“Realizzazione e valutazione dei lembi corneali per DMEK: tecniche a confronto”

XIV CORSO NAZIONALE SIBO 2022

Donor Tissue Preparation for Descemet Membrane Endothelial Keratoplasty: An Updated Review

Rénuka S. Birbal, MD,†‡ Shameema Sikder, MD,§ Jessica T. Lie, PhD,*‡ Esther A. Groeneveld-van Beek, MSc,*‡ Silke Oellerich, PhD,* and Gerrit R. J. Melles, MD, PhD*†‡*

Purpose: To provide an overview of the current literature on donor tissue preparation for Descemet membrane endothelial keratoplasty (DMEK).

Methods: A comprehensive database search without date restrictions was performed in PubMed and in The Cochrane Library in May, 2017. Keywords included Descemet membrane endothelial keratoplasty, corneal transplantation, graft, harvest, dissection, preparation, endothelial cell, and endothelial cell density. Articles aiming to describe or evaluate a technique for DMEK graft preparation were considered eligible and were included in this review.

Results: A graft dissection technique that provides consistent tissue qualities and a low risk of preparation failure is essential for surgeons and eye banks preparing DMEK tissue. Various techniques have been described aiming to facilitate DMEK graft dissection, including manual dissection, pneumatic dissection, and hydrodissection. All show a trend toward a no-touch technique, for example, without direct physical tissue manipulation during tissue harvesting, as a potential ideal approach to minimize graft damage.

Conclusions: An overview of the current harvesting techniques available for DMEK may benefit corneal surgeons and eye banks in choosing the best approach for each specific user.

Key Words: Descemet membrane endothelial keratoplasty, DMEK, preparation, tissue harvesting, graft

(*Cornea* 2017;0:1–8)

In the past decade, endothelial keratoplasty (EK) has rapidly replaced penetrating keratoplasty for the management of corneal endothelial disorders.[1] Descemet membrane endothelial keratoplasty (DMEK), the latest refinement of EK, allowed for further evolution of the field by enabling selective replacement of bare Descemet membrane (DM) with its endothelial layer.[2] Providing near-perfect restoration of the corneal anatomy, DMEK yielded faster visual rehabilitation,[3–6] improved visual outcome,[3–5] and lowered graft rejection rates compared with earlier types of EK.[7–10]

Although DMEK is gaining widespread acceptance and numbers are showing a continued increase of DMEK procedures to 1522 in 2013, 2865 in 2014, and 4694 in 2015 in the United States alone,[11] the procedure is more challenging in preparing and handling the delicate donor graft.[12] Uptake of the procedure may be facilitated by proper training and choosing the most feasible harvesting technique that yields reproducible graft qualities. Because several techniques have been described for DMEK graft preparation, this review aims to provide an overview of the current literature regarding donor tissue dissecting techniques for DMEK and to provide corneal surgeons and eye banks with a useful reference for technique comparison and selection in a given setting.

MATERIALS AND METHODS

A comprehensive database search without date restrictions was performed in PubMed and The Cochrane Library in May 2017. Keywords included Descemet membrane endothelial keratoplasty, corneal transplantation, graft, harvest, dissection, preparation, endothelial cell, and endothelial cell density. Search results were limited to studies published in English, studies on human corneas, and full text available. The title and/or abstract of all records were screened for relevance. Articles aiming to describe or evaluate a technique for DMEK graft preparation were considered eligible and were included in this review, which resulted in inclusion of 50 articles on this topic.

RESULTS

Surgical Technique

Current and evolving techniques to procure donor tissue for DMEK show a trend toward a no-touch technique, in which there is no direct physical graft handling, as a potential ideal approach to minimize endothelial cell loss.[12] Harvesting techniques may broadly be classified into those based on manual peeling and those aiming to achieve detachment of DM by either injecting air or liquid between DM and the posterior stroma (ie, the pre-DM plane).

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From the *Netherlands Institute for Innovative Ocular Surgery, Rotterdam, the Netherlands; †Melles Cornea Clinic Rotterdam, the Netherlands; ‡Amnitrans Eye Bank Rotterdam, the Netherlands; and §Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, MD.
G. R. J. Melles is a consultant for DORC International/Dutch Ophthalmic USA and SurgiCube International. The remaining authors have no funding or conflicts of interest to disclose.
Reprints: Gerrit R. J. Melles, MD, PhD, Netherlands Institute for Innovative Ocular Surgery, Laan op Zuid 88, 3071 AA, Rotterdam, the Netherlands (e-mail: research@niios.com).

Descemet membrane air-bubble separation in donor corneas

Davide Venzano, MD, Paola Pagani, BBiotech Adv, Nadia Randazzo, BBiotech, Francesco Cabiddu, MD, Carlo Enrico Traverso, MD

We describe a technique to obtain Descemet–endothelium disks from donors. To detach Descemet membrane, an air bubble was introduced in the deep stroma of human donor corneas mounted on an artificial chamber. In Group A (n = 5), the bubble was left inflated. In Group B (n = 4), the bubble was deflated immediately after the membrane was detached. In Group C (n = 7), the Descemet–endothelium disk was trephined and separated from the stroma after the bubble was deflated. All tissues were stored at 4°C. Descemet detachment was achieved in 89% of the tissues. After 48 hours, the mean endothelial loss was 83% ± 10% (SD), 15% ± 11%, and 3% ± 3% in the 3 groups, respectively. With this technique, Descemet–endothelium disks were obtained without significant alterations in the endothelial layer.

