect in the corneal epithelium rather than a tear film deficiency.
- This procedure was then repeated again after the instillation of the topical anaesthetic.

3.4.3 ASSESSMENT OF TEAR FLOW RATE USING SCHIRMER'S STRIP

- This technique involved the use of a standardized tear flow strip of absorbent paper.
- With the participant seated in an upright position, the participant was asked to look up and the lower lid pulled down temporally. The tear strip was bent at a right angle and the bent hooked end of the strip was placed at the junction of the temporal and central third of the lower eyelid margin.
- The patient was asked to look up and continue blinking freely, although excessive blinking was discouraged as it leads to significant reflex tearing.
- A stopwatch was started and after 5 minutes or when the strip was completely wet, it was removed and the length of the wet portion was measured and recorded in millimeters.

3.5 STATISTICAL ANALYSIS

Data obtained, was statistically analyzed using statistical package for social sciences (SPSS version 22.0; SPSS Inc., Chicago, IL. USA).

3.6 LIMITATIONS OF STUDY

Time was a major constraint in the course of this study.

CHAPTER FOUR

4.0 RESULTS

A total number of thirty-six (n=36) participants with mean age (22.61±2.66 years; range of 18 - 29 years) consisting of 18 males and 18 females were recruited for this study.

One sample Kolmogorov-Smirnov Z test was used to determine the normality of the distribution. The distribution of data for the blink rate, ear stability and tear flow rate were found to be normal all through the testing period ($p > 0.05$).

The values for mean blink rate, tear stability and tear flow rate pre instillation of lidocaine and post instillation after five and ten minutes are shown in Table 4.1. The mean blink rate, tear stability and tear flow rate reduced five minutes post instillation of lidocaine (from 14.83 ± 2.18 blinks per minute, 16.25 ± 4.38 seconds and 16.40 ± 3.39 mm/5min respectively to 10.77 ± 3.05 blinks per minute, 12.80 ± 3.99 seconds and 12.41 ± 4.50 mm/5 min respectively). After ten minutes, the values of the mean blink rate, tear stability and tear flow rate were found to be higher than the values gotten five minutes post lidocaine instillation but not as high as the baseline values gotten pre lidocaine instillation (13.05 ± 3.69 blinks per minute, 13 ± 2.16 seconds and 13.83 ± 4.09 mm/5 min respectively).

Paired t-test was used to compare the mean of the baseline values between the right and left eyes and it was found that the difference in values between the left and the right was not statistically significant ($p > 0.05$). Therefore, the values of only the right eye were used for further analysis so as to avoid duplication of results. While the Unpaired t- test was used to compare mean values of blink rate, tear stability and tear flow rate between the male (14.55 ± 2.12 blinks/minute, 16.05 ± 3.73 seconds and 15.50 ± 2.84 mm/5 mins respectively) and the female participants (15.11 ± 2.27 blinks/minute, 16.44 ± 5.26 seconds and 17.31 ± 3.73 mm/5

mins respectively) to determine if there is a significant difference relating to gender, and it was found that there was no significant difference between the mean values of the male and female participants ($p > 0.05$).

One-way ANOVA was used to compare the mean blink rate tear stability and tear flow rate before and after five and ten minutes of lidocaine instillation. The difference in the mean blink rate, tear stability and tear flow rate before (14.83 ± 2.18 blinks per minute, 16.25 ± 4.38 seconds and 16.40 ± 3.39 mm/5 min respectively) and after five(10.77 ± 3.05 blinks per minute, 12.80 ± 3.99 seconds and 12.41 ± 4.50 mm/5 min respectively) and ten minutes of lidocaine instillation (13.05 ± 3.69 blinks per minute, 13 ± 2.16 seconds and 13.83 ± 4.09 mm/5 min respectively) was statistically significant ($p > 0.05$) hence the null hypothesis was rejected.

