

(PK). To each of the selected articles, a methodologist assigned ratings of level of evidence, ranging from level I (well-designed and well-conducted randomized clinical trials) to level III (case series, case reports, and poor-quality case-control or cohort studies). Eleven comparative studies were included, showing results from level II and level III studies.

In the conclusions section, Reinhart et al<sup>1</sup> mentioned our Dutch Lamellar Corneal Transplantation Study, which in our opinion is the only level I study comparing DALK with PK. Since the results of this study are published after the cut-off point for inclusion in the report of Reinhart et al,<sup>2</sup> we would like to take the opportunity to highlight our findings. Our outcomes are in line with the results found in the review of Reinhart et al.<sup>1</sup> At 5 medical centers in the Netherlands, 56 patients with a corneal stromal pathology not affecting the endothelium were randomly assigned to DALK according to Anwar's big-bubble technique or PK treatment. Endothelial cell loss, refractive and topographic astigmatism, spherical equivalent, uncorrected visual acuity, and best spectacle-corrected visual acuity (BSCVA) were measured preoperatively and 3, 6, and 12 months postoperatively. Furthermore, complications were recorded. It was shown that perforation of Descemet's membrane occurred in 32% of the DALK patients, and 18% of the patients required conversion to a PK. At 12 months, endothelial cell loss was significantly higher after PK compared with DALK procedures performed without perforation of Descemet's membrane ( $27.7\% \pm 11.1\%$  vs.  $12.9\% \pm 17.6\%$ ). At 3 and 6 months after surgery, the BSCVA was significantly better in the PK group. However, at 12 months a BSCVA of  $0.39 \pm 0.3$  logMAR and  $0.31 \pm 0.3$  logMAR was observed in the DALK and PK group, respectively, which was not significantly different. Refractive and topographic astigmatism were also not significantly different in the DALK group as compared with the PK group.

In addition, we presented the cost-effectiveness of DALK versus PK.<sup>3</sup> Effectiveness was expressed as vision-related quality of life (measured by the 25-item National Eye Institute Visual Functioning Questionnaire) and the amount of endothelial cell loss. It was shown that DALK was more costly but also more effective as compared with PK. The DALK procedures performed without perforation of the Descemet's membrane were even more effective.

In conclusion, we believe that DALK could be an alternative to PK, but further surgical improvements to reduce the perforation rate are needed to improve the effectiveness and cost-effectiveness of DALK.

FRANK J.H.M. VAN DEN BIGGELAAR, PhD  
YANNY Y.Y. CHENG, MD  
RUDY M.M.A. NUIJTS, MD, PhD  
Maastricht, The Netherlands

## References

1. Reinhart WJ, Musch DC, Jacobs DS, et al. Deep anterior lamellar keratoplasty as an alternative to penetrating keratoplasty: a report by the American Academy of Ophthalmology. *Ophthalmology* 2011;118:209–18.

2. Cheng YY, Visser N, Schouten JS, et al. Endothelial cell loss and visual outcome of deep anterior lamellar keratoplasty versus penetrating keratoplasty: a randomized multicenter clinical trial. *Ophthalmology* 2011;118:302–9.
3. van den Biggelaar FJ, Cheng YY, Nuijts RM, et al. Economic evaluation of deep anterior lamellar keratoplasty versus penetrating keratoplasty in the Netherlands. *Am J Ophthalmol* 2011;151:449–59.

Dear Editor:

We read with interest the recent Ophthalmic Technology Assessment (OTA) published in *Ophthalmology*, "Deep Anterior Lamellar Keratoplasty as an Alternative to Penetrating Keratoplasty."<sup>1</sup> Although we found this to be an excellent summary of the comparative outcomes of penetrating keratoplasty (PK) and deep anterior lamellar keratoplasty (DALK), there were a few points not mentioned that we felt are also pertinent when comparing these 2 procedures.

First, apart from optical and tectonic indications as stated in the OTA, DALK is a useful alternative for severe infections that are nonresponsive to medical therapy before perforation. When DALK for therapeutic indications was compared with PK in terms of graft survival and disease recurrence in our center, we found there was a higher rate of eradication of infection with surgical techniques where total stromal removal was achieved as compared with non-Descemet's baring procedures.<sup>2</sup> However, the other advantage of DALK for this indication was the reduced incidence of subsequent graft rejection and secondary endophthalmitis requiring eventual evisceration as compared with PK.<sup>2</sup>

Second, in the current economic climate with spiraling health costs, health service research becomes an important consideration especially in the comparison of 2 different surgical procedures. Cost-effectiveness analyses are useful measures to estimate the ratio between the cost of a surgical intervention and the benefit it produces in terms of the improvement in clinical outcomes or quality of life. Two studies have suggested that DALK is more cost-effective compared with PK. Interestingly, both studies found DALK to be the most expensive procedure compared with PK mainly due to longer operative times.<sup>3,4</sup> However, both studies found DALK to be more cost effective when assessing either the incremental cost-effectiveness with respect to the National Eye Institute Visual Functioning Questionnaire and per patient maximal endothelial cell loss of 20%;<sup>4</sup> or the incremental cost-utility ratio with respect to visual acuity, complications and long-term graft survival.<sup>3</sup> Both studies showed sensitivity analysis indicating the robustness of their findings. The interesting point of both these economic evaluations was that they were from 2 different healthcare systems, one in Europe and one in Asia but the conclusions were the same. This only strengthens the case in favor of performing DALK over PK when possible.

