Original Article

Preparation of endothelial keratoplasty lenticules with Gebauer SLc Original versus Moria CBm Carriazo-Barraquer and Moria One-Use Plus microkeratomes

Mozhgan Rezaei Kanavi, Tahereh Chamani[1], Bahareh Kheiri[2], Mohammad Ali Javadi[2]

Purpose: To investigate endothelial keratoplasty lenticules prepared from fresh whole eyes via Gebauer SLc Original (SLc) versus Moria CBm Carriazo-Barraquer (CBm), and those prepared from corneoscleral buttons via SLc versus Moria One-Use Plus (OUP) in terms of eye bank preparation criteria. **Methods:** Fresh whole eyes-dissected endothelial keratoplasty lenticules with SLc were compared with CBm in terms of thickness profile measurements, over/under dissection values, endothelial cell loss, and postoperative graft failures. A similar comparison was made between corneoscleral buttons-dissected endothelial keratoplasty lenticules with SLc and OUP. **Results:** Means of central thicknesses and increase of thickness toward periphery were not significantly different between 33 fresh whole eyes-dissected endothelial keratoplasty lenticules with SLc and 33 fresh whole eyes-dissected ones with CBm. There was no significant difference between 19 corneoscleral buttons-dissected endothelial keratoplasty lenticules with SLc and 19 corneoscleral buttons-dissected ones with OUP in terms of mean central thickness and post-cut endothelial cell loss. However, in the corneoscleral buttons-dissected endothelial keratoplasty lenticules, a mean increase of thickness was significantly different from central to two pericentral locations with OUP ($P = 0.001$) and from central to two peripheral parts with SLc ($P = 0.011$). Both CBm and OUP systems showed deeper dissection depths than head descriptions as compared to SLc ($P < 0.001$). **Conclusion:** Unlike fresh whole eyes-dissected endothelial keratoplasty lenticules with SLc or CBm, thickness profiles of corneoscleral buttons-dissected endothelial keratoplasty lenticules with both SLc and OUP systems showed a partial asymmetric increase of thickness toward the periphery. A high agreement was observed between endothelial keratoplasty lenticules thicknesses and SLc nomograms.

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Descemet's stripping automated endothelial keratoplasty (DSAEK) with an increasing trend in different countries around the world is the optimum remedy for corneal endothelial disorders.[1-8] The optimal lenticules for DSAEK have been prepared rapidly and consistently via automated dissection of donated corneas.[9,10] Hand-guided Moria Carriazo-Barraquer (CBm) and fully automatic systems such as Gebauer SLc Original (SLc) and Moria One-Use Plus (OUP) are suitable systems that are being used for the standard preparation of DSAEK tissues.[11,12] Although multiple factors can influence the thickness of provided DSAEK lamellae,[13-15] the SLc system excepting its more agreement with the selected cutting depth was comparable with the CBm and OUP in terms of variability, lamellar surface roughness, or endothelial cell loss.[11,12]

In the Central Eye Bank of Iran, the majority of precut endothelial keratoplasty lenticules have been prepared from donated fresh whole eyes with a hand-guided CBm system.[16] However, there have been some instances in which whole eyes or corneoscleral buttons excised from whole eyes are subjected to either SLc- or OUP-automated systems. Given that there was no report on the preparation of endothelial keratoplasty lenticules from fresh whole eyes by using SLc versus CBm, and studies on the comparison between SLc and OUP systems were performed on limited numbers of cases,[11,12] this study was designed to address these issues.