Bonferroni pairwise comparison (post hoc test) was used to locate the source of the difference in blink rate, tear stability and tear flow rate before and after the instillation of lidocaine (five and ten minutes after) and it was found to be statistically significant ($p < 0.05$). The difference in mean blink rate between pretest and after five minutes of instillation of the anaesthetic (4.05 ± 0.87 blinks/min.), between pretest and after ten minutes (1.77 ± 1.51 blinks/min) and between after five minutes and ten minutes of instillation of the anaesthetic (2.27 ± 0.64 blinks/min) were statistically significant ($p < 0.05$). The difference in mean tear stability between pretest and after five minutes of instillation of the anaesthetic (3.44 ± 0.51 seconds) and between pretest and after ten minutes of instillation of the anaesthetic (3.24 ± 2.34 seconds) were found to be statistically significant ($p <0.05$) but the difference in mean tear stability between after five minutes and ten minutes of instillation of the anaesthetic (0.20 ± 1.83 seconds) was found to be statistically insignificant ($p > 0.05$). The difference in mean tear flow rate between pretest and after five minutes of instillation of the anaesthetic (3.98 ±

1.11 mm/5 mins.) and between pretest and after ten minutes of instillation of the anaesthetic (3.22 ± 0.77 mm/5 mins.) were found to be statistically significant ($p < 0.05$) but the difference in mean tear flow rate between after five minutes and ten minutes of instillation of the anaesthetic (0.76 ± 0.41 mm/5 mins) was found to be statistically insignificant ($p > 0.05$).

Regression analysis was carried out to estimate the relationships between age and baseline blink rate, tear stability and tear flow rate. The *F*- value between age and blink rate was not statistically significant ($p > 0.05$), this indicates that there is no significant amount of variance in the outcome variable. Also, the relationship between age and tear flow rate was not statistically significant but the *F* – value between age and tear stability was statistically significant ($p < 0.05$; *Tear stability = –3.644 + 0.80 Age)* [$r = -0.52$, $r^2 = 27.1\ \%$, $p = 0.001$]; an increase in age showed a decrease in the tear film stability.

Table 4.1*: Descriptive analysis of baseline, five minutes and ten minutes after instillation of lidocaine values of the blink rate, tear stability and tear flow rate.*

		MEAN ± S.D	95% CONFIDENCE INTERVAL	
			Lower limit	**Upper limit**
BASELINE VALUES	Blink rate (blinks/min)	14.83 ± 2.18	14.83 – 0.70	14.83 + 0.70
	Tear stability (secs)	16.25 ± 4.50	16.25 – 1.47	16.25 + 1.47
	Tear flow rate (mm/5 min)	16.40 ± 3.39	16.40 – 1.09	16.40 + 1.09
5 MIN. AFTER	Blink rate (blinks/min)	10.77 ± 3.05	10.77 – 0.98	10.77 + 0.98
	Tear stability (secs)	12.80 ± 3.99	12.80 – 1.29	12.80 + 1.29
	Tear flow rate (mm/5 min)	12.42 ± 4.50	12.42 – 1.47	12.42 + 1.47
10 MIN. AFTER	Blink rate (blinks/min)	13.05 ± 3.69	13.05 – 1.19	13.05 + 1.19
	Tear stability (secs)	13.00 ± 2.16	13.00 – 2.16	13.00 + 2.16
	Tear flow rate (mm/5 min)	13.18 ± 4.09	13.18 – 4.09	13.18 + 4.09
	AGE	22.61 ± 2.66	22.61 – 0.86	22.61 + 0.86

Table 4.2: ***Unpaired t-test table showing the difference in the mean values of the blink rate, tear stability and tear flow rate between the male and female participants***

	GENDER	**N**	**MEAN ± S.D**	**STD ERROR**	**95% CONFIDENCE INTERVAL**	
					Lower limit	Upper limit
BLINK RATE	MALE	18	14.55 ± 2.12	0.25	14.55 – 0.49	14.55 + 0.49
	FEMALE	18	15.11 ± 2.27	0.27	15.11 – 0.53	15.11 + 0.53
TEAR STABILITY	MALE	18	16.05 ± 3.73	0.44	16.05 – 0.88	16.05 + 0.88
	FEMALE	18	16.44 ± 5.26	0.63	16.44 – 1.24	16.44 + 1.24
TEAR FLOW RATE	MALE	18	15.50 ± 2.84	0.34	15.50 – 0.67	15.50 + 0.67
	FEMALE	18	17.31 ± 3.73	0.44	17.31 – 0.87	17.31 + 0.87