MARCUS ANG, MBBS, MMED  
JODHBIR S. MEHTA, FRCSED  
Singapore

**References**

1. Reinhart WJ, Musch DC, Jacobs DS, et al. Deep anterior lamellar keratoplasty as an alternative to penetrating keratoplasty a report by the American Academy of Ophthalmology. *Ophthalmology* 2011;118:209–18.
2. Anshu A, Parthasarathy A, Mehta JS, et al. Outcomes of therapeutic deep lamellar keratoplasty and penetrating keratoplasty for advanced infectious keratitis: a comparative study. *Ophthalmology* 2009;116:615–23.
3. Koo TS, Finkelstein E, Tan D, Mehta JS. Incremental cost-utility analysis of deep anterior lamellar keratoplasty compared with penetrating keratoplasty for the treatment of keratoconus. *Am J Ophthalmol* 2011;152:40–7.
4. van den Biggelaar FJ, Cheng YY, Nuijts RM, et al. Economic evaluation of deep anterior lamellar keratoplasty versus penetrating keratoplasty in the Netherlands. *Am J Ophthalmol* 2011;151:449–59.

**Author reply**

Dear Editor:

We thank Marcus Ang, Jodhbir S. Mehta, Frank J.H.M. van den Biggelaar, Yanny Y.Y. Cheng, and Rudy M.M.A. Nuijts for their generous comments and additional observations. The 9 pages of our manuscript, as well as the 35 pages of the supplemental online appendix (both published in *Ophthalmology*) were extensively revised and shortened. Specifically, 2 of the deleted sections addressed applications of deep anterior lamellar keratoplasty (DALK) that Ang and Mehta identify. These applications were deemed to be somewhat peripheral to the objectives of the ophthalmic technology assessment, but are reprinted here.

“Therapeutic indications, or the removal of infected corneal tissue when medical therapy alone has failed to stabilize the eye, have also been managed with DALK. This includes treatment of *Acanthamoeba* keratitis,<sup>1</sup> *Acanthamoeba* keratitis treated with phototherapeutic keratectomy and deep lamellar keratoplasty,<sup>2</sup> bilateral mycobacterial keratitis complicating LASIK surgery,<sup>3</sup> microsporidial keratitis,<sup>4</sup> and advanced infectious keratitis of various causes<sup>5</sup> treated with therapeutic DALK and therapeutic penetrating keratoplasty.

Also not addressed in this review is the use of DALK in conjunction with procedures to restore corneal epithelial stem cell populations addressed by Yao et al<sup>6</sup> for late stage management of severe chemical or thermal burns and Singh and Singh Bhinder<sup>7</sup> using conjunctival and/or amniotic membrane transplants.”

We thank Ang and Mehta for the opportunity to revisit those issues.

The Dutch Lamellar Corneal Transplantation Study results were not available to us at the time of submission of our manuscript, nor were the cost-effectiveness papers of van den Biggelaar et al<sup>8</sup> and Koo et al.<sup>9</sup> All 3 papers are important additions to the DALK literature and we would encourage all surgeons performing keratoplasty to consider the conclusions of their studies.

WILLIAM J. REINHART, MD  
Cleveland, Ohio

DAVID C. MUSCH, PhD, MPH  
RONI M. SHTEIN, MD  
Ann Arbor, Michigan

DEBORAH S. JACOBS, MD  
Needham, Massachusetts

W. BARRY LEE, MD  
Atlanta, Georgia

STEPHEN C. KAUFMAN, MD, PhD  
Minneapolis, Minnesota

**References**

1. Parthasarathy A, Tan DT. Deep lamellar keratoplasty for acanthamoeba keratitis. *Cornea* 2007;26:1021–3.
2. Taenaka N, Fukuda M, Hibino T, et al. Surgical therapies for Acanthamoeba keratitis by phototherapeutic keratectomy and deep lamellar keratoplasty. *Cornea* 2007;26:876–9.
3. Susiyanti M, Mehta JS, Tan DT. Bilateral deep anterior lamellar keratoplasty for the management of bilateral post-LASIK mycobacterial keratitis. *J Cataract Refract Surg* 2007;33:1641–3.
4. Ang M, Mehta JS, Mantoo S, Tan D. Deep anterior lamellar keratoplasty to treat microsporidial stromal keratitis. *Cornea* 2009;28:832–5.
5. Anshu A, Parthasarathy A, Mehta JS, et al. Outcomes of therapeutic deep lamellar keratoplasty and penetrating keratoplasty for advanced infectious keratitis: a comparative study. *Ophthalmology* 2009;116:615–23.
6. Yao YF, Zhang B, Zhou P, Jiang JK. Autologous limbal grafting combined with deep lamellar keratoplasty in unilateral eye with severe chemical or thermal burn at late stage. *Ophthalmology* 2002;109:2011–7.
7. Singh G, Singh Bhinder H. Evaluation of therapeutic deep anterior lamellar keratoplasty in acute ocular chemical burns. *Eur J Ophthalmol* 2008;18:517–28.
8. van den Biggelaar FJ, Cheng YY, Nuijts RM, et al. Economic evaluation of deep anterior lamellar keratoplasty versus penetrating keratoplasty in The Netherlands. *Am J Ophthalmol* 2011;151:449–59.
9. Koo TS, Finkelstein E, Tan D, Mehta JS. Incremental cost-utility analysis of deep anterior lamellar keratoplasty compared with penetrating keratoplasty for the treatment of keratoconus. *Am J Ophthalmol* 2011;152:40–7.

**Conjunctival Melanoma**

Dear Editor:

Shields et al<sup>1</sup> reported their extensive and valuable clinical observations in 382 consecutive patients with conjunctival melanoma. The authors provide a detailed and very useful overview of the clinical risk factors associated with orbital invasion, metastasis, and death in a significantly large series of patients with conjunctival melanoma. We wonder if the authors have information about histologic tumor thickness (depth of invasion), histologic ulceration, and other histologic features that have been reported to correlate with clinical outcomes for conjunctival melanoma,