Methods

In a retrospective cohort study between February 2017 and September 2017, endothelial keratoplasty lenticules prepared from fresh whole eyes via SLc versus CBm and endothelial keratoplasty lenticules prepared from corneoscleral buttons via SLc versus OUP were investigated in terms of thickness

Ocular Tissue Engineering Research Center, Shahid Beheshti University of Medical Sciences, [1]Central Eye Bank of Iran, [2]Ophthalmic Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Correspondence to: Dr. Mozhgan Rezaei Kanavi, Ocular Tissue Engineering Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran, No 23, Paydarfard-9th Boostan St., Pasdaran Ave, Tehran - 1666673111, Iran. E-mail: mrezaie47@yahoo.com; rezaeikanavi@sbmu.ac.ir

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profile measurements, failed preparation, dissection depths in form of over/under dissection values, endothelial cell loss, and postoperative graft failure. All the procedures were performed by an experienced eye bank technician (T. Ch), in a grade "A" clean room. Fresh whole eyes of very good to excellent endothelial rating[16] and without flat anterior chamber were selected. The single-pass technique of different pass times (range of 15–21s) was implemented in all the cases. The selection of microkeratome heads for Moria CBm/Moria OUP- and Gebauer SLc-dissected endothelial keratoplasty lenticules was based on the Nahum's[17] and Gebauer's nomograms, respectively. The same digital tonometer (Icare PRO, Vantaa, Finland) and ultrasound pachymetry (SP-100; Tomey GmbH, Erlangen, Germany) were used in the study groups for measuring all intraocular pressures and corneal thicknesses, respectively. To conduct the study, full ethical approval was obtained from the Institutional Review Board of the Central Eye Bank of Iran and the ethics committee of the Ophthalmic Research Center at the Shahid Beheshti University of Medical Sciences, Tehran-Iran.

Preparation of endothelial keratoplasty lenticules from fresh whole eyes

Preparation of endothelial keratoplasty lenticules from fresh whole eyes by using CBm (Moria S.A., Antony, France) was performed as previously described.[16,17] Briefly, after the total removal of corneal epithelium, the whole eye was tightly wrapped in sterile gauze and secured with straight hemostat forceps. The limboscleral area was vacuumed to increase intraocular pressure. By using the digital tonometer, the intraocular pressure was measured and after obtaining a constant pressure of above 70 mmHg, the central corneal thickness of the cornea was measured using the ultrasound pachymetry. Based on Nahum's nomogram[18] and pachymetry values, the microkeratomes heads (range: 300–450 μm) were selected and used to cut manually the anterior lamellar flap. After relocating the anterior lamellar flap on the posterior stromal bed, the excised corneoscleral disc was stored in Optisol GS (Bausch and Lomb, Irvine, CA, USA) at 4°C.

The preparation steps of endothelial keratoplasty lenticules from fresh whole eyes with the SLc system (Gebauer Medizintechnik GmbH, Neuhausen, Germany) were almost similar to those prepared via CBm. Based on Gebauer's nomogram and pachymetry values, cutting heads (range: 375–600 μm) were selected to remove the anterior lamellar flap. This step was performed by using a handpiece assembled with a cutting head showing blade oscillations and transversal motions when pressing an automatized footswitch. After reattaching dissected anterior lamellar flap on top of dried out posterior stromal bed, the corneoscleral disc was excised and transferred to Optisol GS at 4°C.

Preparation of endothelial keratoplasty lenticules from corneoscleral buttons

Endothelial keratoplasty lenticules were dissected from corneoscleral buttons preserved in Optisol GS by using SLc or OUP (Moria S.A., Antony, France) system in accordance with the manufacturers' instructions. The corneoscleral buttons were excised from donated whole eyes after complete removal of the corneal epithelium. The artificial anterior chamber pressure was set to 70 mmHg and based on Gebauer's nomogram and pachymetry values, cutting heads (range: 350–550 μm) were selected to remove anterior corneal lamella from the artificial anterior chamber-mounted corneoscleral button while pressing the automated footswitch. After repositioning the anterior corneal cap on the top of the posterior stroma, the corneoscleral button was returned to its Optisol GS medium.