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Online Video

In cases in which the corneal disease is limited to the endothelium, as in bullous keratopathy or Fuchs endothelial dystrophy, replacing only this layer avoids the disadvantages of a full-thickness graft. Penetrating keratoplasty has a long record of success, but clinical complications such as high and irregular astigmatism, complications related to sutures, and corneal anesthesia have been observed.[1,2]

Descemet-stripping endothelial keratoplasty (DSEK) has had a significant impact on the treatment of pseudophakic bullous keratopathy[3–5] and corneal edema due to endothelial dystrophy. Endothelial grafts seem to avoid the more severe complications of open-sky surgery without damaging the corneal surface, changing the preexisting astigmatism minimally.[6] Descemet membrane endothelial keratoplasty (DMEK), as described by Melles et al.,[7] may represent the next step in the evolution of DSEK. Harvesting endothelium and Descemet membrane is challenging, and the techniques of obtaining viable corneal endothelium from donors using a variety of instruments are evolving.

The use of compressed air introduced from the endothelial side of the donor cornea to separate Descemet membrane while maintaining stromal support with an anterior microkeratome cut to facilitate introduction and placement of the donor tissue in the anterior chamber of the recipient was suggested by Busin et al.[8] Our report describes the use of an artificial anterior chamber to apply the Anwar air-bubble technique to harvest Descemet membrane with minimal manipulation of the corneal endothelium to prevent substantial cell loss, allowing good cell viability for selective transplantation. This technique, introduced by Anwar to separate Descemet membrane from the stroma,[9] is widely used for deep anterior lamellar keratoplasty (DALK).[10]

SURGICAL TECHNIQUE

Eighteen human corneas not suitable for therapeutic transplantation were made available by the Melvin

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From Clinica Oculistica (Venzano, Traverso), Centro di Ricerca Clinica e Laboratorio per il Glaucoma e la Cornea, Di.N.O.G., Universita di Genova, Azienda Osperdaliera Universitaria San Martino; Fondazione Banca degli Occhi Melvin Jones (Pagani, Randazzo, Traverso); and U. O. Anatomia Patologica (Cabiddu), Azienda Opsedaliera Universitaria San Martino, Genova, Italy.

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Corresponding author: Carlo Enrico Traverso, MD, Centro di Ricerca Clinica e Laboratorio per il Glaucoma e la Cornea, Clinica Oculistica, Di.N.O.G., Universita di Genova, Viale Benedetto XV, 5 - 16132 Genova, Italy. E-mail: mc8620@mclink.it.

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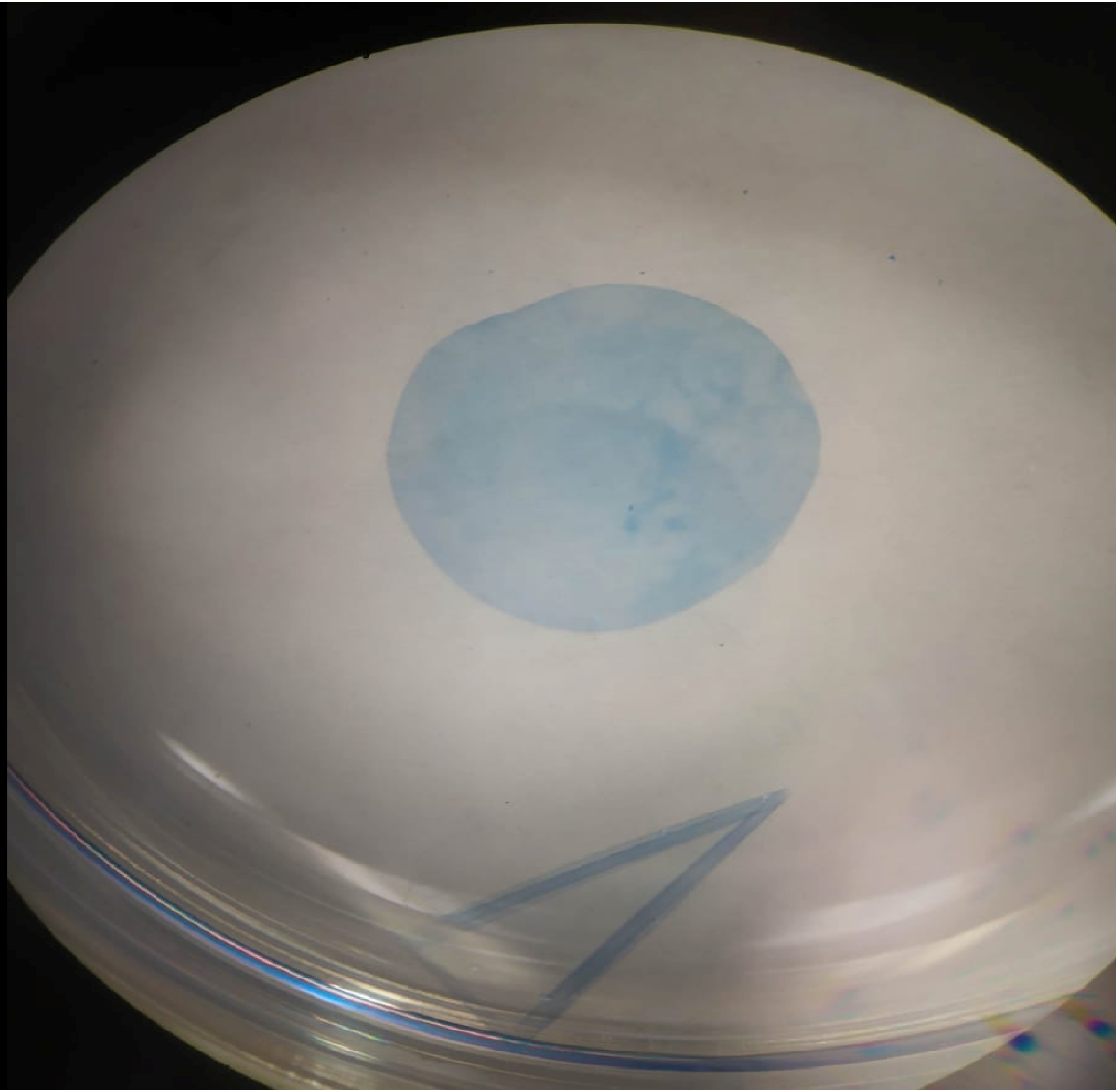

