Uses of tissue adhesives in Ophthalmology

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LIST OF ABBREVIATIONS

AC	Anterior chamber.
ALTK	Automated lamellar therapeutic keratoplasty.
AM	Amniotic membrane.
AMT	Amniotic membrane transplantation.
BCVA	Best corrected visual acuity.
BSA	Bovine serum albumin.
CDB	Chemically-defined bioadhesive.
CDVA	Corrected distance visual acuity.
Ce6	Chlorine6.
CS-PEG	Chondroitin sulfate-polyethylene glycol.
CTA	Cyanoacrylate tissue adhesive.
CXL	Cross linking.
DLK	Deep anterior lamellar keratoplasty.
DM	Descemet's membrane.
Epi-BM	Epithelial basement membrane.
FDA	Food and drug administration.
FG	Fibrin glue.
FIB	Fibrinogen.
GDD	Glaucoma drainage device.
HA-MA	Hyaluronic acid with methacrylate group.
HSV	Herpes simplix virus.
ICG	Indocyanin green.
IOL	Intraocular lens.
IOP	Intraocular pressure.
NPDS	Non penetrating deep sclerotomy.
OVV	Orbital venous varix.
PDGF	Platelet-derived growth factors.
PGLSA-MA	PEG, Glycerol, Succinic acid, Methacrylate.
PPP	Platelet poor plasma.
PRP	Platelet rich plasma.
RF	Riboflavin.
TGF	Transforming growth factor.
UVA	Ultraviolet light A waves.
VA	Visual acuity.

LIST OF FIGURES

Introduction

INTRODUCTION

Suturing is a time consuming task in ophthalmology, and suture induced irritation and redness are frequent problems. Postoperative wound infection and corneal graft rejection are examples of possible suture related complications. To prevent these complications, ophthalmic surgeons are switching to sutureless surgery. A number of recent developments have established tissue adhesives like cyanoacrylate glue and fibrin glue as attractive alternatives to sutures. ***(1)***

Currently, tissue adhesives and glues are an alternative technology in clinical applications that are important both to the medical industry and surgical profession.An adhesive is the material that does the sticking and the material to which the adhesive bonds is called the substrate, for our purpose this could be any tissue (skin, conjunctiva, blood vessels).***(2)***

In a broad sense, tissue adhesives can be categorized into biologic, composite biologic and synthetic. A possible and promising new application for tissue adhesives is to be done through genetic engineering.***(3)*** The most popular example for synthetic adhesives is cyanoacrylate which was first synthesized in 1949 and later, it was used to close wounds and bond other human tissues.***(4)***

Other example, is the human fibrin glue which is a blood-derived product that is absorbable, relatively easy to use, and can be kept at room temperature or in a refrigerator. It may be used instead of cyanoacrylate tissue adhesives in the treatment of progressive corneal thinning and small perforations, potentially resulting in less corneal and conjunctival

inflammatory reaction. Although the use of fibrin as a biologic adhesive was first introduced in 1909, it was not until 1944 that fibrin was used for skin graft fixation. Also it was in early forties that fibrin glue was introduced to ophthalmology to fixate penetrating corneal grafts in rabbits ***(5)***.

Nowadays, tissue glue is being used for conjunctival closure following pterygium and strabismus surgery, forniceal reconstruction surgery, amniotic membrane transplantation, lamellar corneal grafting, closure of corneal perforations and descematoceles, management of conjunctival wound leaks after trabeculectomy, lid surgery, adnexal surgery and as a hemostat to minimise bleeding ***(6)***.

AIM OF THE ESSAY

This essay aims at evaluating different types of tissue adhesives in management of various ophthalmic problems by comparing between synthetic adhesives (*e.g,* cyanoacrylate derivatives) and biologic adhesives (*e.g,* fibrin-based adhesives).

Also, it defines the indication, the way to use, the possible role and effectiveness, its safety and the results obtained from its use.

Chapter 1

TISSUE ADHESIVES

TISSUE ADHESIVES

An ideal tissue adhesive should have some special properties including sufficient working time before inducing firm adhesion, adequate tensile strength to maintain wound integrity, biocompatiblity, permeablity to fluids and metabolites to prevent necrosis. It must not induce inflammation, disappear eventually to permit healing at the interface, not carrying the risk of transferring an infectious agent. It should be, of course, accessible and affordable ***(1)***.

Bonding strength:

A chemical bond is the physical process responsible for the attractive interactions between atoms and molecules, and that which confers stability to diatomic and polyatomic chemical compounds. Chemical bonding is determining tensile strength which is by definition: the maximum tension the material can withstand without tearing. In general, shear (side–side force) and compression/ distraction strength is high once two surfaces are bonded ***(2)***.

