Retinal Detachment Surgery and Proliferative Vitreoretinopathy

From Scleral Buckling to Small Gauge Vitrectomy

Ulrich Spandau
Zoran Tomic
Diego Ruiz-Casas
Editors

Second Edition

Springer

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ISBN 978-3-031-11945-3 ISBN 978-3-031-11946-0 (eBook)
https://doi.org/10.1007/978-3-031-11946-0

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

This book is dedicated to all VR surgeons who strive to give their patients good treatment through excellent surgery and dedicated care.

Preface

The retinal detachment is the most important surgery for a vitreoretinal surgeon. Its broad pathological spectrum presents a never-ending challenge.

Ophthalmology is a specialized handcraft. But in contrast to a handyman, we do not work with dead objects but with a living organ, which wants to be treated like a raw egg.

The best situation for an ocular surgeon would be to operate one eye as an exercise and the second eye for real. Especially in PVR detachment, such a situation would be a dream. The pathology is extremely difficult and we have a broad choice of surgical options: Vitrectomy, episcleral buckling, intra-operative gases and liquids.

If you want to become a good VR surgeon you need:

1. Theoretical knowledge: The retina behaves logically in a detachment. Retinal detachment requires knowledge about Lincoff rules and where to find the primary hole.
2. Practical knowledge of many different *surgical techniques* (binocular ophthalmoscopy, scleral buckling, vitrectomy, retinectomy, phacoemulsification, secondary IOL implantation). A surgeon needs many different weapons to succeed against retinal pathologies.
3. *Experience*, because experience results in correct assessment. An important part of experience is a tight and complete follow-up of your patients which results in valuable feedback about your surgery.
4. *Visit* other vitreoretinal clinics in order to learn tips and tricks and to be able to assess the quality of your surgery within the surgical world.
5. Modern *equipment* and qualified *staff*. A microscope with a good viewing system is essential for a successful surgery. Vitreoretinal surgery requires well-educated staff.
6. And finally, last but not least and maybe the most important point: *Motivation* and *passion* for ophthalmology and surgery.

Retinal detachment surgery requires theoretical and practical knowledge. Easy retinal detachments can be learned within 1 year but complicated retinal detachments require 5 years of training. Avoid being ideological about the best method to attach the retina. Be pragmatic. The simplest method which reattaches the retina is the best. And the best method for one eye may not be the best method for another eye.

What is the difference between theory and praxis? Theory means that you know everything, but nothing works. Praxis means that everything works, but you do not know why. So try to acquire as a vitreoretinal surgeon a good mixture of practical and theoretical knowledge.

In this book, all surgical techniques to reattach the retina are demonstrated in detail. The surgery is described like a cookbook: First the instruments and material and then the surgery step-by-step. The surgery is illustrated with pictures, drawings and many videos.

Additional videos can be viewed on the youTube channel of Ulrich Spandau and Diego Ruiz-Casas.

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Acknowledgements I want to thank my wife, Katrin, for her non-ending patience regarding her book-writing husband and I want to thank my children, Maximilian, Moritz and Oskar, for showing me that there is a world outside my beloved ophthalmology.

Introduction

Proliferative vitreoretinopathy (PVR) is the biggest surgical challenge within surgical ophthalmology. Small gauge vitrectomy offers new possibilities to tackle with this difficult pathology. The trocars and the small instruments are less traumatic than the old 20G vitrectomy resulting in improved postoperative results.

The book is divided in several parts. It starts with an historical introduction from the father of modern vitreoretinal surgery, Relja Zivojnovic, from Rotterdam. The first part explains the theoretical knowledge for retinal detachment including the four Lincoff rules. All devices and instruments for detachment surgery are then demonstrated. In the next part all surgical techniques for an easy retinal detachment are demonstrated. It includes pneumatic retinopexy (Toronto technique), cryopexy and vitrectomy (Moorfield technique), combined phaco/vitrectomy (Frankfurt technique), encircling band with vitrectomy (Stockholm technique) and much more. The following parts show the surgical management of PVR detachment, ora dialysis, choroidal detachment and even pediatric detachment. In the next part well-known surgeons from all over the world demonstrate their specific surgical techniques with interesting video cases. Finally,all postoperative aspects including complications and follow-up are explained.

The whole textbook is practical, down to earth and hands on. The surgery is described in great detail so you can reproduce it the next day in your OR.

Editors
Ulrich Spandau
Diego Ruiz-Casas
Zoran Tomic

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All videos can be found in a playlist on my YouTube channel:
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Part I

Basics of Retinal Detachment Surgery

All videos of this part are found in a playlist on my youTube channel:
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1 Surgery of Vitreoretinal Disorders—Past, Present, and Future

Relja Živojnović

Pre-Gonin era: Retinal detachment has always been a dramatic and terrifying experience for the patient, and for the surgeon, a source of frustration for a long time. Practical knowledge in the nineteenth century was based on pathoanatomical observations, and the therapy consisted of drainage and bed rest. The invention and introduction of ophthalmoscopy by Helmholtz in 1851, enabling fundus visualization in vivo for the first time marked the decisive step in understanding and treatment of retinal detachment. Nevertheless, it took 70 long years to totally comprehend the course and dynamics of the pathological process. The main components of this process—traction, fluid, current in the eye as well as the hole in the retina were observed separately, but were not causally connected. The importance of particular components of the pathological process was either over- or underestimated, while the therapy itself relied on the surgeon's assumptions. Cutting of the» vitreous strands«–Deutschmann, Graefe; intraocular injection of various substitutes with or without drainage of subretinal fluid; extensive diathermy—Lagrange; shortening of the eyeball—Müller, combined with strict bed rest and positioning are some of many futile attempts whose rare positive results were at the most only temporary.