As for the OUP system, all steps were similar to those described for the SLc system. The pressure of the artificial anterior chamber was set to 70 mmHg and "Speed 2" on the Moria control unit was selected for forwarding speed. Moreover, the cutting heads (range: 300–450 μm) used for removing anterior lamellar cap were chosen based on Nahum's nomogram[18] and pachymetry values.

Slit-lamp biomicroscopic and specular microscopic examinations

All donated corneas, whether in the form of fresh whole eyes or corneoscleral buttons were subjected to precut slit-lamp biomicroscopic examinations (Haag Streit, BQ 900, Koeniz, Switzerland) to exclude cases with prior ocular surgery, old stromal scar, and opacities, or any endothelial disorders. As for fresh whole eyes, endothelial cell density was approximated using 40× magnification of slit-lamp[16] and fresh whole eyes of very good to excellent endothelial rating were selected. Slit-lamp biomicroscopic examinations were also performed on all post-cut endothelial keratoplasty lenticules. Specular microscopy (KeratoAnalyzer EKA-10; Konan Medical Inc., Hyogo, Japan) was used to calculate endothelial cell density in corneoscleral buttons before microkeratome dissection and in all corneoscleral buttons- and fresh whole eyes-dissected endothelial keratoplasty lenticules 12–15h after dissection.

Post-cut thickness measurements

To obtain thickness profile of endothelial keratoplasty lenticular, post-cut tissue container was fixed on precalibrated Visante optical coherence tomography (Carl Zeiss Meditec, Inc., Dublin, CA, USA) by using a custom-designed mount[19] and measurements of the endothelial keratoplasty lenticule were performed in two perpendicular meridians and at a median time interval of 14 h (range of 12h–16h) from the placement of tissue in Optisol GS. All measurements in each meridian were performed at five settings: the most central, two pericentral (3.21 mm diameter), and two peripheral (6.29 mm diameter) regions. Given that Visante optical coherence tomography measurements, in general, are not adjusted based on Optisol GS-cornea refractive index, to minimize these errors in the Visante optical coherence tomography system when measuring tissue thickness in Optisol GS medium, correction factors of −2.2% and −8.7% were calculated for the values obtained at the pericentral and midperipheral locations, respectively.[20] As for dissection depths of CBm and SLc microkeratomes, over/under dissection values were calculated as the deduction of endothelial keratoplasty lenticules central thicknesses from the differences between pachymetry values and implemented microkeratome blades. After the transplantation of post-cut DSAEK tissues, postoperative reports were investigated in terms of rates of failed grafts, which were reported as a loss of graft clarity or nonattached endothelial keratoplasty lenticules.

Statistical analysis

SPSS software (IBM Corp. released 2013, IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) was

used to perform statistical analyses. The thickness values of post-cut DSAEK tissues were presented as means and standard deviations and statistically compared between CBm and SLc groups in fresh whole eyes and between SLc and OUP groups in corneoscleral buttons using a generalized linear model and ANOVA test. T-test was used to compare over/under dissection values between CBm and SLc separately for fresh whole eyes and corneoscleral buttons. Correlation between the two eyes of each donor was investigated by using a generalized estimating equation. A *P* value less than 0.05 was considered statistically significant.

Results

SLc- vs CBm-cut endothelial keratoplasty lenticules from fresh whole eyes

Donor criteria, thickness profiles, and endothelial cell densities of prepared endothelial keratoplasty lenticules via CBm and SLc systems are shown in Table 1. Briefly, 69 fresh whole eyes from 43 donors were enrolled; 35 from 20 donors and 34 from 23 donors were dissected with SLc and CBm, respectively. The preparation of endothelial keratoplasty lenticules failed in two eyes (5.1%) in the SLc group due to incomplete pass/cut, and in one eye (2.9%) in the CBm group due to the occurrence of corneal perforation. The reason for incomplete pass/cuts in the SLc group was proved to be the unexpected eclipse of microkeratome turbines with debris material. There was no significant difference between SLc and CBm groups in terms of pre-dissection central corneal thickness (P = 0.71), central thickness of endothelial keratoplasty lenticules (P = 0.734), post-cut endothelial cell density (P = 0.081), numbers of ultrathin endothelial keratoplasty lenticules (of less than <100 μm central thickness) (P = 0.862), and rate of failed graft (P = 0.919). As illustrated in Fig. 1, there was no significant difference between SLc and CBm groups in terms of the increase of endothelial keratoplasty lenticule thickness from the center toward the periphery (P = 0.438).