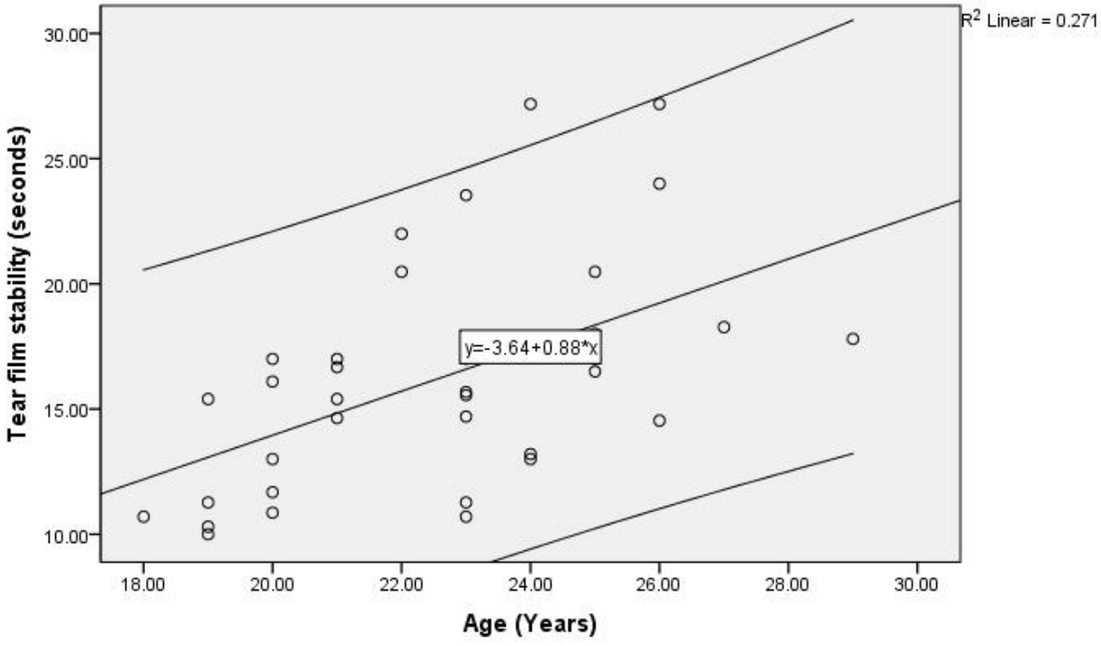

Fig 4.1: A graph showing the inverse relationship between age and tear film stability

CHAPTER FIVE

5.0 DISCUSSION

This research sought to study the effect that topical lidocaine HCl 1.0% had on the blink rate, tear stability and tear flow rate

From the results, it was noticed that the instillation of lidocaine had a decreasing effect on the blink rate, tear stability and tear flow rate. The mean blink rate after the instillation of lidocaine was decreased due to the fact that anaesthetics leads to a suppression of protective reflexes (Date *et al.,* 2020) and blinks are considered as an ocular protective reflex in response to tactile, optical or auditory stimuli; this was consistent with the work carried out by Borges and Garcia (2010) on the distribution of spontaneous inter blink interval with and without topical anaesthetic where it was observed that topical anaesthetic reduces the rate of spontaneous blinking.

The reduction in the tear flow rate was consistent with the study carried out by Nwaji and Barrah (2005) to determine the effect of lignocaine anaesthetic on tear production (the rate of tear production equals tear flow rate); results showed that there was a reduction in the quantity of tears produced two minutes after the instillation of lignocaine, but the reduction in tear production was transient as the reading reverted to near baseline ten minutes after the instillation of lidocaine. This transient reduction was also observed in this study as the mean value of the tear flow rate taken ten minutes after the instillation of lidocaine (13.06 ± 4.09 mm/5 min) was close to the mean value of the baseline tear flow rates (16.40 ± 3.39 mm/5 min).

Assessment of rate of tear flow without the use of anaesthetic measures both basal and reflex tear flow this is also known as Schirmer I test, while the use of anaesthetic to measure the rate

of tear flow measures just reflex tearing (Schirmer II test) hence the rate of tear flow will be significantly lower, but in individuals with dry eye syndrome the value of Schirmer II test will be reduced more.

These major findings go a long way to confirm that local anaesthetics measure only basic secretion thus reducing normal tear production/secretion, which is both reflex and basic (Strughold 1953). This could be attributed to the fact that local anaesthetics have an adrenergic potentiating effect and because lacrimal fluid receive a preganglionic parasympathetic supply from lacrimal muscles and leave the facial nerve to synapse in the sphenopalatine ganglion before running into the lacrimal gland, its stimulation produces secretion of tears (Grosvenor 2002).

