

Essentials in Ophthalmology  
Series Editor: Arun D. Singh

Jorge L. Alió  
Jorge L. Alió del Barrio *Editors*

# Modern Keratoplasty

Surgical Techniques and Indications

MOREMEDIA 

 Springer

---

# Contents

<b>1 Introduction: Current Status of Modern Corneal Transplantation—Success, Failures and Turning Points. . . . .</b>	<b>1</b>
Jorge L. Alió, Dominika Wróbel-Dudzińska, and Tomasz Żarnowski	

## Part I Preparing the Patient

<b>2 Modern Eye Banking: Preservation, Type of Tissues, and Selection . . . . .</b>	<b>17</b>
Loïc Hamon, Loay Daas, Adrien Quintin, Tarek Safi, Isabel Weinstein, and Berthold Seitz	
<b>3 Risk Classification and Management of Corneal Grafts, Human Leukocyte Antigen Matching, and Options for Immunosuppression Therapy . . . . .</b>	<b>41</b>
Paula W. Feng and Guillermo Amescua	
<b>4 Management of the Vascularized Cornea Before Corneal Graft Surgery: Fine-Needle Diathermy and Inhibition of VEGF . . . . .</b>	<b>59</b>
Nadim S. Azar, Matias Soifer, and Victor L. Perez	

## Part II Penetrating Keratoplasty

<b>5 Main Issues to Overcome in Modern Penetrating Keratoplasty . . . . .</b>	<b>71</b>
Farideh Doroodgar, Sana Niazi, Hassan Hashemi, and Mohammad Ali Javadi	
<b>6 Improvements in Surgical Techniques and Suturing in Penetrating Keratoplasty . . . . .</b>	<b>103</b>
Abdo Karim Tourkmani and Colm McAlinden	
<b>7 Closing the Wound: Can Sutures Be Avoided? . . . . .</b>	<b>117</b>
Luca Menabuoni, Alessandra Balestrazzi, Luca Buzzonetti, Romina Fasciani, Claudio Macaluso, Luigi Mosca, Roberto Pini, Giada Magni, Paolo Matteini, Fulvio Ratto, Michele Rossi, and Francesca Rossi	

- 8 Femtosecond-Assisted Penetrating Keratoplasty and Deep Anterior Lamellar Keratoplasty** ..... 127  
Alfredo Vega-Estrada and Jorge L. Alió
- 9 Femtosecond Laser-Assisted Tuck-In Penetrating Keratoplasty** ..... 139  
Jorge L. Alió del Barrio, Olena Al-Shymali, and Jorge L. Alió
- 10 Rescuing Failed Penetrating Keratoplasty Grafts** ..... 145  
Jorge L. Alió del Barrio, Scott Robbie, Marcus Ang, Andrea Montesel, and Jorge L. Alió
- 11 Excimer Laser-Assisted Keratoplasty: Penetrating Keratoplasty “Excimer-PKP” and Deep Anterior Lamellar Keratoplasty “Excimer-DALK”** ..... 159  
Loay Daas, Loïc Hamon, Elias Flockerzi, Shady Suffo, and Berthold Seitz

### Part III Epithelial Lamellar Keratoplasty

- 12 Keratolimbal Grafts: Outcomes, Innovations and Alternatives.** ..... 169  
Rafael I. Barraquer and Juan Alvarez de Toledo
- 13 Simple Limbal Epithelial Transplantation** ..... 191  
Anahita Kate and Sayan Basu
- 14 Cultivated Limbal Epithelial Transplantation (CLET).** ..... 203  
Paolo Rama
- 15 Mesenchymal Stem Cells for Regeneration of the Ocular Surface** ..... 211  
Marina López-Paniagua, Sara Galindo, Margarita Calonge, Inmaculada Pérez, José M. Herreras, Ana de la Mata, and Teresa Nieto-Miguel
- 16 Induced Pluripotent Stem Cells in Epithelial Lamellar Keratoplasty** ..... 225  
Sanja Bojic, Francisco Figueiredo, and Majlinda Lako

### Part IV Stromal Lamellar Keratoplasty

- 17 Bowman Layer Transplantation** ..... 245  
Achraf Laouani, Lydia van der Star, Silke Oellerich, Korine van Dijk, Gerrit R. J. Melles, and Viridiana Kocaba
- 18 Anterior Lamellar Keratoplasty: Current State of the Art** .... 257  
Enrica Sarnicola, Caterina Sarnicola, and Vincenzo Sarnicola
- 19 Stromal Lenticule Addition Keratoplasty (SLAK)** ..... 283  
Leonardo Mastropasqua, Niccolò Salgari, Manuela Lanzini, and Mario Nubile

<b>20 Lamellar Surgeries with SMILE Lenticules</b> . . . . .	297
Sri Ganesh and Sheetal Brar	
<b>21 Corneal Allogenic Intrastromal Ring Segments (CAIRS)</b> . . . . .	311
D. Sravani and Soosan Jacob	
<b>22 Advanced DALK Techniques: Mushroom Mini Big Bubble DALK</b> . . . . .	319
Kunal A. Gadhvi and Bruce D. Allan	
<b>23 Large Diameter Deep Anterior Lamellar Keratoplasty</b> . . . . .	331
Angeli Christy Yu and Massimo Busin	
<b>24 Regenerative Surgery of the Corneal Stroma for Advanced Keratoconus</b> . . . . .	341
Mona El Zarif, Jorge L. Alió del Barrio, and Jorge L. Alió	