The anticipated dissection depths (central thicknesses of endothelial keratoplasty lenticules) for SLc agreed with the head labeling and the CBm heads dissected significantly deeper than the SLc heads (P < 0.001). The deviation from targeted 85 μm central thickness of endothelial keratoplasty lenticule did not differ significantly between the two systems (P = 0.734) [Table 2].

Corneoscleral button-dissected endothelial keratoplasty lenticules via SLc vs OUP

Table 3 illustrates donor criteria, endothelial cell densities, and thickness profiles of corneoscleral button-dissected endothelial keratoplasty lenticules with OUP and SLc systems. Briefly, 42 corneoscleral buttons from 31 donors were enrolled; 22 from 15 donors and 20 from 16 donors were dissected with SLc and OUP, respectively. The preparation failed in three eyes (13.6%) in the SLc group due to incomplete pass/cut and in one eye (5%) in the OUP group due to corneal perforation. There was no significant difference between SLc and OUP groups in terms of pre-dissection central corneal thickness (P = 0.177), pre- and post-dissection endothelial cell densities (P = 0.100 and P = 0.412, respectively), numbers of ultrathin endothelial keratoplasty lenticules (P = 0.288), and rate of failed graft (P = 0.555). As shown in Fig. 2, no significant difference was observed between SLc and OUP groups in terms of mean central thickness of endothelial keratoplasty lenticules (P = 0.234) and increase of endothelial keratoplasty lenticule thickness from central towards peripheral regions (P = 0.254). Unlike OUP-dissected endothelial keratoplasty lenticules in which the mean increase of thickness was statistically different from central to two pericentral locations (P = 0.001), no significant difference was observed in the corresponding parts of SLc-dissected

Table 1: Donor criteria, endothelial cell density, and thickness profiles of the prepared endothelial keratoplasty lenticules from fresh donated whole eyes via Moria CBm versus Gebauer SLc system

Donor, cornea, and dissection specifications	CBm group	SLc group	*P*
No. of donors	23	20	-
No. of fresh whole eyes	34	35	-
Donors' age Range (mean±SD)	20–59 (41.5±10.8) Yrs	20–71 (44.1±13.5) Yrs	0.379
Donors' sex	Male (95.6%)	Male (60%)	<0.001
Mean CCT (range)	669±84 μm (488-796)	677±82 μm (498-915)	0.710
Failed preparation	1 (2.9%)	2 (5.1%)	0.642
Mean central thickness of endothelial keratoplasty lenticules	128±24 μm	126±26 μm	0.734
Mean increase of endothelial keratoplasty lenticule thickness from central to pericentral locations	22.18±13.9 μm vs 21.91±21.41 μm (*P*=0.951)	17.58±14.67 μm vs 16.15±9.69 μm (*P*=0.589)	0.184
Mean increase of endothelial keratoplasty lenticule thickness from central to peripheral locations	72.58±23.12 μm vs 61.88±28.78 μm (*P*=0.101)	66.94±27.02 μm vs 59.06±25.94 μm (*P*=0.303)	0.355
Mean difference between 2 pericentral locations	17.36±18.29 μm	11.36±9.69 μm	0.091
Mean difference between 2 peripheral locations	31.73±20.19 μm	35.94±24.46 μm	0.438
Mean ECD	2817±238 cell/mm^2	2723±190 cell/mm^2	0.081
agreement between the endothelial keratoplasty lenticule thickness and head labeling	5 of 33 (18.2%)	32 of 37 (86.5%)	<0.0001
Ultrathin endothelial keratoplasty lenticule	4 (12.0%)	5 (13.5%)	0.862
Failed graft	1 (3.0%)	1 (2.7%)	0.919