Statistical analysis of the data obtained from 36 participants showed that lidocaine causes a significant ($p > 0.05$) reduction in the blink rate, tear stability and tear flow rate. It was also observed that the difference in values between the left and the right eye were not statistically significant ($p > 0.05$). Sex had no significant relationship with blink rate, tear stability and tear flow rate (table 4.5); this was consistent with the work carried out by Nwaji and Barrah (2005). Age was found to have an inverse significant relationship with the tear flow rate (as age increases, the stability of the tear film decreases) this was not consistent with the work carried out by Amaechi and Osunwoke (2004) on the relationship between invasive and non-invasive tear break up time in young adults. However, it is consistent with the work carried out by Ozdemir and Temizdemir (2010) on Age and Gender related tear function changes in normal population, in which it was found that there was a significant difference in the tear break up time value between the older and the younger participants

This decrease in tear stability as age increases could be due to the fact that keratoconjunctivitis sicca and chronic marginal blepharitis occurs frequently in middle and advancing ages and also tear secretion in women declines after the onset of menopause. Also, dry eye disease is often common among the elderly due to risk factors such as polypharmacy, lid laxity, inflammatory systemic conditions, androgen deficiency and oxidative stress. The occurrence of various illnesses associated with aging such rheumatoid arthritis, vitamin A deficiency, allergic eye diseases also increase the risk of development of dry eye disease which leads to an unstable tear film.

With age, there are changes in the corneal sensitivity and rate of tear evaporation and also there is an aqueous tear deficiency (Sharma and Hindman 2014). Thus, all these accounts for the inverse relationship between tear film and age observed in this study.

CHAPTER SIX

6.0 C0NCLUSION AND RECOMMENDATION

6.1 CONCLUSION

In conclusion, this study shows a negative significant relationship ($p < 0.05$) between the use of topical Lidocaine 1.0% ophthalmic solution and the rate of blinks, tear stability and rate of tear flow. Although the effect is negative, ten minutes after the instillation of topical lidocaine, the mean values of the blink rate, tear stability and tear flow rate are close to the baseline mean value. Thus, the use of topical lidocaine in the eye care profession can be said to be safe but the practitioner should always endeavor to screen for dry eye disease before the administration of the anaesthetic as lidocaine causes a severe reduction in the rate of tear flow thus exacerbating the symptoms of dry eye disease.

6.2 RECOMMENDATION

- More advanced research is encouraged based on the effect lidocaine has on the blink rate, tear stability and tear flow rate.
- As it has been revealed that topical lidocaine leads to worsening of symptoms in patients with dry eye disease, suitable alternatives can be discovered and researched on.
- It has been shown in this study that an increase in age is accompanied by a decrease in the tear film stability thus, the age of patients should be taken into consideration before administering topical lidocaine for diagnostic or therapeutic purposes.

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APPENDIX I

RAW DATA MEASURED FROM THE PARTICIPANTS

Table 1: Raw data of the baseline values of the blink rate, tear stability and tear flow rate measured before lidocaine instillation.

S/N	BLINK RATE (blinks/min)	TEAR STABILITY (SECS)		TEAR FLOW RATE (PER 5 MIN.)		SEX	AGE
	OU	OD	OS	OD	OS		
1	18	27.18	23.544	15	14	F	24
2	12	11.27	14.64	16	17	M	23
3	12	18	11.68	19	18	M	25
4	14	20.48	10.86	11	14	M	25
5	13	15.55	16.1	13	13.5	F	23
6	15	10.7	11	15	13	M	23
7	17	13	14.54	20	17	F	24
8	17	16.67	14.01	14	15	F	21
9	13	17	15.68	18	15	F	21
10	15	17	18.27	20	18	F	23
11	18	27.18	23.54	15	14	M	26
12	12	17.8	18.54	16	17	M	29
13	12	11.27	14.64	19	18	M	19
14	14	17	11.68	11	14	F	20
15	13	20.48	10.86	13	13.5	F	22
16	15	15.4	16	15	13	F	19
17	17	10.7	9.6	20	17	M	18
18	17	13.2	14.54	14	15	F	24
19	13	24	22.01	18	15	M	26
20	15	17	15.68	20	18	M	25
21	15	18.27	17	18	20	M	27
22	13	15.68	17	15	18	F	23
23	16	22	25.67	15	14	M	22
24	16	14.54	13	17	20	F	26
25	14	10	11.7	13	15	F	19
26	12	16.1	15.55	13.5	13	M	20
27	14	10.86	20.08	14	11	M	20
28	12	11.68	18	18	19	F	20
29	12	14.64	11.27	17	16	M	21
30	18	23.54	27.18	14	15	M	23

31	19	15.4	16	19.1	18.5	F	21
32	18	14.7	11.86	22.5	20	F	23
33	16	10.3	11	15.5	14	M	19
34	15	13	14.54	13	15.1	M	20
35	14	16.5	13.01	28	30	F	25
36	18	17	15.32	16	18	M	25

Table 2: Raw data of the values of the blink rate, tear stability and tear flow rate taken 5 minutes after lidocaine instillation.