On the other hand, when an adhesive fails to bond the substrate together, the failure can be one of several modes. One is *an adhesive failure* whereby the adhesive fails at the interface of the substrate. Another type of failure is *a cohesive failure* or *material failure,* whereby the adhesive fails within itself, and the third type of failure is *a substrate failure,* whereby the adhesive and cohesive bonds are so strong that the substrate or tissue fails ***(2)***.

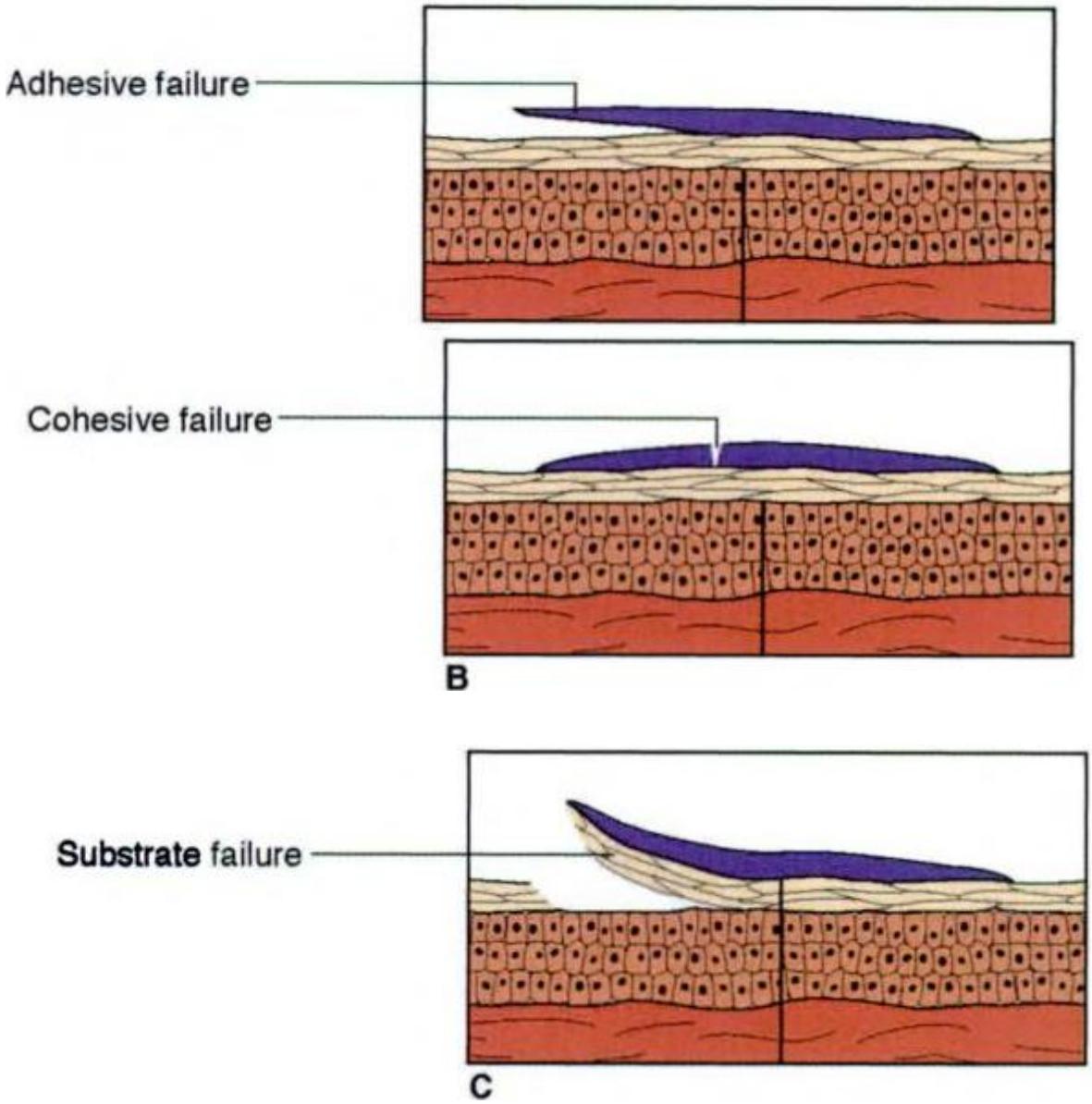

Fig 1: Types of bond failure [1]

Categories of adhesive use:

Adhesives can be used in different forms according to their functions. For example they can be used as being sealants by preventing flow and seepage of blood and other body fluids. They can be considered haemostatic agents when they stop the flow from leaking blood vessels. They may be applied as wound dressings for abrasions, burns, surgical incisions , and also for wound closure. Finally they have been used and approved as embolic agents, but care should be taken in arteriovenous malformation because the risk of pulmonary embolism ***(2)***.

Chapter 2

Synthetic Tissue Adhesives