CCT: Central corneal thickness; ECD: Endothelial cell density

Table 2: Endothelial keratoplasty lenticule preparation with the Gebauer SLc and Moria CBm

System	Head	N	CCT (μm)	Central thickness (μm) of endothelial keratoplasty lenticule	Over (–)/Under (+)	Deviation 85
SLc	600	7	776±78	136±26	−39.86±64.42	50.71±26.06
	575	6	682±37	106±42	−1±41.75	21.33±41.84
	550	5	709±22	127±22	−32.2±23.3	42.2±21.63
	525	5	658±33	125±14	−8±22.17	40.2±14.29
	500	3	633±9	119±12	−14.33±13.61	33.67±12.01
	475	4	625±13	124±6	−26.25±17.78	38.75±5.74
	425	1	559	130	−4	45
	375	2	503±7	156±28	27.5±20.51	70.5±27.58
	Total	33				
CBm	450	26	704±49	126±26	−128.04±46.54	41.31±25.81
	400	2	593±39	150±5	−43±43.84	64.5±4.95
	350	5	516±17	126±9	−40.4±11.06	40.6±8.82
	Total	33				
	P-value				<0.001	0.734

Means of CCT before preparation (measured via pachymetry), the central thickness of endothelial keratoplasty lenticule, number of fresh whole eyes dissections per Moria CBm and Gebauer SLc head (N), over/under dissection values, and deviation of central endothelial keratoplasty lenticule thickness from the targeted 85 μm (Dev 85). For the Moria CBm, all the implemented heads cut significantly deeper than the Gebauer SLc heads (P<0.001). The deviation from targeted 85 μm central thickness of endothelial keratoplasty lenticule did not differ significantly between the systems (P=0.734)

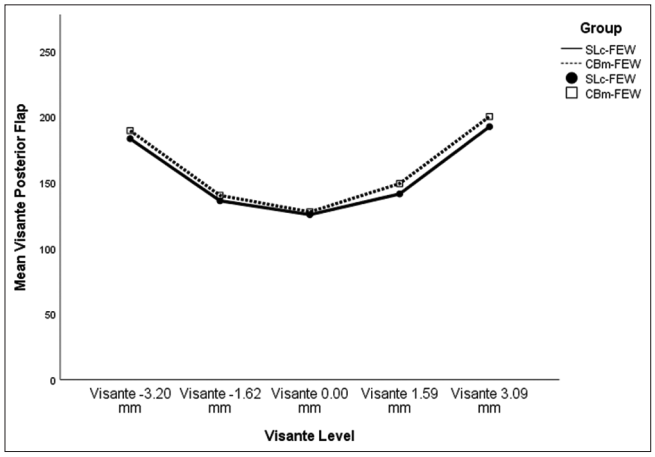

Figure 1: Mean thickness values of the endothelial keratoplasty lenticules in five settings on Visante optical coherence tomography for the Gebauer SLc and Moria CBm systems. The illustrated graphs show a symmetric increase of thickness from the central to the peripheral locations in endothelial keratoplasty lenticules dissected from fresh donated whole eyes with both Moria CBm and Gebauer SLc systems