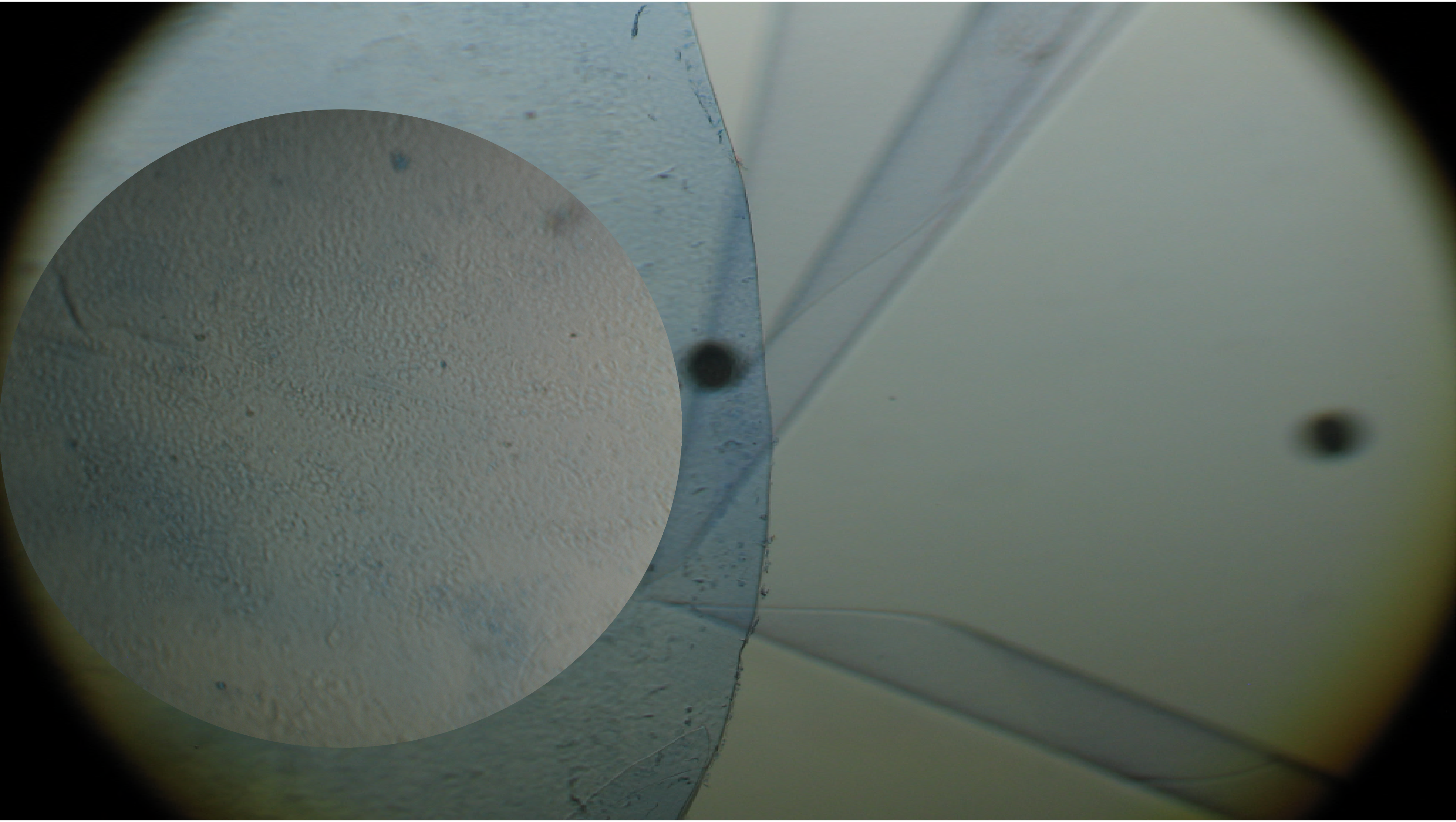

DMEK lenticule preparation from donor corneas using a novel 'SubHyS' technique followed by anterior corneal dissection

Gianni Salvalaio, Mohit Parekh, Alessandro Ruzza, Stefano Ferrari, Davide Camposampiero, Diego Ponzin

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjophthalmol-2013-304466).

