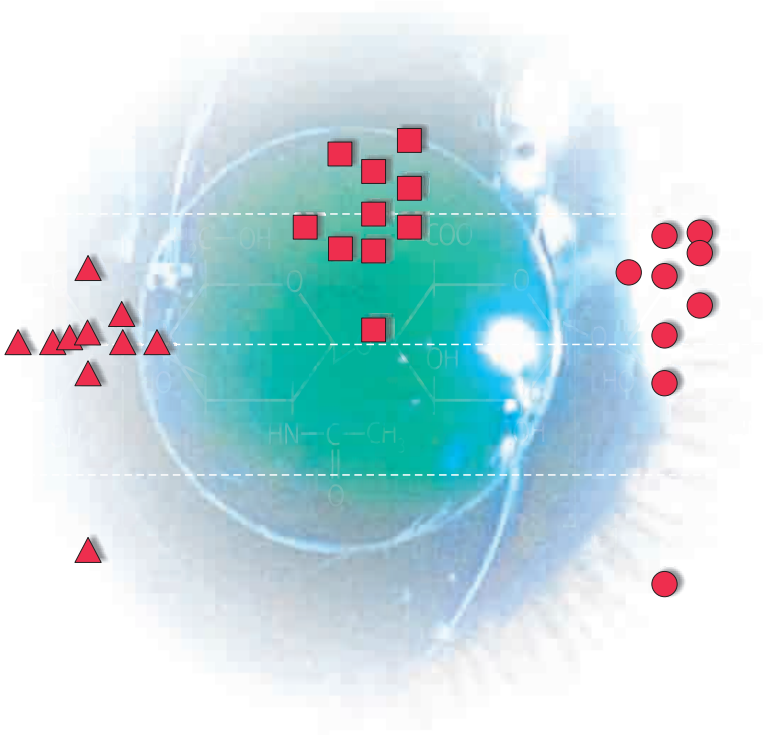
Ophthalmic Viscoelastic Devices (OVD) in Ocular Surgery

Gerd U. Auffarth



UNI-MED

SCIENCE

Ophthalmic Visco-elastic Devices (OVD) in Ocular Surgery

UNI-MED

UNI-MED Verlag AG
Bremen - London - Boston

Auffarth, Gerd U.:
Ophthalmic Viscoelastic Devices (OVD) in Ocular Surgery/Gerd U. Auffarth.-
1st Edition – Bremen: UNI-MED, 2012
(UNI-MED SCIENCE)
ISBN 978-3-8374-5281-5

MEDICINE - STATE OF THE ART

UNI-MED Verlag AG, one of the leading medical publishing companies in Germany, presents its highly successful series of scientific textbooks, covering all medical subjects. The authors are specialists in their fields and present the topics precisely, comprehensively, and with the facility of quick reference in mind. The books will be most useful for all doctors who wish to keep up to date with the latest developments in medicine.

Preface and acknowledgements

Modern Ophthalmic Viscoelastic Devices (OVD), also called viscoelastics, form a central part of ocular surgery. Starting off as a replacement for vitreous in its early development, viscoelastics became the gate opener for modern cataract surgery in the 1980s and 1990s.

Without OVDs the advancement of modern cataract surgery as we know it would not have been possible. Indirectly, advanced intraocular lenses, such as multifocal intraocular lens (IOL) technology, toric IOLs or even accommodative IOLs could not have been developed.

OVDs have opened up new fields of surgery, such as visco-glaucoma surgery, and are used in all kinds of eye surgery today. There is a diversity of viscolastic substances, which differ in molecular weight or offer a unique combination of substances.

New developments such as the visco-adaptive substances (Healon 5, DiscoVisc) tried to combine different physico-chemical properties of different OVDs to make them suitable for various surgical situations ("one OVD for everything") but never really gained a large market share and are still niche products for specific indications. However, they have intensified the research in the field of OVDs and proven that viscoelastics are surgical tools to be used for diverse purposes, in a range of situations.