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1.1 The Beginning of Retinal Surgery—Jules Gonin

In the early twentieth century, after extensive studies of pathological specimens, ophthalmoscopic observation of the dynamics of the pathological process and looking for holes in the retina, trying all the hitherto applied surgical methods in the treatment of retinal detachment, Jules Gonin, Lausanne, Switzerland, came to the epochal conclusion that a hole in the retina is the cause of detachment. Using Paquelin's thermocautery to perforate the eyeball on the spot of the defect and incarcerating its edges by the withdrawal of the needle, he achieved retinal reattachment. Using this method, he successfully reattached the retina in 40–50% of cases. After long years of disbelief and dismissal, he finally got recognition for his work at the international congress in Amsterdam in 1929. His enthusiastic followers were Arruga in Spain, Amsler in Switzerland, and Wewe in the Netherlands. However, in spite of the 40–50% success rate in the previously inoperable cases, a large number of patients still could not be treated successfully. The reason was that the treatment did not comprise the other two components of the pathological process, vitreoretinal traction and fluid current in the eye. Shortening of the eyeball to reduce its volume as introduced by Lindner and later by Wewe, based on earlier attempts by Müller, resulted in certain improvements.

U. Spandau et al. (eds.), *Retinal Detachment Surgery and Proliferative Vitreoretinopathy*,
https://doi.org/10.1007/978-3-031-11946-0_1

Ophthalmoscopy. As it was said before, in 1850, Helmholtz introduced ophthalmoscopy, which technically consisted of a strong source of light near the patient's head, a concave mirror with a hole in the middle through which the surgeon—by means of reflected light via convex lens—could see the lightened fundus. In the 1950s, that system was developed into a sophisticated ophthalmoscope with light and a system of lenses, which was used as both direct and indirect ophthalmoscope. Development of visualization was of crucial importance for the development of vitreoretinal surgery and had a curious course. In the early 1950s, Schepens, Boston, USA, and the Fison in London, UK, designed the binocular indirect ophthalmoscope, which was accepted and used in these countries at the time. In Germany, the Zeiss ophthalmoscope for direct and indirect ophthalmoscopy came into use very early. In the 1960s, it was replaced by the bonoscope, an indirect monocular ophthalmoscope with extra strong light. In France, indirect ophthalmoscopy was as good as unknown and direct ophthalmoscope was used in surgery, which culminated in the use of Goldmann´s three-mirror glass under the microscope. The superiority of the binocular indirect ophthalmoscope with the possibility of indentation of the periphery was obvious, so in the 1980s, it was eventually generally accepted. For diagnostic purposes, besides the ophthalmoscope, Goldmann's three-mirror glass and panfundoscope for its panoramic picture were used. In the 1990s, they were all replaced by 90D lens.

1.2 Scleral Indentation

The introduction of scleral indentation was a capital contribution to this surgery, as it simultaneously treated all three components of the pathological process: vitreoretinal traction, fluid current, and their consequence—the retinal hole. The first attempt at indentation—»buckle«—was reported in 1937, when Jess sutured a gauze tampon under Tenon's capsule. Although basically logical, this attempt did not find followers. The father of the»buckle« surgery was undoubtedly Ernst Custodis, Duesseldorf, Germany, who used a plastic "egzoplant" sutured on the sclera. This technique was soon accepted and increased positive results in the surgery to 80%. However, frequent complications of globe perforation due to the hardness of the plastic material, combined with surface diathermy, inspired surgeons in many countries to look for other solutions. For detachments with multiple holes in the periphery, Arruga introduced *cerclage equatorial*—circumferential buckle—by suturing a nylon thread through the sclera on the equator of the eyeball. The logic and simple use of this method were appealing. Perhaps that is why perforation of the globe during surgery and ischemia of the anterior segment postoperatively were rather frequent complications. The idea itself was perfected by Schepens, Boston, USA, who used softer material, i.e., silicone. An encircling band with or without a radial buckle, combined with diathermy replaced finally Arruga's cerclage. Complications with plastic material inspired Pofique and Spira Lyon, France to use biological material—human sclera. Lamellar scleral pocket—*poche scleral*—filled with pieces of the human sclera or sutured upon the sclera—*poche apportee*—filled with the same material were frequently used in the 1960s. At the same time, Kloeti, Zuerich, Switzerland, propagated the use of fascia lata as cerclage material. Naturally, biological materials did not cause any complications, but the effect of indentation was short-lived, and in some cases caused redetachment. Looking for new materials more or less ended, when Lincoff, New York, USA, introduced silastic sponge and replaced diathermy with cryocoagulation. In the early 1970s, this became the method of choice in the treatment of detachment and has been sustained as such up to the present time. Recently hydrogel as the material for indentation has not brought much change.

Retinopexy: The purpose of retinopexy is to create a chorioretinal scar and it has no impact on vitreoretinal traction. After the use of thermocautery in Gonin's time, surgery moved on to non-perforative diathermy as introduced by Pischel. Diathermy coagulation, technically improved by Wewe, was applied for many years. In the 1970s, Lincoff, following Bietti's (Rome, Italy) experience, combined the silastic buckle with cryocoagulation, which, properly used, did not damage the sclera. It should be mentioned that extensive use of diathermy but also of cryocoagulation, may have very serious consequences and provoke proliferative process in the eye. At the beginning of the 1960s, Meyer Schwickerath, Essen, Germany, introduced xenon photocoagulation, which opened a new chapter in retinopexy. Laser coagulation based on the same principle and introduced by Zweng and Little, USA, was technically much easier to use and replaced completely xenon photocoagulation. In this way, the chapter of retinopexy has been completed.

1.3 Intraocular Tamponade

Owing to his attempt in 1911 to treat retinal detachment by means of intravitreal air injection, Ohm can be regarded as the forerunner of tamponade. With much more understanding of the pathological process, Rosengren, Gothenburg, Sweden, used the air for tamponade in 1938. In the early 1970s, Norton, Miami, USA, introduced SF6, and in the early 1980s, Lincoff pioneered long-lasting gases, which have the advantage of long-lasting tamponade and the disadvantage of expansion under low pressure.