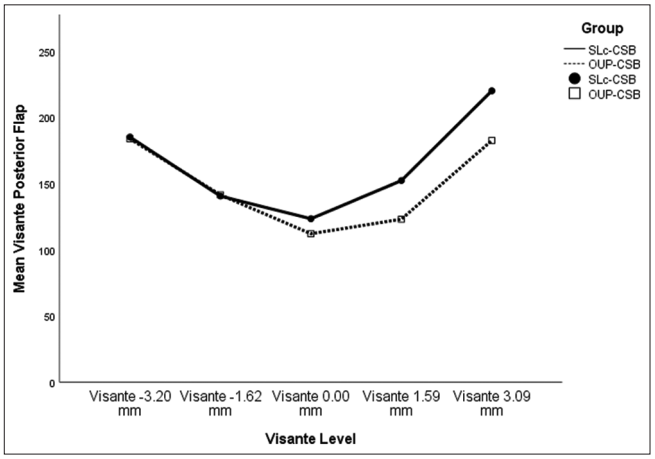

Figure 2: Mean thickness values of the endothelial keratoplasty lenticules in five settings on Visante optical coherence tomography for the Gebauer SLc and Moria One-Use Plus (OUP) systems. Note the presence of moderate asymmetric contours from the central to the pericentral locations in endothelial keratoplasty lenticules dissected from excised corneoscleral buttons with Moria OUP system and from the central to the peripheral locations in endothelial keratoplasty lenticules dissected from excised corneoscleral buttons with Gebauer SLc

endothelial keratoplasty lenticules (P = 0.121). Albeit that means of an increase in endothelial keratoplasty lenticules thicknesses from central to two peripheral locations in the SLc group were considerably different (P = 0.011), such a difference was not observed in corresponding parts of OUP-dissected endothelial keratoplasty lenticules (P = 0.914) [Table 3].

Both SLc and OUP systems showed a significant reduction of endothelial cell density after the dissection as compared to the pre-dissection values (P = 0.004 for SLc and P = 0.003 for OUP). The means of endothelial cell density 12–15h after the dissection decreased by an average of 12.1% (range of 10.2–12.7%) in the SLc and 9.2% (range of 8.6–11%) in the OUP group; however, the reduction rate was not significantly different between two groups (P = 0.490). As demonstrated in Table 4, the anticipated cut depths (central thicknesses of endothelial keratoplasty lenticules) for SLc agreed with the head labeling, and the OUP heads dissected significantly deeper than the SLc heads (P < 0.001). OUP 450 and 350 heads showed significantly deeper dissection than the corresponding SLc counterparts (450 heads, P = 0.02; 350 heads, P < 0.001). No difference was observed between the two systems in terms of deviation from targeted 85 μm central thickness of endothelial keratoplasty lenticule (P = 0.234).

Discussion

The current study, unlike Fuest *et al*.[11] that compared endothelial keratoplasty lenticule preparation from

Table 3: Donor criteria, endothelial cell density, and thickness profiles of the prepared endothelial keratoplasty lenticules from excised corneoscleral buttons via Moria OUP versus Gebauer SLc system

Donor, cornea, and dissection specifications	OUP group	SLc group	*P*
No. of donors	16	15	-
No. of corneoscleral buttons	20	22	-
Donors' age Range (mean±SD)	20-65 (44.4±18.8) Yrs	17-72 (47.9±20.2) Yrs	0.533
Donors' sex	Male (75%)	Male (86.7%)	0.481
Mean CCT (range)	570±58 μm (450–650)	593±50 μm (495–670)	0.177
Failed preparation	1 (5.0%)	3 (13.6%)	0.359
Mean central thickness of endothelial keratoplasty lenticules	112±27 μm	123±30 μm	0.234
Mean increase of endothelial keratoplasty lenticule thickness from central to pericentral locations	13.11±13.22 μm vs 29.37±16.66 μm (*P*=0.001)	29.47±21.89 μm vs 20.68±12.62 μm (*P*=0.121)	0.063
Mean increase of endothelial keratoplasty lenticule thickness from central to peripheral locations	70.47±36.19 μm vs 71.68±33.09 μm (*P*=0.914)	96.68±47.81 μm vs 61.74±31.96 μm (*P*=0.011)	0.333
Mean difference between two pericentral locations	19.63±13.66 μm	17.21±17.99 μm	0.631
Mean difference between two peripheral locations	37.21±29.46 μm	49.68±39.13 μm	0.254
Pre-dissection mean ECD	2786±262 cell/mm2	2966±385 cell/mm2	0.100
Post-dissection mean ECD	2606±330 cell/mm2	2531±220 cell/mm2	0.412
Post-dissection ECL	12.1% (range of 10.2%-12.7%)	9.2% (range of 8.6%-11%)	0.490
agreement between the endothelial keratoplasty lenticule thickness and head labeling	5 of 19 (26.3%)	17 of 19 (89.4%)	<0.0005
Ultrathin endothelial keratoplasty lenticule	7 (36.8%)	4 (21.0%)	0.288
Failed graft	2 (10.5%)	1 (5.3%)	0.555