S/N	BLINK RATE (blinks/min)	TEAR STABILITY (SECS)		TEAR FLOW RATE (mm/5 min.)	
	OU	OD	OS	OD	OS
1	12	22.06	21.54	11	9
2	14	19.76	15.23	6	8
3	6	11.72	11.81	18	16
4	6	8.27	11.34	7	5
5	9	17.5	14.7	9	10
6	10	9.05	9	11.5	10
7	15	10.24	11.8	16	14
8	12	10.71	11.54	10	9
9	8	12.7	12.68	15	12
10	11	13	14.3	16	15
11	12	22.06	21.54	11	9
12	14	19.76	15.1	6	8
13	6	11.72	11	18	16
14	7	8.27	11.34	7	5
15	9	7.5	14.7	9	10
16	10	9.05	9	11.5	11
17	15	10.24	11.8	15	12
18	12	10.71	11.82	10	9
19	8	12.1	12.45	15	12
20	11	13	11.3	16	15
21	11	21.54	22.06	15	16
22	18	15.23	19.76	12	15
23	12	11.81	11.72	9	10
24	15	11.34	8.27	14	16
25	10	14.7	7.5	10	11
26	9	9	9.05	10	9
27	6	11.8	10.24	5	7
28	6	11.54	10.71	16	18
29	14	12.68	12.7	8	6

30	12	14.3	13	9	10
31	14	7.5	14.7	18	17
32	13	11.8	10.24	21	19.1
33	12	10	9.6	12	12
34	11	12.54	13.72	10	11
35	8	12.7	12.68	25	23
36	10	13	14.3	15	13

Table 3: Raw data of the values of the blink rate, tear stability and tear flow rate taken 10 minutes after lidocaine instillation.

S/N	BLINK RATE	TEAR STABILITY (SECS)		TEAR FLOW RATE (PER 5 MIN.)	
	OU	OD	OS	OD	OS
1	24	15.18	13.2	8	1.5
2	18	18.08	17	16	14
3	10	15.14	13.22	18	17
4	12	11.86	10.72	12.5	12
5	13	10.05	11.37	10	9
6	12	10.3	10	12.1	12
7	16	12.17	13.28	14	14
8	10	14.2	12.1	9	10
9	10	14.15	13.2	17	14
10	12	12	13.1	14	13
11	24	15.18	14.2	8	3
12	18	13.08	12.3	11	14
13	10	15.14	13.22	18	17
14	12	11.86	10.72	12	11
15	13	10.05	11.37	10	9
16	12	10.3	10	12	12
17	16	12.17	13.28	14	14
18	10	14.2	12.18	9	10
19	12	14.1	13.2	14	17
20	10	13	13.11	14	13
21	10	14.2	14.15	14	17
22	10	12.1	14.2	10	9
23	16	13.28	12.17	14	14
24	12	10	10.3	11	12
25	13	11.37	10.05	9	10
26	12	10.72	11.86	12	12
27	10	13.22	15.14	17	18
28	18	17	18.08	14	16

29	14	13.2	15.18	3	8
30	10	17	15.2	15	16
31	16	10.05	11.37	17	17
32	10	12.17	13.28	22	20
33	13	10	11	12	12
34	11	12	13.1	12	11
35	10	14.7	12	25	20
36	11	15	13	15	12

APPENDIX II

Table 4: One sample Kolmogorov-Smirnov-Z test table indicating the normality of the distribution.

		p- Value > 0.05	**TEST STATISTIC**
AGE		0.20	0.116
BASELINE	BLINK RATE	0.11	O.13
	TEAR STABILITY	0.02	0.15
	TEAR FLOW RATE	0.11	0.13
5 MINUTES AFTER LIDOCAINE INSTILLATION	BLINK RATE	0.20	0.10
	TEAR STABILITY	0.02	0.23
	TEAR FLOW RATE	0.20	0.12
10 MINUTES AFTER LIDOCAINE INSTILLATION	BLINK RATE	0.00	0.22
	TEAR STABILITY	0.19	0.12
	TEAR FLOW RATE	0.06	0.14