Tamponade is fully effective only when combined with indentation. Without indentation, propagated as fast and cheap surgery, it only has a temporary effect because of the persistence of vitreoretinal traction. From the early 1970s, the»buckle« surgery combined with cryocoagulation, drainage if necessary, with or without tamponade has become the method of choice in the treatment of retinal detachment and it is successful in 90–95% of detachments with the mobile retina. But it failed with detachments complicated by multiple equatorial ruptures, giant tears, and detachments caused by proliferative process.

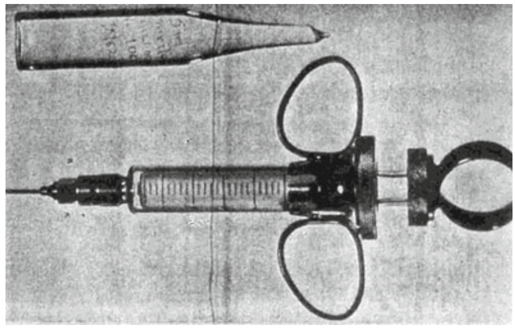

Fig. 1.1 Cibis syringe for injection of silicone oil

Introduction of silicone oil. In the 1970s, Paul Cibis, Saint Louis, USA, introduced silicone oil in retinal detachment surgery (Fig. 1.1). Under control of binocular ophthalmoscope in the reversed picture, using the surface tension of silicone oil and expansion of the silicone bubble, he tried to separate the detached retina from the changed vitreous and fibrotic membranes. At the same time, he tried to attach the retina by evacuating intraocular fluid. With successful results, he left silicone oil in the eye as permanent tamponade. By this extremely difficult technique, he achieved surprisingly good results in some cases that used to be inoperable. Probably owing to its difficult application, this technique had only a few followers in USA (Okun, Watzke). In the mid-1960s attempts of the use of this technique in some European countries were published—Moreau in France, Dufour in Switzerland, Liesenhof, Lund in Germany. Cibis' early death and legal problems concerning the use of silicone oil being an industrial product not registered by the FDA resulted in the restricted spread of this method. In Europe, surgeons did not use binocular ophthalmoscope and were not very familiar with the dynamics and consequences of pathological processes in the eye, which resulted in poor outcomes and the discontinuation of the use of silicone oil in Europe in the late 1960s.

Modern times. In the early 1970s John Scott, Cambridge, UK, impressed by Cibis' results with silicone oil, attempted the treatment of complex cases in which conventional technique was unsuccessful. Trying to separate fibrotic membranes and the changed vitreous body from the contracted retina by means of expansion of the silicone bubble, he also used intraocular instruments. He used the bent pick needle to lift membranes, the blunt flute needle for fluid evacuation, and scissors. The surgery was performed under the control of a binocular ophthalmoscope in the reversed picture. With a positive outcome, the central retina could be reattached and the fibrotic tissue and membranes pushed to the periphery. Silicone oil would stay as permanent tamponade preventing re-contraction of fibrotic tissue. With his skill, insight into the course of the pathological process, as well as by his enormous persistence, John Scott achieved remarkable results. Owing to the difficulty of the procedure itself and his good results, only a small number of surgeons could be compared to him, so Cambridge was the place of reference for patients from all over the world. With this method, John Scott made a huge step forward in the treatment of difficult cases, but even this method had its limitations. Giant tears with PVR, traumatic detachments with the incarcerated retina, diabetic tractional detachment, and others could not be treated successfully in this way. Permanent tamponade with silicone oil also caused complications in the long run.

At the end of the 1960s, David Kasner, Miami, USA, tried a new treatment of prolapse of the vitreous body during cataract surgery and trauma of the eye and called it open sky vitrectomy. Using cellulose sponges and scissors, he removed the prolapsed vitreous body. Through successful surgery, he proved that the vitreous body was not of vital importance to the eye. In 1970, the new technique inspired Robert Machemer, Miami, USA, with the technical assistance of J.M. Parel, to design an instrument that enabled entering the vitreous space through a relatively small opening, and under the microscope to remove the blurred vitreous body. The multifunctional instrument called Vitreous Infusion Suction Cutter was a revolutionary step in the history of vitreoretinal surgery. After a short time, O'Malley introduced a bimanual system with a separate source of light and standardized system of 20 gauge instruments. Pars plana vitrectomy opened new possibilities in vitreous body surgery, but it was not aimed at the treatment of retinal detachment. Even more, the fear of injuring the retina during surgery was great and comparable to the fear of loss of the vitreous body in earlier cataract surgery. In USA, the standard procedure for the treatment of retinal detachment for more than 10 years was the silastic buckle with cryopexy and possible gas tamponade. Complex cases of detachment with proliferative process usually were not operated on. The only kind of detachment in which vitrectomy was implemented was the detachment caused by a hole in the macula, which due to its location used to present a problem. In the past, indentation techniques were applied with modest success, such as the silver ring of Rosengren, the silver plomb of Gloor, Zurich, Switzerland, and others. For this kind of detachment, pars plana vitrectomy with removal of epiretinal membranes, gas tamponade, and positioning was the method of choice then and has remained so ever since. Recently, the relocation of the macula as introduced by Machemer in the 1990s is one more indication of the implementation of vitrectomy.

Pars plana vitrectomy has opened new possibilities for research of proliferative processes which now can also be followed in pathological specimens of the ocular tissue. In the late 1970s, Machemer described the proliferative process in the eye on the basis of acquired specimens and clinical experience, and introduced the familiar name Proliferative Vitreo Retinopathy (PVR), instead of MVR (Massive Vitreous Retraction).