International Center for Ocular Physiopathology (ICOP), The Veneto Eye Bank Foundation, Zelarino, Venice, Italy

Correspondence to
Diego Ponzin, The Veneto Eye Bank Foundation, Padiglione Rama, Via Paccagnella 11, Zelarino, Venice 30174, Italy; diego.ponzin@fbov.it

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ABSTRACT

Purpose To describe a novel submerged hydro-separation (SubHyS) technique followed by anterior corneal dissection to prepare a Descemet endothelial graft (DEG) for Descemet's membrane endothelial keratoplasty from human donor corneas.

Methods 30 human donor corneas were immersed in liquid (organ culture (OC) storage medium). Using a 25-gauge needle, approximately 0.3 mL of OC was injected (SubHyS) in the posterior stroma to create a liquid bubble. The bubbled cornea was mounted onto a modified artificial chamber with the epithelial side facing the air. The endothelium was protected with a viscoelastic solution. The anterior cornea was excised with a Barron radial vacuum trephine and the residual peripheral stroma was removed manually using micro-scissors. The DEG was dismounted and washed. The endothelial cell density (ECD) and mortality of the prepared DEG was determined. All the DEGs were preserved in deturgescent medium for 7 days using a cornea claw which was fixed to the sclera. ECD and mortality were checked post preservation.

Results Complete detachment of Descemet's membrane and stroma was achieved in all 30 cases. Bubble burst was observed in five cases (excluded from the study) due to overfilling of the liquid. The average diameter of the excised DEG was 10.96 mm. The average endothelial cell loss post preservation was 27.69%. Histological analysis confirmed elimination of the residual stroma (n=13).

Conclusions The DEGs can be preserved in a deturgescent medium for up to 7 days. The procedure provides a standardised, pre-validated (quality assured), pre-separated, no-touch, ready-to-use tissue and also reduces the preparation time. Further, the tissues can be trephined as per the surgeon's convenience and can either be rolled or a contact lens could be used for final delivery of the DEG using a surgical glide.

INTRODUCTION

Endothelial keratoplasty (EK) has become a popular form of corneal transplantation in patients with diseased endothelium. The most widely practiced form of EK is Descemet's stripping automated EK (DSAEK), which is used to transplant a layer of donor stroma in addition to Descemet's membrane (DM) and endothelium. DSAEK is a more standardised and optimised method which is the primary choice of EK for many surgeons due to its ease of harvest, tissue manipulation, transplantation and postoperative visual outcomes.

Descemet's membrane endothelial keratoplasty (DMEK) is a recent surgical technique which allows the replacement of a diseased endothelium with a healthy donor DM and endothelial layer. It does not involve a layer of stroma as DSAEK. This recent development is gaining popularity in terms of graft survival and early rehabilitation rate, as only the damaged layer is replaced while the rest of the cornea is left intact, unlike penetrating keratoplasty (PK). The tissue separation using the big bubble technique has been a gold standard primarily used for deep anterior lamellar keratoplasty (DALK), but has now been used to separate the Descemet endothelial graft (DEG) for DMEK.[1]

As DMEK decreases the unwanted damage to the corneal interface, it may also optimise and enhance the postoperative visual outcome.[2] DMEK may be advantageous with respect to complete visual rehabilitation, increase in graft survival rates, and more importantly, it can be less expensive with minimal surgical instruments required for the preparation.[3 4] Although various methods of mechanical dissection of the donor corneal tissue have been described,[1 5–11] DMEK is not considered as one of the best options because of the high surgical skills required for harvesting and transplanting the donor endothelium. It was found that such challenging transplantations can lead up to 16% of tissue wastage and endothelial cell loss of >8% just after donor tissue preparation.[5–7] Moreover, the handling of such a delicate tissue adds another challenge.[1 7 8] Therefore, there is still room for further refinements aimed at standardising the technique, which could be easier and more importantly validated.[12] Also, compared with PK, DMEK provides faster visual recovery with less astigmatism.[13] However, it has been found that the visual outcomes often do not meet the expected visual potential, with visual acuity often limited to 20/40.[7] However, pneumatic dissection and most peeled DMEK grafts do not have any adherent stroma which is an issue with air bubble prepared grafts.[1 14–16] It is important to understand whether the stromal residues are helping the attachment of the graft or the very thin residues are responsible for graft detachment. With all these issues, improvement in donor tissue preparation, validation and transplantation has become the next challenge for DMEK surgery.