This book combines basic knowledge about the physical and chemical abilities of OVDs. Its clinical use in different situations, starting from cataract surgery through to all kinds of ophthalmo-surgical procedures as well as intravitreal interventions tries to cover almost all clinical situations where OVDs could be applied. It gives the reader "tips and tricks" from the expert for their use.

I would like to thank the publishers for their patience. Also, I would like to thank Mrs. Miriam Benz, MA and Dr. sc. hum. Sybille Scholtz for their translation.

I hope that this book not only helps the young resident starting in ophthalmic surgery, but also holds some interesting "pearls" for the experienced surgeon.

Heidelberg, September 2012 *Gerd U. Auffarth, MD, F.E.B.O*

Contents

Introduction

1. Introduction

Ophthalmo-viscosurgical devices (OVDs) are nowadays regarded as standard tools in ophthalmic surgery. The discovery and development of those compounds started approximately 75 years ago in 1934 with isolating hyaluronic acid as the substance of the vitreous body of the human eye.

The use of OVDs became increasingly popular for cataract surgery, glaucoma surgery, cornea surgery, trauma surgery and vitreoretinal surgery (Dick et al. 2001a). Since the introduction of viscoelastic substances in the 1970s the properties of these agents have improved the quality of anterior segment surgery.

OVDs (Arshinoff 2003c) – formerly called viscoelastics or viscoelastic substances – are a class of non active clear gel-like chemical compounds with viscous and elastic properties. The specific physical properties make them useful e.g. for ophthalmic surgery, mainly cataract surgery (Bellucci 2000). Here they create and maintain the anterior chamber depth and visibility, protect the corneal endothelium and other intraocular tissues during surgery. They minimize interaction between tissues and instruments during surgery and ensure therefore high tissue integrity (Arshinoff 1995).

Development, production and use of OVDs require ongoing research to evaluate the biocompatibility, purity, and ocular structure protection of the materials in question (Arshinoff 2000b, Arshinoff et al. 2002, Holmen et al. 2003, Augustin et al. 2004, Holzer et al. 2001a, Cavallini 2002, Wolkoff 2003). In vivo studies have proven that the molecular and chemical structure of hyaluronic acid is ideal, and interactions between molecules and receptor tissues (Madsen, 1989) and inflammatory and immunogenic reactions (Dick et al. 1989) have also been studied extensively.

1.1. Historical development of modern intraocular lens surgery

Although cataract surgeries were already being carried out 2000 years ago in ancient Greece, by the Romans and the Arabic/Indian cultures, the history of intraocular lens implantation is only 50 years old (Hirschberg 1908a, Apple et al. 1989).

▶ Intraocular lenses – Generation I

The development of modern cataract surgery with intraocular lens implantation began after WWII with the first implantation of an IOL (intraocular lens) by Sir Harold Ridley in the St. Thomas Hospital in London (☞ Fig. 1.1 and 1.2a-c) (Apple et al. 1989). On November 29 1949, Ridley carried out his first lens implantation on a 45-year-old woman. The intraocular lens material consisted of polymethyl methacrylate (PMMA, Plexiglas). During WWII Ridley treated pilots with perforated foreign body injuries to the eyes that had occurred through splinters of the Plexiglas domes in the cockpits. He learned that these splinters remained relatively inert in the internal eye (Apple et al. 1984, 1989, Ridley 1951).

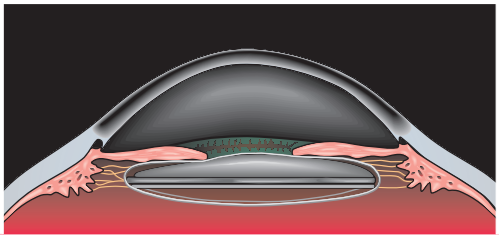
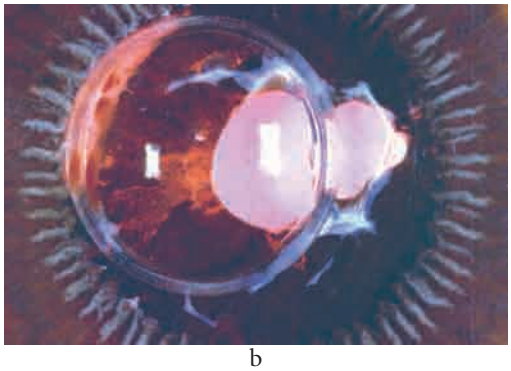