Pars plana vitrectomy was rather hesitantly accepted in Europe by way of pioneers in particular countries: Kloeti in Switzerland, Laqua and Heimann in Germany, and Leaver in the UK. In the 1970s, Jean Haut, Paris, France, was the first to combine vitrectomy with silicone oil.

1.4 The New Concept

In the early 1970s, practicing retinal surgery in Rotterdam, the Netherlands, I was dissatisfied with my results. Visiting other centers in Europe—Zurich, Bonn, Paris—and comparing my work with that of the others, I did not notice major differences in results. After several visits to John Scott, I was convinced that his technique and approach were absolutely superior to anything I had seen before. In the late 1980s, I implemented his technique in surgery of a considerable number of patients and achieved results satisfying for that time. After a year, together with Diane Mertens, I abandoned binocular ophthalmoscopy. I switched to the surgical microscope with a contact lens (Fig. 1.2). Now I had a free hand and a direct image as in reality. For me, the surgical microscope is part of vitrectomy as a surgical technique.

I also abandoned combined vitrectomy with silicone oil, using it only as temporary tamponade. As the admitted patients were increasingly complex, it was soon obvious that this technique also had its limitations. In complex cases, when due to proliferative process the retina was contracted, incarcerated or shortened, removal of all membranes and scarred tissue was not sufficient to produce results we aspired to. The only solution for these cases appeared to be surgical intervention—retinotomy and retinectomy. Initially, only one-eyed patients in a desperate situation were treated in this manner. Nevertheless, I very soon managed to operate a considerable number of the most difficult, previously inoperable cases with favorable results.

I, therefore, established a new concept of treatment, which consisted of vitrectomy, meticulous removal of all epi- and subretinal membranes, retinal surgery, retinotomy, retinectomy, if necessary, laser coagulation, and temporary tamponade with silicone oil. After the first publications and frequent presentations at meetings, the introduction of retinal surgery in the arsenal of surgical measures was soon accepted and adopted.

At the very beginning of the development of this demanding technique, I was confronted with the absence of adequate instruments for this new kind of surgery. The presence of Ger Vijfvinkel, a technician in our hospital, was crucial for the development of new instruments (Fig. 1.3).

His frequent presence in the operating theater and observation of surgery resulted in prompt design and construction of adequate instruments. Besides numerous small instruments, we developed together the foot-driven silicone pump (Fig. 1.4), the back-flush needle with a silicone tip (Fig. 1.5), 4-port system, 25-gauge vitreous cutter and instruments, replaced Ando's plastic tacks with steel ones for perioperative use, etc. Ger Vijfvinkel with his inventiveness contributed considerably to the development of vitreoretinal surgery.

This new, more aggressive concept of vitreoretinal surgery was not associated with many postoperative complications. After the introduction of 6 o'clock iridectomy (Ando, Japan, 1986), the problem of the pupillary block was solved. Other complications could be ascribed to inadequate surgical technique or to the continuation of proliferative process which required frequent reoperations. This proliferative process was also often provoked by careless surgery. It should be mentioned that the pathological basis of all complex cases was the biological process

Fig. 1.2 The surgical microscope is an essential part of vitrectomy

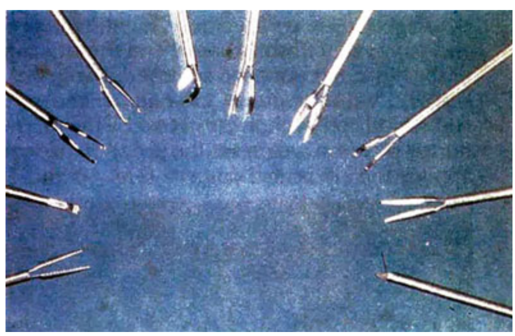

Fig. 1.3 Scissors and forceps

Fig. 1.4 Air driven silicone oil pump

Fig. 1.5 Back-flush needle with silicone tip

and that surgical therapy is only adequate and indicated in absence of better and more appropriate treatment.

In the last 20 years, no radical changes in therapy have taken place. Introducing PFCL (heavy liquid) Stanley Chang greatly simplified the surgical process. Double filling silicone with PFCL as used by Peperkamp, Rotterdam, Netherlands, in the prevention of inferior detachment gave positive results. Improved visualization of membranes by the use of colors—trypan blue—as well as triamcinolone acetonide for better visualization of vitreous cortex, made the surgical process easier and safer. The use of finer instruments, thinner vitreous cutters, as well as sutureless vitrectomy, simplified the course of surgery. Even with all this technical progress, meticulous removal of complete proliferative tissue before retinal surgery and injection of silicone oil remains an absolute must for the success of the operation.

A correctly performed »buckle« surgery with a binocular ophthalmoscope and its success rate of 90–95%, with the mobile retina, is practically complications-free. (Choroidal bleeding at drainage is the complication most frequently mentioned, which we practically reduced to zero by using the blunt lacrimal probe for penetration of the choroid after incision of the sclera.) This conventional surgery is much cheaper than vitrectomy in terms of both personnel and instruments. Pars plana vitrectomy in itself is an invasive method with more possible complications such as endophthalmitis, cataract, etc. However, nowadays there are few people ready to master indirect ophthalmoscopy and I am afraid that in the future, conventional surgery will lose the battle with 90D lens, wide angle microscope, and vitrectomy.