Thus, as there are no reported methods of a pre-standardised/validated or ready-to-use tissue, we describe a method that could potentially be used for preparation of a DMEK tissue, and its effect in

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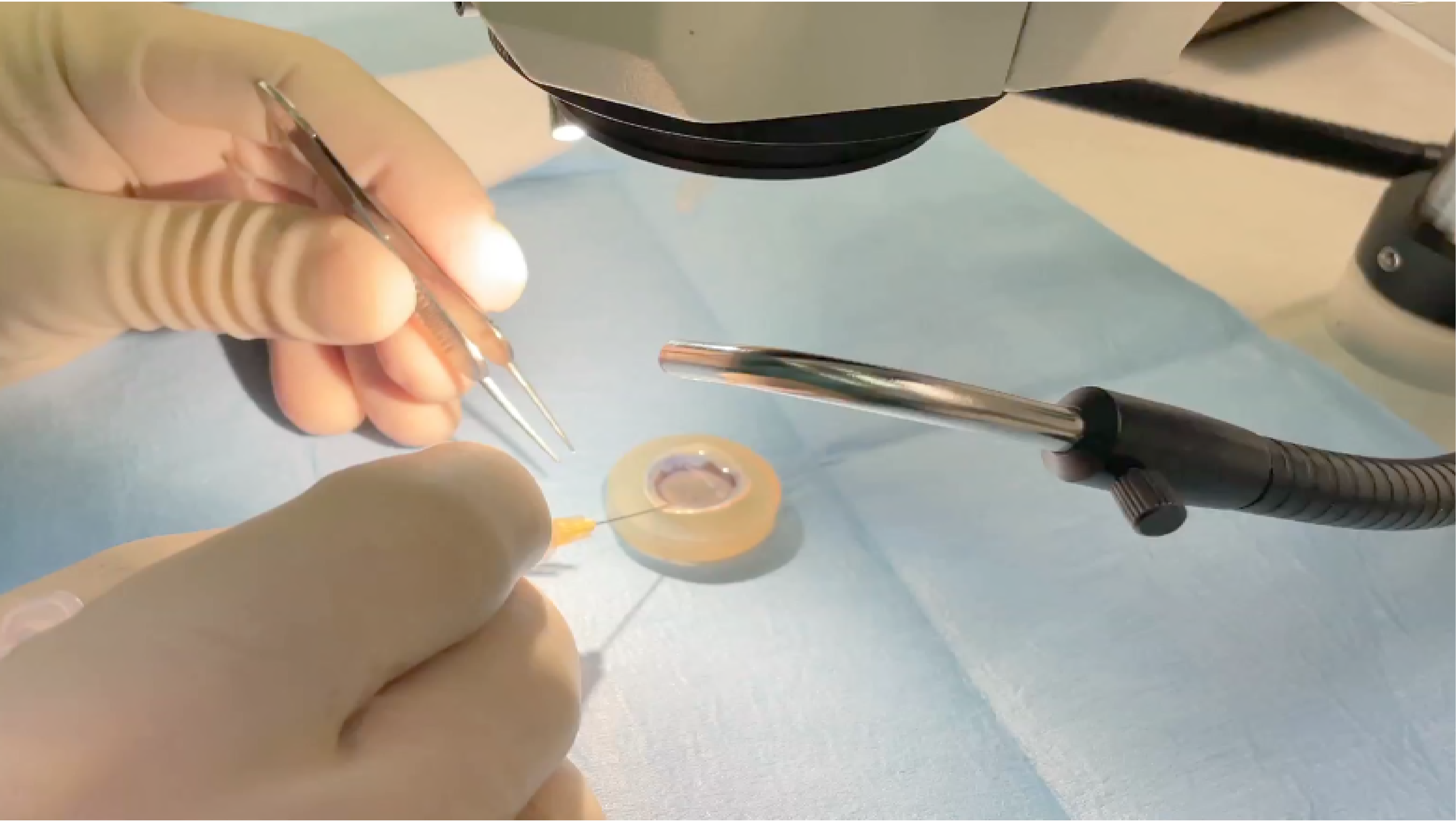

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CORNEA

Novel liquid bubble dissection technique for DMEK lenticule preparation

Peter Szurman [1,2] · Kai Januschowski [1,2] · Annekatrin Rickmann [1] · Lara-Jil Damm [1] · Karl Thomas Boden [1] · Natalia Opitz [1]

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Abstract

Purpose Descemet endothelial keratoplasty (DMEK) has replaced penetrating keratoplasty in many cases of endothelial cell disorders. While DMEK has been greatly improved by the introduction of no-touch injection cartridges, the tear-free preparation of the delicate Descemet's membrane (DM) remains a critical step. We present a novel liquid bubble dissection technique for DM preparation that could offer several advantages.

Methods After identification of the iris base, a sharp dissection until Schwalbe's line was performed. Then, a narrow tunnel was created with a blunt spatula using a tangential dissection technique. After the tunnel was created, the liquid bubble dissection was performed. The complete detachment process took only a few seconds after a successful preparation of the tunnel in the correct plane between the DM and corneal stroma.

Results Between February and September 2015, we consecutively performed 86 DMEK lenticule preparations using the liquid bubble technique. The preparation time until complete detachment was about 3 min (mean 194 ± 20 s). Ninety-two percent of preparations were completely uncomplicated; the total success rate was 99 %. One graft could not be used for transplantation because of a central tear. The graft failure rate was 1.16 %, similar to other authors.

Conclusions The presented novel liquid bubble technique is easy, can be learned and performed rapidly, is highly reproducible in a standardized fashion with minor tissue manipulation (no touch) and, with a low rate of graft preparation failure, necessitates no special equipment and allows for a simultaneous and selective staining of the stromal side of DM, thus avoiding direct contact.