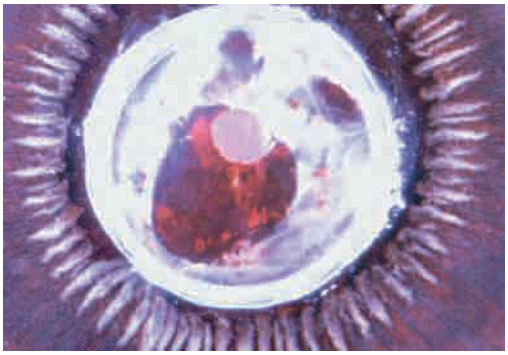
Fig. 1.1: Schematic representation of an implanted Ridley lens. Following extracapsular lens extraction, the lens should be fixated in the capsular bag. (Taken from: Apple et al. Intraocular lenses. Evolution, designs, complications and pathology. Baltimore, Williams & Wilkins, 1989).

Fig. 1.2b+c show two autopsy eyes implanted with Ridley lenses (image taken from the vitreous to the posterior lens surface and ciliary body). Problems that led to complications over the years following surgery were generally due to the crude operating techniques of the time (Apple et al. 1984, 1989).

a



b



c

Fig. 1.2a-c: **a:** Photograph of Sir Harold Ridley, London, England. **b+c:** photographs of two autopsy eyes with Ridley lenses (image taken from the vitreous to the posterior lens surface and ciliary body. **b:** Right eye; **c:** left eye). At the time of this patient's death, the lenses had been implanted for a period of approximately 30 years. In spite of lens luxation of the right eye (**b**), the last determined visual acuity was 20/20 in both eyes (Surgeons: Right eye: W. Reese, MD, left eye: T. Hamdi, MD, Philadelphia).

The most serious complications are lens luxation (which can still occur years after surgery) and inflammatory reactions. Modifications of implantation techniques were introduced in the early 1950s by Parry, while Epstein used this time to modify lens designs. Throughout these and the following years Ridley implanted approximately 1000 of his lenses. Apple coined the phase of the first intraocular lens implantations which lasted from 1949 to the mid 1950's Generation I of the development of intraocular lenses (Apple et al. 1984, 1989, Epstein 1986).

Ridley was treated with hostility by many ophthalmologists, particularly those from academic circles. Nonetheless, there were some surgeons including Binkhorst, Reese, Parry and Epstein who followed Ridley's example, implanting his lenses or creating modified versions, as well as modifying implantation techniques. Once again the problem of lens luxation was of significance. The search for other fixation points for the intraocular lens began. Thus the next generation (Generation II) of the intraocular lens was born, namely the early anterior chamber intraocular lenses (AC-IOL).

▶ Intraocular lenses – Generation II

The period between the early 1950s to the early 1960s marked the second generation of intraocular lenses, in which the early anterior chamber lenses were further developed (☞ Fig. 1.3) (Apple et al. 1989). Surgeons hoped the anterior chamber lenses would be less prone to decentration since the lenses were to be fixated in the chamber angle.

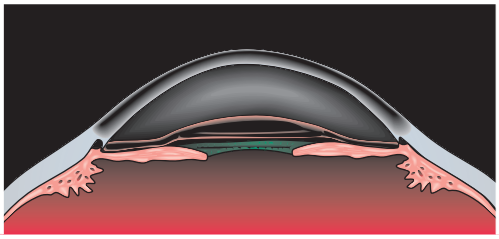


Fig. 1.3: Schematic representation of an implanted anterior chamber lens. The lens could be fixated in the anterior chamber following intra- or extra-capsular cataract extraction. (Image taken from Apple et al. Intra-ocular lenses. Evolution, designs, complications and pathology. Baltimore, Williams & Wilkins, 1989).

AC-IOL could be implanted after extracapsular as well as intracapsular cataract extraction. It was