Finally, I would like to add a few comments. Development of the surgery has confirmed an old truth again: Not a single, even the most important step in development can exist alone but only builds on earlier achievements of its predecessors. Still, the development of vitreoretinal surgery was many times slowed down for seemingly incomprehensible reasons. For instance, it took many years before absolutely superior binocular ophthalmoscopy was generally accepted in Europe. Further, more than 10 years after the epochal invention of pars plana vitrectomy, the complex pathology was not treated in USA, while at the same time, such cases were successfully treated in Cambridge. How to explain it? Was it complacency, vanity, conservatism, or arrogance? Perhaps some of it all but the main reason was the poor flow of information. For a long time, retinal surgeons were perceived as curious people, almost nerds, and were isolated. Results of both successful and unsuccessful operations were considered inadequate. For quite a while, the prestigious bi-annual Gonin club meeting was almost the only place for the exchange of ideas and experiences. The presentation technique was weak and unconvincing. Mutual visits were not frequent or common, and learning and transfer of knowledge were not formalized, at least not in Europe.

This situation dramatically changed in the early 1980s. With the introduction of new surgical methods, new technology, and better results, interest in new surgery was on the rise. At numerous meetings, the new surgery was presented by new visual means: film, video, live surgery, in an attractive, instructive, and impressive way. Initially, that advancement was limited to the developed countries, but now, it has covered most countries that can afford it. Vitreoretinal surgery is not restricted to a small number of places. Instead, the number of centers, as well as the number of vitreoretinal surgeons, have multiplied.

2 Lincoff Rules and Surgical Techniques for Retinal Detachment

Zoran Tomic and Ulrich Spandau

2.1 Lincoff Rules for Retinal Detachment

A thorough and correct assessment of the detached retina is essential for surgical success. The retina behaves logically. And you need to understand this logic in order to understand retinal detachment.

What is the anatomical course of a retinal detachment?

Lincoff and Gieser [1] found the following development of a retinal detachment (Fig. 2.1): A retinal detachment spreads first to the ora serrata. The subretinal fluid continues then to the optic disc.

The next most important theoretical knowledge for retinal detachment are the Lincoff rules.

Lincoff rules: Lincoff and Gieser examined 1000 patients with retinal detachments and extracted 4 different shapes of retinal detachments [1]:

(1) The superior detachment is identical to a total detachment. A superior detachment develops/goes over to a total detachment (Fig. 2A, B).
(2) The superotemporal/superonasal detachment (Fig. 2C, D).
(3) The inferior shallow detachment (Fig. 2E).
(4) The inferior highly bullous detachment (Fig. 2F).

The **second finding** of Lincoff and Gieser is that every detachment shape (1–4) has a rupture at a specific location. This rupture (=primary hole) is responsible for the specific shape of detachment. More ruptures are possible but in most cases, there is only one second hole which is within 1 quadrant of the primary hole. The location of the primary hole is as follows (Fig 2.3):

(1) Superotemporal/superonasal detachment: The primary hole lies within 1 ½ clock hours of the highest border.
(2) Superior/total detachment: The primary hole is located within a triangle where the apex is located at 12:00 and the sides at 10:30 and 1:30.
(3) The inferior shallow detachment has a hole on the side with the higher detached edge. The hole is located in an area between the upper edge of the retinal detachment and 6:30.
(4) The inferior highly bullous detachment is the most astounding one. The small hole is not, as one may expect, located in the inferior pole but at 11:00 or 1:00. A peripheral bridge connects the hole with the inferior detachment.

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U. Spandau et al. (eds.), *Retinal Detachment Surgery and Proliferative Vitreoretinopathy*,
https://doi.org/10.1007/978-3-031-11946-0_2