Table 5: ***Paired t-test table showing the comparison between the mean values of the right and left eye.***

PARAMETERS	EYE	MEAN	STD. DEVIATION	STD. ERROR OF MEAN	p-VALUE
TEAR	**O. D**	16.25	4.50	0.75	0.88
STABILITY	**O. S**	15.71	4.38	0.73	
TEAR FLOW	**O. D**	16.40	3.39	0.56	0.64
RATE	**O. S**	16.26	3.29	0.54	

Table 6: ***One- way ANOVA table showing the effect of lidocaine on blink rate, tear stability and tear flow rate.***

		SUM OF SQUARES	dF	MEAN OF SQUARES	F	SIG.
BLINK RATE	BETWEEN GROUPS	297.5	2	148.7	16.08	0.00
	WITHIN GROUPS	971.1	105	9.24		
	TOTAL	1268.6	107			
TEAR STABILITY	BETWEEN GROUPS	269.7	2	134.8	9.89	0.00
	WITHIN GROUPS	1432.0	105	13.63		
	TOTAL	1701.8	107			
TEAR FLOW RATE	BETWEEN GROUPS	322.5	2	161.2	9.95	0.00
	WITHIN GROUPS	1700.5	105	16.19		
	TOTAL	2023.1	107			

Table 7: ***Bonferroni pairwise comparison test table.***

DEPENDENT VARIABLE	ASSESSMENT TIME (a)	ASSESSMENT TIME (b)	MEAN DIFFERENCE (a-b)	STD ERROR OF MEAN	SIG.
BLINK RATE	Pretest	5 minutes after	4.05	1.40	0.000
	Pretest	10 minutes after	1.77	1.40	0.044
	5 minutes after	10 minutes after	–2.27	1.40	0.006
	10 minutes	5 minutes after	2.27	1.40	0.006
TEAR STABILITY	Pretest	5 minutes after	3.44	1.70	0.000
	Pretest	10 minutes after	3.24	1.70	0.001
	5 minutes after	10 minutes after	–0.20	1.70	1.000
	10 minutes after	5 minutes after	0.20	1.70	1.000
TEAR STABILITY	Pretest	5 minutes after	3.98	1.85	0.000
	Pretest	10 minutes after	3.22	1.85	0.003
	5 minutes after	10 minutes after	–0.76	1.85	1.000
	10 minutes	5 minutes after	0.76	1.85	1.000

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
BRbaseline	36	7.00	12.00	19.00	14.833	.36406	2.18436	4.771	.243	.393	-1.178	.768
TSODbaseli	36	17.18	10.00	27.18	16.252	.75056	4.50339	20.281	.799	.393	.373	.768
TSOSbaselin	36	17.58	9.60	27.18	15.710	.73009	4.38057	19.189	1.003	.393	.570	.768
TFRODbase	36	17.00	11.00	28.00	16.405	.56655	3.39932	11.555	1.132	.393	2.507	.768
TFROSbasel	36	19.00	11.00	30.00	16.266	.54917	3.29502	10.857	2.058	.393	7.571	.768
Age	36	11.00	18.00	29.00	22.611	.44415	2.66488	7.102	.234	.393	-.586	.768
BR5min	36	12.00	6.00	18.00	10.777	.50883	3.05297	9.321	.083	.393	-.478	.768
TSOD5min	36	14.56	7.50	22.06	12.802	.66538	3.99226	15.938	1.105	.393	.593	.768
TSOS5min	36	14.56	7.50	22.06	12.895	.59756	3.58539	12.855	1.240	.393	1.405	.768
TFROD5mi	36	20.00	5.00	25.00	12.416	.75079	4.50476	20.293	.610	.393	.311	.768
TFROS5min	36	18.00	5.00	23.00	11.891	.68254	4.09525	16.771	.543	.393	.174	.768
BR10min	36	14.00	10.00	24.00	13.055	.61585	3.69513	13.654	1.630	.393	2.525	.768
TSOD10min	36	8.08	10.00	18.08	13.006	.36122	2.16731	4.697	.367	.393	-.458	.768
TSOS10min	36	8.08	10.00	18.08	12.801	.30933	1.85600	3.445	.731	.393	.942	.768
TFROD10m	36	22.00	3.00	25.00	13.183	.68188	4.09128	16.739	.478	.393	1.667	.768
TFROS10mi	36	18.50	1.50	20.00	12.791	.67418	4.04506	16.363	-.637	.393	1.125	.768
Valid N (listwise)	36											