## **Part V Endothelial Keratoplasty**

<b>25 Endothelial Keratoplasty. Historical Review and Current Outcomes</b> . . . . .	365
Farideh Doroodgar, Hassan Hashemi, Sana Niazi, Sepehr Feizi, and Mohammad Ali Javadi	
<b>26 Endothelial Keratoplasty: Current State of the Art</b> . . . . .	381
Anjulie Gang, Francis W. Price, and Marianne O. Price	
<b>27 Corneal Endothelial Cell Transfer</b> . . . . .	395
Shigeru Kinoshita, Morio Ueno, and Chie Sotozono	
<b>28 Ultrathin DSAEK</b> . . . . .	407
Angeli Christy Yu and Massimo Busin	
<b>29 Innovations in Descemet Membrane Endothelial Keratoplasty (DMEK)</b> . . . . .	415
Darren S. J. Ting and Marcus Ang	
<b>30 Descemet Stripping Only (DSO)</b> . . . . .	431
Maryam Eslami and Greg Moloney	
<b>31 Pre-Descemets Endothelial Keratoplasty (PDEK): Science and Surgery</b> . . . . .	437
Harminder Singh Dua	
<b>32 Pre-Descemet's Endothelial Keratoplasty (Pdek): Clinical Considerations and Surgical Details</b> . . . . .	451
Priya Narang and Amar Agarwal	
<b>33 Descemet Membrane Transplantation</b> . . . . .	461
Hon Shing Ong and Jodhbir S. Mehta	
<b>34 Femtosecond Laser-Assisted Deep Lamellar Endothelial Keratoplasty</b> . . . . .	471
Jorge L. Alió del Barrio, Verónica Vargas, and Bruce D. Allan	

---

**35 Femtosecond Descemet Membrane Endothelial Keratoplasty** ..... 479  
Nir Sorkin, David S. Rootman, and Michael Mimouni

**36 Cultured Cells for Corneal Endothelial Therapy**..... 485  
M. P. De Miguel, M. Cadenas Martín, A. Moratilla,  
and F. Arnalich-Montiel

**37 What Is New in Keratoprotheses** ..... 499  
Saif Bani Oraba and Christopher Liu

**38 Intraoperative OCT in Anterior Segment Surgery** ..... 513  
Francis W. Price Jr, Anjulie Gang, and Marianne O. Price

**39 Epilogue: Corneal Graft Surgery, a Glance to the Future** ..... 519  
Jorge L. Alió and Jorge L. Alió del Barrio

**Index**..... 521





# Mesenchymal Stem Cells for Regeneration of the Ocular Surface

Marina López-Paniagua, Sara Galindo,  
Margarita Calonge, Inmaculada Pérez,  
José M. Herreras, Ana de la Mata,  
and Teresa Nieto-Miguel

---

Marina López-Paniagua, Sara Galindo, Ana de la Mata  
and Teresa Nieto-Miguel contributed equally.

---

M. López-Paniagua · S. Galindo · M. Calonge  
A. de la Mata  
IOBA (Institute of Applied Ophthalmobiology),  
University of Valladolid, Valladolid, Spain

CIBER-BBN (Biomedical Research Networking  
Center in Bioengineering, Biomaterials and  
Nanomedicine), Carlos III National Institute of  
Health, Madrid, Spain

Castile and Leon Networking Center for Regenerative  
Medicine and Cell Therapy, Valladolid, Spain  
e-mail: [marina@ioba.med.uva.es](mailto:marina@ioba.med.uva.es); [sgalindor@ioba.med.uva.es](mailto:sgalindor@ioba.med.uva.es); [calonge@ioba.med.uva.es](mailto:calonge@ioba.med.uva.es);  
[adelamatas@ioba.med.uva.es](mailto:adelamatas@ioba.med.uva.es)

I. Pérez  
IOBA (Institute of Applied Ophthalmobiology),  
University of Valladolid, Valladolid, Spain

Castile and Leon Networking Center for Regenerative  
Medicine and Cell Therapy, Valladolid, Spain

Department of Nursing, Faculty of Nursing,  
University of Valladolid, Valladolid, Spain  
e-mail: [maku@ioba.med.uva.es](mailto:maku@ioba.med.uva.es)

J. M. Herreras  
IOBA (Institute of Applied Ophthalmobiology),  
University of Valladolid, Valladolid, Spain

CIBER-BBN (Biomedical Research Networking  
Center in Bioengineering, Biomaterials and  
Nanomedicine), Carlos III National Institute of  
Health, Madrid, Spain

Castile and Leon Networking Center for Regenerative  
Medicine and Cell Therapy, Valladolid, Spain

University Clinic Hospital, Valladolid, Spain  
e-mail: [herreras@ioba.med.uva.es](mailto:herreras@ioba.med.uva.es)

T. Nieto-Miguel (✉)  
IOBA (Institute of Applied Ophthalmobiology),  
University of Valladolid, Valladolid, Spain

CIBER-BBN (Biomedical Research Networking  
Center in Bioengineering, Biomaterials and  
Nanomedicine), Carlos III National Institute of  
Health, Madrid, Spain

Castile and Leon Networking Center for Regenerative  
Medicine and Cell Therapy, Valladolid, Spain

Department of Cell Biology, Genetics, Histology and  
Pharmacology, University of Valladolid, Valladolid,  
Spain  
e-mail: [tnietom@ioba.med.uva.es](mailto:tnietom@ioba.med.uva.es)