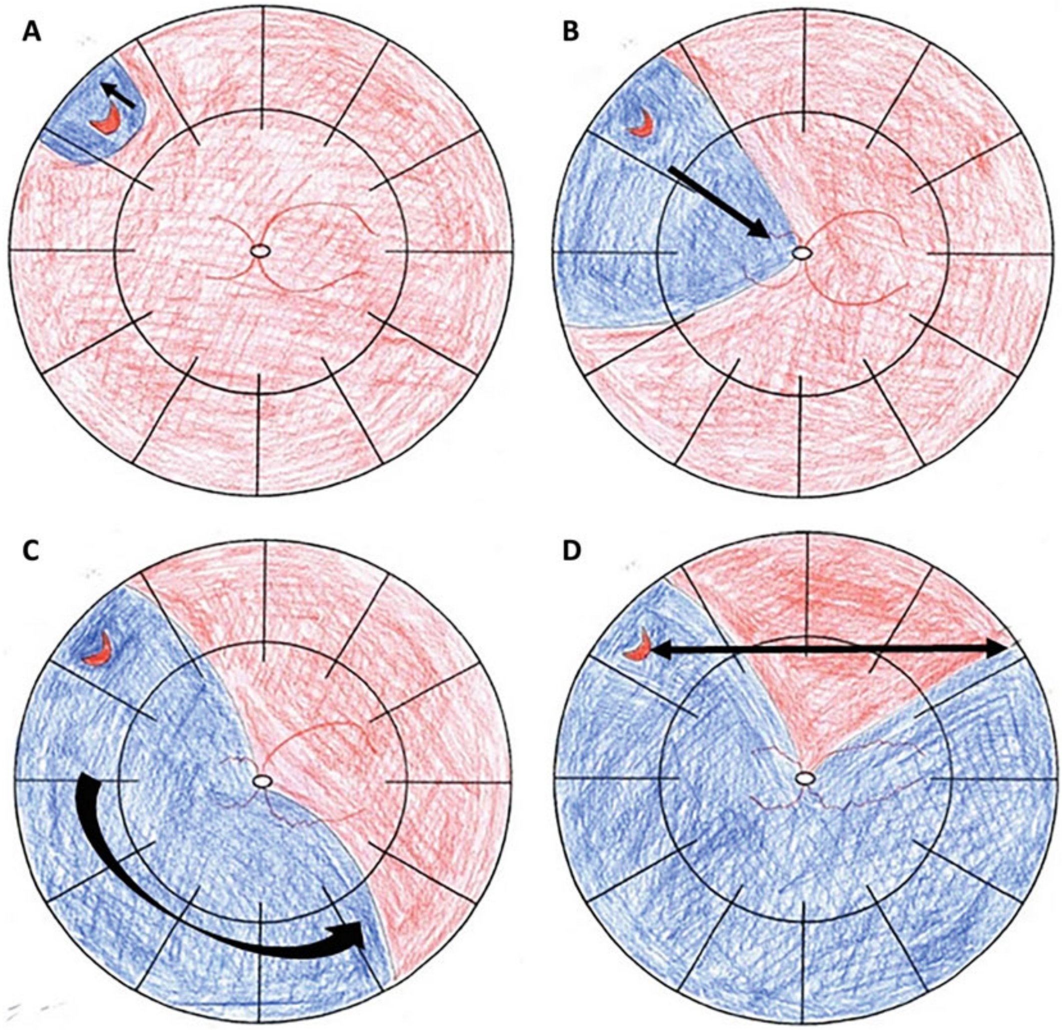

Fig. 2.1 Development of a retinal detachment. A horse shoe tear at 10:30. The detachment spreads first to the ora serrata **A**. Then the subretinal fluid moves towards the optic disc **B**. Then the retinal detachment continues towards the inferior pole **C**. Finally the detachment moves upwards until it reaches the height of the break on the other side **D**. It will not move further, a total retinal detachment is not possible with a hole at 10:30

Frequency of Lincoff 1-4 detachments [1]:
The frequency of the superior detachments is 80%.
The frequency of the inferior detachments is 20%.

We mention always the retinal rupture and the influx of fluid into the subretinal fluid. But we forget that the RPE pumps continuously subretinal fluid out of the eye (Fig 2.4). Why is this important? If the rupture is closed, then the subretinal fluid will be removed by the eye itself. Drainage is NOT necessary. In episcleral buckling surgery, for example, a buckle seals the hole but drainage is not required. The retina will be attached after 1–2 days.

2.2 Short Introduction to Surgical Methods

Retinal detachment surgery is divided into two main techniques: (1) Internal approach with gas injection and (2) External approach with episcleral buckling.

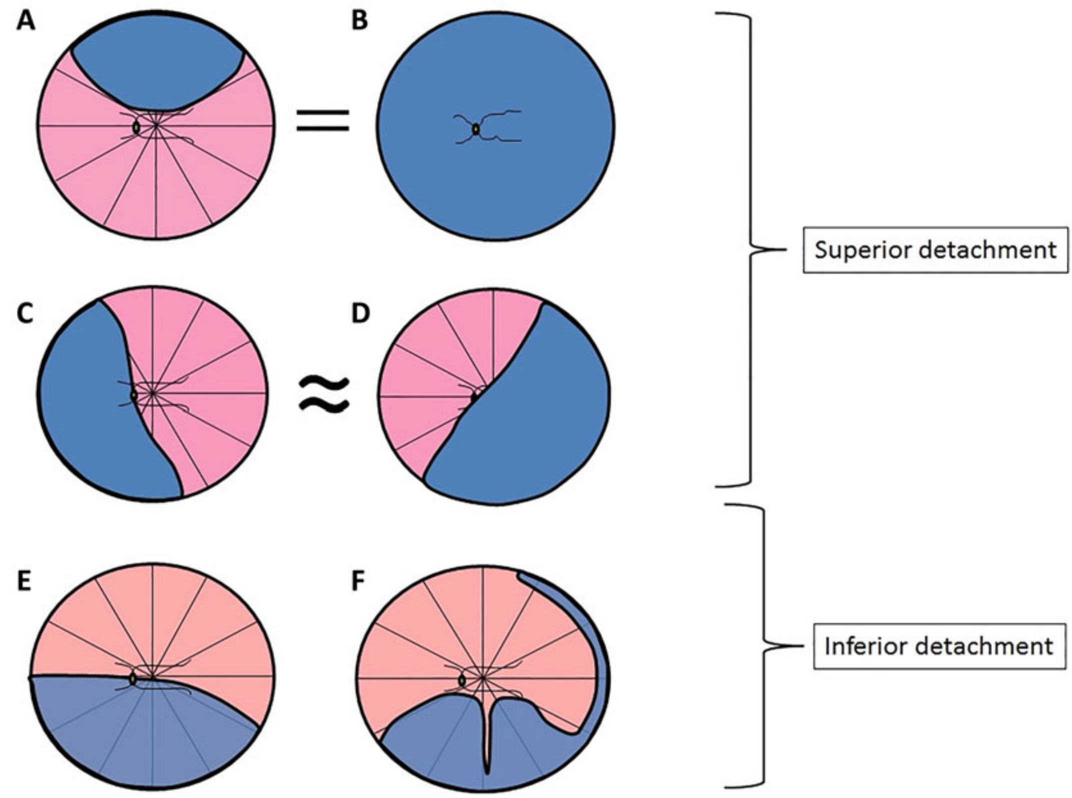

Fig. 2.2 Lincoff and Gieser found two types of superior detachments and two types of inferior detachments. The superior **A** or total detachment **B** is identical. The superonasal **C** detachment is equivalent to the superotemporal **D** detachment. Regarding the inferior detachments a shallow detachment **E** and a highly bullous detachment **F** can be identified

At the University of Stockholm we employ the following surgical methods:

(1) Pneumatic retinopexy
(2) Lenssparing vitrectomy with cryopexy and gas (Moorfield technique)
(3) Combined phaco + vitrectomy with chandelier light and PFCL (Frankfurt technique)
(4) Encircling band + vitrectomy + C_3F_8 (Stockholm technique)
(5) Bimanual peeling + 180–360° retinotomy for PVR detachment
(6) Minimal buckling surgery with chandelier light and microscope

We will give a short introduction to the aforementioned techniques:

(1) Pneumatic retinopexy is very popular in California and has recently experienced a renaissance in Canada. Macula on and off detachments with breaks from 8 o'clock over 12 o'clock to 4 o'clock can be treated with this technique. The retina is reattached with gas injection and one day later laser photocoagulation of the break is performed. The risk for a recurrent RD is increased but the final visual and anatomical outcome is high.