Keywords DMEK · Descemet membrane endothelial keratoplasty · Preparation · Liquid bubble · Dissection · Lamellar keratoplasty

Introduction

Fuchs endothelial dystrophy and bullous keratopathy following intraocular surgery are common reasons for corneal decompensation. Descemet membrane endothelial keratoplasty (DMEK) was first described by Melles and colleagues [1] and has been established as an alternative to penetrating keratoplasty (PKP) in many cases of corneal endothelial cell disorders. Advantages of DMEK are rapid visual rehabilitation, better visual outcome, less postoperative astigmatism, low transplant rejection rates and uncomplicated postoperative management compared to penetrating keratoplasty [2, 3].

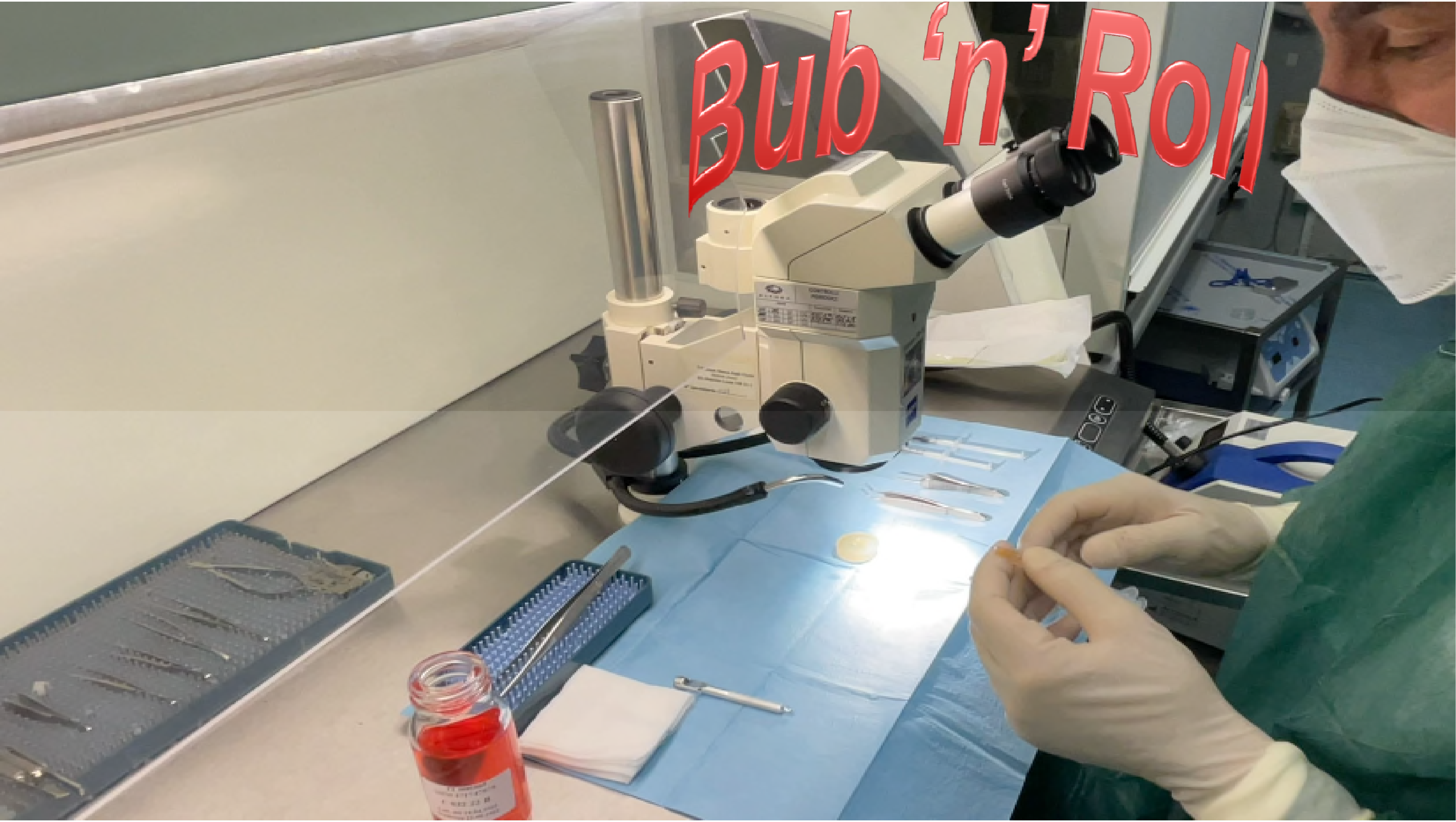
The disadvantages can be found in the nature of the procedure: Having to prepare and transplant a delicate 8–10-μm-thin membrane and the adjacent endothelial cell layer, transplant survival greatly depends on the skill of the surgeon while manipulating the tissue.