CCT: Central corneal thickness, ECD: Endothelial cell density, ECL: Endothelial cell loss, OUP: One-Use Plus

Table 4: Endothelial keratoplasty lenticule preparation with the Gebauer SLc and Moria OUP

System	Head	N	CCT (μm)	Central Thickness (μm) of Endothelial Keratoplasty Lenticule	Deviation 85	Over (-)/Under (+)
SLC	550	5	658±11	112±19	26.8±18.83	+4±20.58
	525	1	652	82	-3	-45
	475	3	596±7	94±12	8.67±12.1	-27.33±6.81
	4501	3	575±6	156±37	70.67±36.53	+30.67±41.4
	425	6	553±9	129±7	44.17±7.44	+1.17±12.81
	3502	1	495	182	97	+37
	Total	19				
OUP	450 (1)	7	631±12	90±22	4.86±21.62	-91.14±27.13
	400	2	580±14	98±21	13±21.21	-82±35.36
	350 (2)	6	533±20	123±15	37.5±14.92	-60.33±10.69
	300	4	513±59	143±16	57.75±16.4	-70.25±65.61
	Total	19				
	P-value				0.234	<0.001

Means of central corneal thickness (CCT) before preparation (measured via pachymetry), central thickness of endothelial keratoplasty lenticule, number of corneoscleral button dissections per Gebauer SLc and Moria OUP head (N), over/under dissection values, and deviation of central endothelial keratoplasty lenticule thickness from the targeted 85 μm (Dev 85). For the Moria OUP, all the implemented heads cut significantly deeper than the Gebauer SLc heads (*P*<0.001). Moria OUP 450 and 350 heads showed significantly deeper dissection than the according Gebauer SLc counterparts (450 heads, *P*=0.02; 350 heads, *P*<0.001). The deviation from targeted 85 μm central thickness of endothelial keratoplasty lenticule did not differ significantly between the systems (*P*=0.234)

corneoscleral buttons between hand-guided CBm and fully automatic SLc microkeratome, investigated the thickness profiles of endothelial keratoplasty lenticules dissected from fresh whole eyes with CBm as compared to those dissected with SLc system and demonstrated comparable results between the two systems in terms of mean central corneal thickness and mean increase of thickness toward the periphery. Moreover, the present study showed comparable results for the thickness profiles of endothelial keratoplasty lenticules prepared from corneoscleral buttons between those dissected with SLc and those dissected with the OUP system. In our study, the thickness of SLc-dissected endothelial keratoplasty lenticules,

whether from fresh whole eyes or corneoscleral buttons, had a very good agreement with the cutting head description. However, the dissection depths in both CBm and OUP systems were substantially deeper than the head descriptions. These results were similar to those reported by Fuest *et al*.[11,12] except that the endothelial keratoplasty lenticules in their series were dissected only from corneoscleral buttons, not from fresh whole eyes. The superiority of the SLc system over OUP in this regard may be due to the use of a transparent visual applanation plate in SLc for setting the desired cutting diameter.