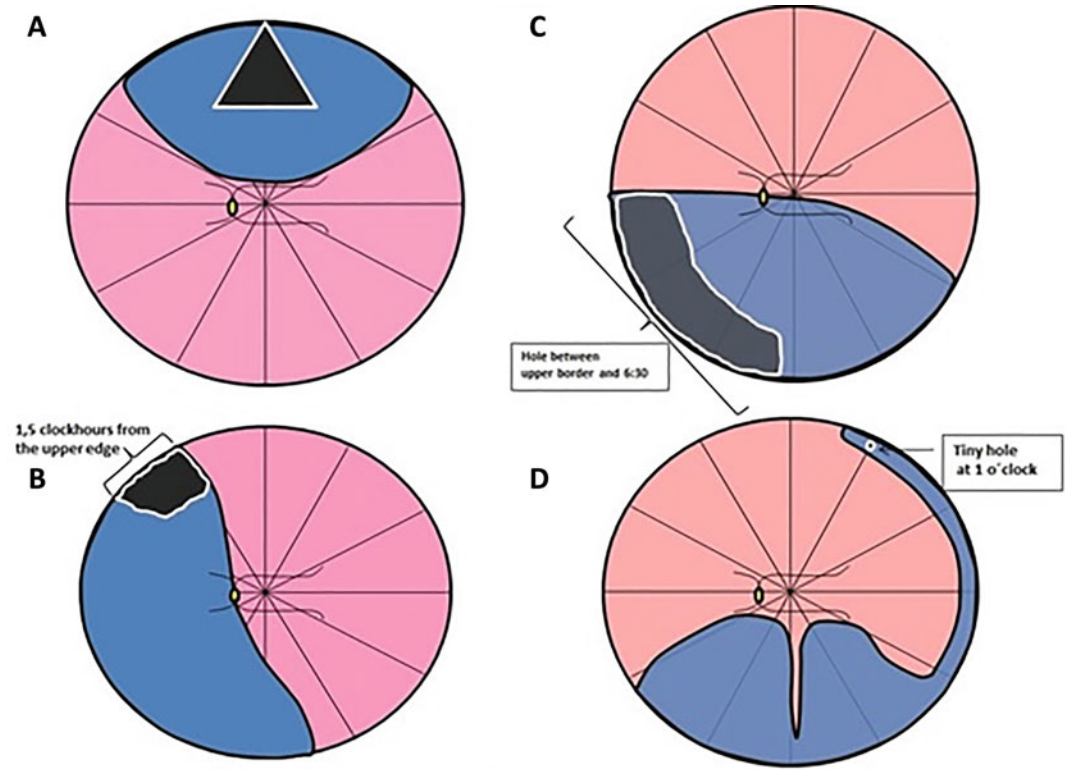

Fig. 2.3 **A: Superior or total detachment**. The primary break is located within a triangle where the apex is located at 12:00 and the sides at 10:30 and 1:30. **B: Superotemporal/superonasal detachment**. The primary break lies within 1 ½ clock hours of the highest border **C: Inferior shallow detachment**. The hole is located in an area between the upper edge of the retinal detachment and 6:30. **D: Inferior highly bullous detachment**. A small hole is located at 11:00 or 1:00

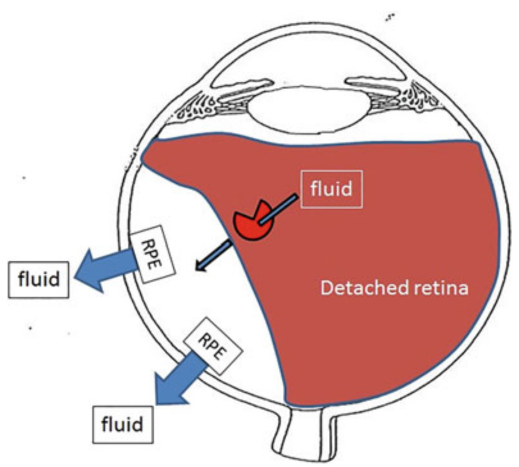

Fig. 2.4 Fluid flows through the rupture into the subretinal space. At the same time, the RPE pumps the subretinal fluid outside. A bullous detachment is attached after 1–2 days

(2) The Moorfield technique is the most common technique at Moorfield hospital, London. A lens sparing vitrectomy is performed, the retinal ruptures are treated with cryopexy and gas is injected. A vitreous base shaving is not performed. The surgical time is short and the required material is limited. This technique is used for all types of RD. Also, macula off techniques are operated with this technique.

(3) The combined phaco/vitrectomy is nowadays the gold standard technique for RD and was developed by Prof Eckardt in Frankfurt, Germany. In patients with an age over 50 years, phacoemulsification is performed and a chandelier light is inserted. A complete vitrectomy with vitreous base shaving is performed. The anterior vitreous

can be removed completely reducing the risk for a PVR redetachment.

(4) The Stockholm technique is the standard technique for all types of detachments at St Eriks hospital in Stockholm. This technique is especially advisable for myopic patients and inferior detachments. The surgery is usually performed without phacoemulsification. An encircling band is placed, and a central and peripheral vitrectomy is performed. The subretinal fluid is removed through a posterior retinotomy. The standard tamponade is C_3F_8.

(5) This method is employed for PVR detachments with intravitreal and retinal PVR. An encircling band is placed, a chandelier light is inserted and the membranes are removed with bimanual peeling. If necessary a 180–360° retinotomy is performed. This technique is surgically very demanding and requires several intravitreal instruments.