Therefore, a focus of recent investigations was put on Descemet's membrane (DM) dissection techniques [4–10]. Salvaio and colleagues reported about a novel 'SubHyS' technique for DMEK lenticule preparation [10]. It seems to be

✉ Peter Szurman
Peter.Szurman@kksaar.de

1 Knappschaft Eye Clinic Sulzbach, Knappschaft Hospital Saar, An der Klinik 10, 66280 Sulzbach/Saar, Germany

2 Centre for Ophthalmology, University Eye Clinic Tuebingen, Tuebingen, Germany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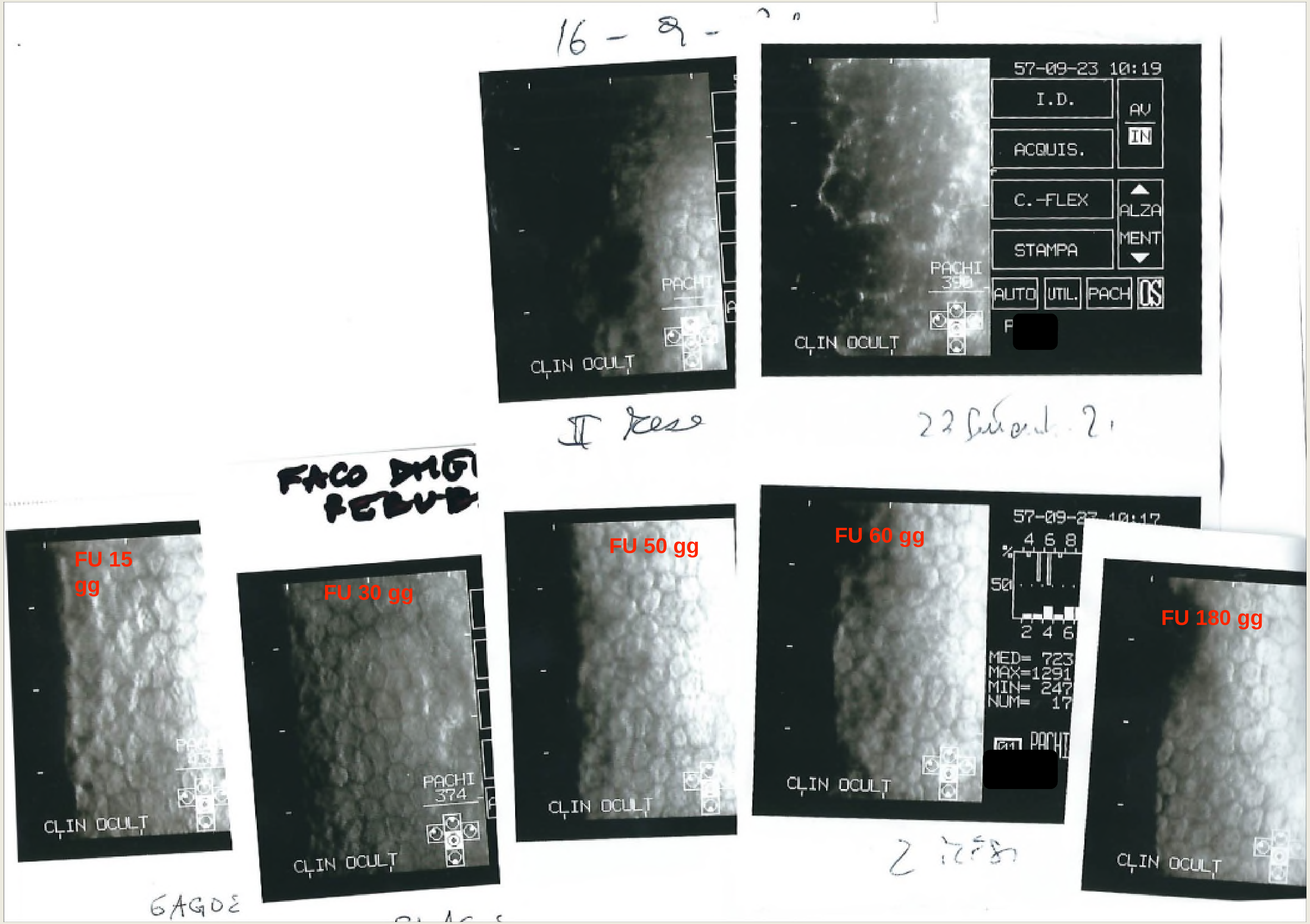
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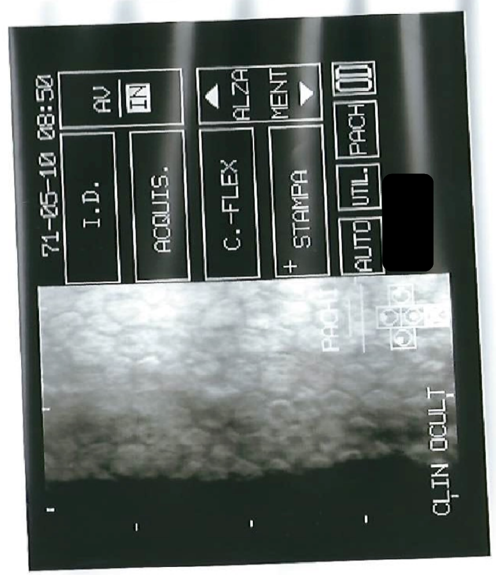