In the current study, although there was a symmetric increase of thickness toward the periphery in endothelial keratoplasty lenticules dissected from fresh whole eyes with both CBm and SLc systems, this increase was partially asymmetric for endothelial keratoplasty lenticules that were prepared from corneoscleral buttons with both SLc and OUP systems. Nevertheless, given the low rates of postoperative failed grafts in all study groups, it does not seem that this asymmetricity in endothelial keratoplasty lenticules contours would have had a significant effect on the detachment rate of grafted lenticules. These variations in endothelial keratoplasty lenticules thickness profiles were expected to occur due to donor tissue-related factors[14] plus inherent errors associated with preparation technique, especially in manual dissection.[19] However, the Visante optical coherence tomography measurements of endothelial keratoplasty lenticules in the current study showed that the variations of thickness profiles were more significant with automated dissection of corneoscleral buttons than with manual cutting of fresh whole eyes. This can be partly due to the higher experience of our eye bank technician (T. Ch) on the preparation of endothelial keratoplasty lenticules from fresh whole eyes as compared to her experience on automatic preparation of endothelial keratoplasty lenticules from corneoscleral buttons.[16] Therefore, obtaining endothelial keratoplasty lenticules of uniform contours from corneoscleral buttons with hands-free microkeratomes is expected to occur over time. As for donor-related factors in the current study, there was no significant difference between fresh whole eyes- and corneoscleral buttons-dissected endothelial keratoplasty lenticules in terms of donors' age, and intracameral pressure was attempted to be constant during the dissection process for all the implemented systems.

The results of our study revealed no significant difference in the rate of fresh whole eyes-dissected ultrathin endothelial keratoplasty lenticules between CBm and SLc groups. The rate of corneoscleral buttons-dissected ultrathin endothelial keratoplasty lenticules was also not significantly different between OUP and SLc groups. This means that both hand-guided and hands-free systems with no significant variability can reliably be used for the preparation of ultrathin endothelial keratoplasty lenticules via a single pass technique.

Our results in terms of endothelial cell loss after dissection of corneoscleral buttons with SLc (121%) or OUP (9.2%) were similar to the reported rate of 11% in a study by Rose *et al*.[21] In preparation of pre-dissected endothelial keratoplasty lenticules from corneoscleral buttons, due to implementation of an artificial anterior chamber and direct contact of corneal endothelium with fluid flow,[22-25] it is expected to observe more endothelial cell loss than when endothelial keratoplasty lenticules are dissected from fresh whole eyes in which the anterior chamber of the whole eye supports the dissection and induces less endothelial manipulation.[16]

Our study as a preoperative eye bank investigation had drawbacks in terms of lack of specular microscopic data on endothelial cell densities in fresh whole eyes prior to the dissection. Performing specular microscopy with its particular setting specialized for excised corneas was not possible for fresh whole eyes. Furthermore, posttransplantation specular microscopy either was not performed or the corresponding data were not available in the current study.

Conclusion

Our study demonstrated that the thickness profiles of fresh whole eyes-dissected endothelial keratoplasty lenticules with automatic SLc were comparable with those of manual CBm system, showing a symmetric increase of thickness towards the periphery. In corneoscleral button-dissected endothelial keratoplasty lenticules with both SLc and OUP systems, although an opportunity of the user-independent cut was provided, the increase of thickness toward the pericentral and peripheral areas was partially asymmetric. Unlike CBm and OUP systems in which the dissection depths were substantially deeper than the head labeling, thickness of SLc-dissected endothelial keratoplasty lenticules, whether from fresh whole eyes or corneoscleral buttons, showed a good agreement with the head descriptions; indicating that SLc system may be a good candidate for those eye bank technicians or surgeons that are on learning curve for endothelial keratoplasty lenticule preparation. Furthermore, considering the potential risk of endothelial cell loss after the dissection of corneoscleral buttons with both SLc and OUP systems, preparation of pre-dissected endothelial keratoplasty lenticules from fresh whole eyes whether with SLc or with CBm is preferred in the eye banks that harvest donated whole eyes.

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Conflicts of interest

There are no conflicts of interest.

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