APPENDIX III

REGRESSION ANALYSIS TABLES

1. Relationship between Age and Blink rate

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Age[b]	.	Enter

a. Dependent Variable: BRbaseline

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.067[a]	.004	-.025	2.21126

a. Predictors: (Constant), Age

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.751	1	.751	.154	.697[b]
	Residual	166.249	34	4.890		
	Total	167.000	35			

a. Dependent Variable: BRbaseline

b. Predictors: (Constant), Age

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	13.590	3.193		4.257	.000	7.102	20.078
	Age	.055	.140	.067	.392	.697	-.230	.340

a. Dependent Variable: BRbaseline

2. Relationship between Age and Tear stability

Deleted[Okafor (C), Ben SPDC-PTP/ON/D]:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-3.644	5.632		-.647	.522	-15.090	7.802
	Age	.880	.247	.521	3.556	.001	.377	1.383

a. Dependent Variable: TSODbaseline

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	192.457	1	192.457	12.648	.001[b]
	Residual	517.361	34	15.216		
	Total	709.818	35			

a. Dependent Variable: TSODbaseline

b. Predictors: (Constant), Age

3. Relationship between Age and Tear flow rate

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Age[b]	.	Enter

a. Dependent Variable: TFRODbaseli

b. All requested variables entered.

Deleted[Okafor (C), Ben SPDC-PTP/ON/D]:

Deleted[Okafor (C), Ben SPDC-PTP/ON/D]:

Model Summary

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	10.767	4.884		2.205	.034	.843	20.692
	Age	.249	.215	.195	1.162	.253	-.187	.685

a. Dependent Variable: TFRODbaseline

Residual	[illegible]	[illegible]	[illegible]	[illegible]		
Total	404.439	35				

a. Dependent Variable: TFRODbaseline

b. Predictors: (Constant), Age

APPENDIX IV

BIODATA/CONSENT FORM ON THE EFFECT OF TOPICAL LIDOCAINE HCl 1.0% ON TEAR FLOW RATE, TEAR STABILITY AND BLINK RATE IN YOUNG ADULTS

Dear Sir/Ma

I am a final year student of the Department of Optometry, University of Benin. I am carrying out a research on the" Effect of Topical Lidocaine HCl 1.0% on Tear Flow Rate, Tear Stability and Blink Rate in Young Adults" at the University of Benin, Ugbowo campus. The procedure is safe and data collected will be treated with utmost confidentiality. Also, every protocol regarding health and safety will be maintained. Please kindly provide answers to the following questions. Thank you.

Participant's Signature: _____

Kindly Tick the appropriate boxes in the following:

SECTION A: SOCIODEMOGRAPHIC DATA

1. Sex: Male [ ] Female [ ]
2. Age (In years): _____

SECTION B: CASE HISTORY

1. Have you ever visited an eye clinic before? Yes [ ] No [ ]

If yes what was the complaint? _____

2. Do you have any systemic illness? Yes [ ] No [ ]

If yes, State _____

3. Are you currently on any topical or systemic medication? Yes [ ] No [ ]

If yes, State _____

4. Are you currently experiencing any of the symptoms listed below?

- Itching Yes [ ] No [ ]
- Redness Yes [ ] No [ ]
- Pain in or around the eye Yes [ ] No [ ]
- Tearing while carrying out near work Yes [ ] No [ ]
- Photophobia Yes [ ] No [ ]
- Gritty sensation Yes [ ] No [ ]

5. Do you have any allergies?

If yes, state _____

BEFORE LIDOCAINE INSTILLATION

	O. D	**O. S**
TEAR VOLUME		
TEAR STABILITY		
BLINK RATE		

5 MINUTES AFTER LIDOCAINE INSTILLATION

	O. D	**O. S**
TEAR VOLUME		
TEAR STABILITY		
BLINK RATE		

10 MINUTES AFTER LIDOCAINE INSTILLATION

	O. D	O. S
TEAR VOLUME		
TEAR STABILITY		
BLINK RATE		