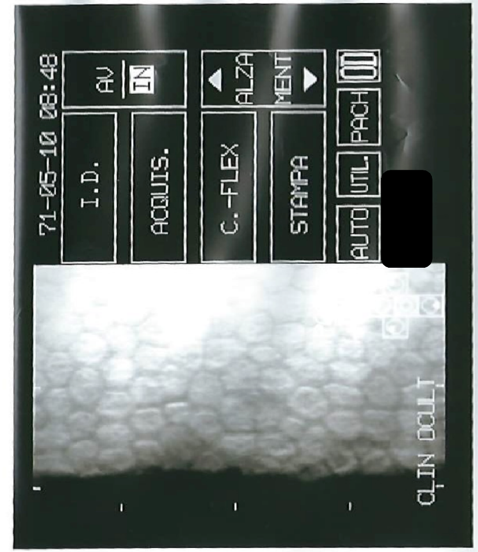

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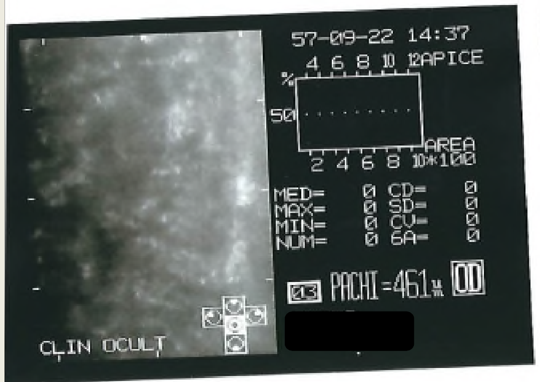

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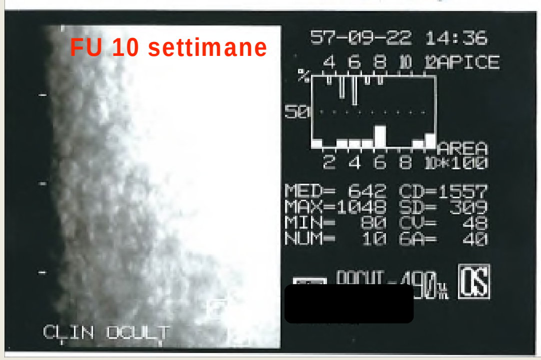

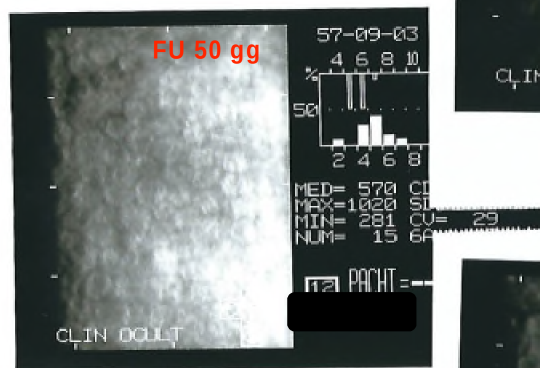

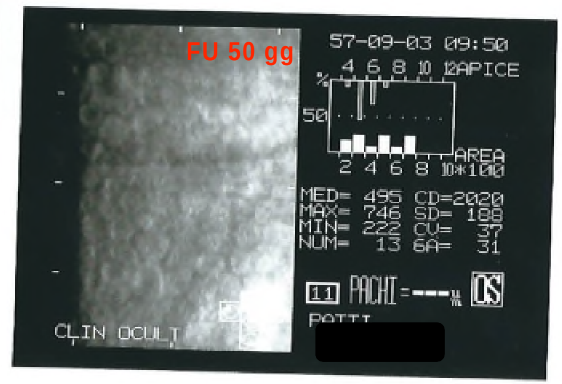

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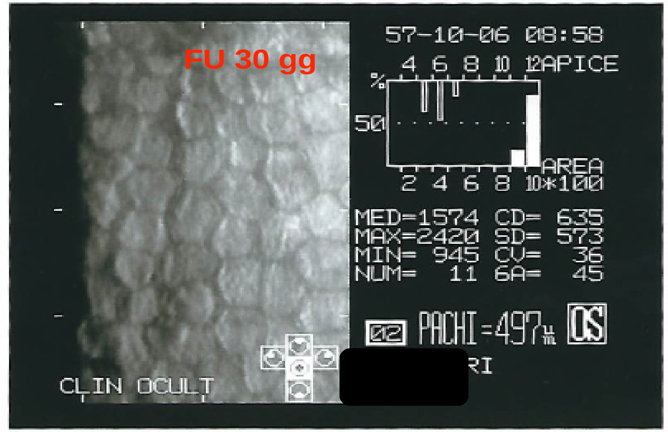

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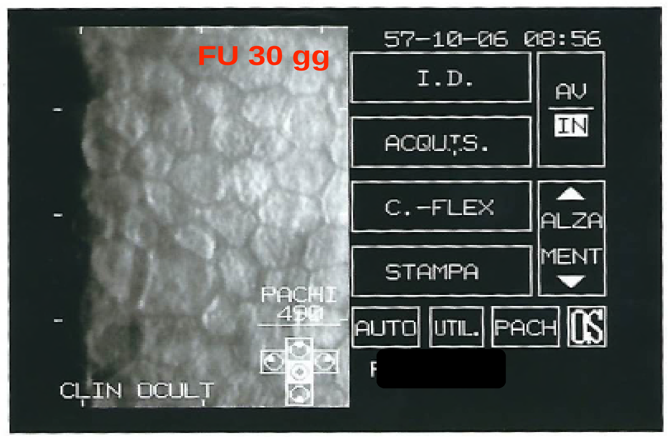

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