(6) Episcleral buckling is still required for RD surgery and is demonstrated in this book with an easier technique. Indirect binocular ophthalmoscopy is not required. For visualization of the fundus, a chandelier light is inserted and a microscope with a viewing system is employed. Cryopexy and suturing of the segmental buckle are done with the microscope.

2.3 Which Technique for Which Detachment

All superior retinal detachments with breaks from 8 over 12 to 4 o'clock including macula off can be operated with pneumatic retinopexy, Moorfield technique and phaco/vitrectomy.

An inferior detachment with breaks from 5 to 7 o'clock can be operated with episcleral buckling, Stockholm technique and Frankfurt technique with Densiron Xtra tamponade.

Ora dialysis and young myopes are excellent indications for episcleral buckling.

2.4 Assessment at the University of Stockholm

The choice of surgical technique for surgical management of retinal detachment differs from clinic to clinic and even from surgeon to surgeon. Here we present the choice of techniques we use at the University of Stockholm.

Attached retinal break versus detached retinal break.

An eye with a retinal detachment has always a detached tear and sometimes also attached tears. We recommend treating all attached breaks *with laser before* surgery. We recommend laser and not cryopexy because the healing time is faster and the PVR risk lower. In contrast, a detached break is treated *during* surgery. A detached break can only be treated with cryopexy. Treatment with laser is only possible after attachment of the tear with PFCL or gas.

Focal detachment: Pneumatic retinopexy technique.

A retinal break with detached edges is a focal detachment. A focal detachment requires treatment with gas or episcleral buckle to attach the break onto the retinal pigment epithelium and then laser photocoagulation or cryopexy of the retinal edges. A focal detachment cannot be treated with laser alone. Figure 2.5 shows an example where a focal detachment was treated with laser photocoagulation. A complete laser barrier was not performed. This focal detachment may spread later to a large detachment, especially when a posterior vitreous detachment (PVD) occurs. *Remember*: A focal detachment is only sufficiently treated when the edge of the break is attached. We treat these focal detachments with pneumatic retinopexy.

*Superotemporal, superonasal and superior detachments with **macula on**: Moorfield technique.*

Retinal detachments with attached macula are best operated with the Moorfields technique (Fig. 2.6A, B). We operate macula on

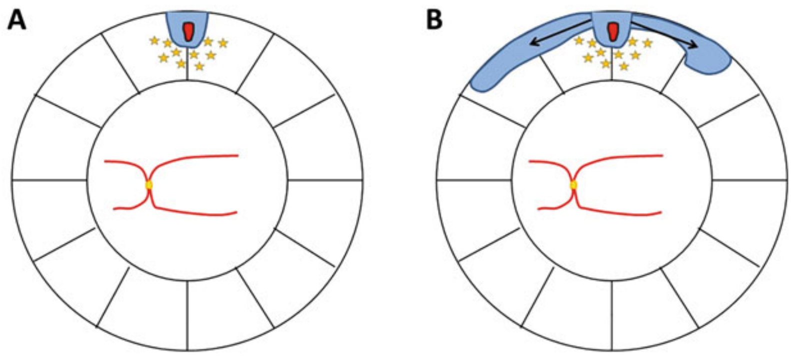

Fig. 2.5 **A**: An eye with a focal detachment at 12 o'clock. The focal detachment was treated with a partial laser barrier. The posterior part could not be treated due to the focal detachment. **B**: An eye with a focal detachment at 12 o'clock. This focal detachment may remain stable for several years but in the case of PVD, the focal detachment may spread to both sides

detachments with detached tears between 8 to 12 and 4 o'clock. We do not use this technique for detached breaks from 4 to 8 o'clock. We do not operate macula off RD´s with this technique because the postoperative posture is strict. Surgery is easy, fast and has low costs. A core and peripheral vitrectomy are performed; shaving is not necessary. The break is treated with cryopexy and then gas is injected.

Superotemporal, superonasal and superior detachments with ***macula off****: Phaco/vitrectomy (Frankfurt technique).*

The huge majority (80%) of retinal detachments are superior, superotemporal and superonasal. Usually, one detached retinal break is present (Figs. 2.7 and 2.8). If the macula is detached we choose the combined phaco/vitrectomy technique. Why? We want to attach the macula during surgery. Pneumatic retinopexy and Moorfield technique attach the macula after surgery with postoperative posture.

Myopic detachments, several break detachment: Stockholm technique.

Myopic detachments with lattice and several breaks are best operated with an encircling band, vitrectomy and gas tamponade. Usually, phacoemulsification is not performed, the subretinal fluid is removed from a posterior retinotomy and tamponade with C_3F_8 is chosen (Fig. 2.9).

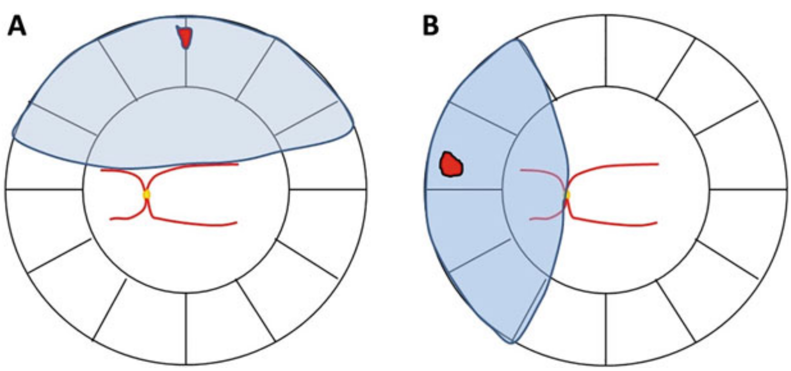

Fig. 2.6 **A**: A superior retinal detachment from 9:00 to 2:30 and one retinal break at 12 o'clock. Macula is attached. **B:** A nasal retinal detachment with the attached macula and one retinal break at 9 o'clock. Macula is attached