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Comparison of Clear Corneal Incision Morphology Changes in Biaxial Microincision Cataract Surgery by Transverse and Torsional Phacoemulsification: Cohort Study

Transvers ve Torsiyonel Fakoemülsifikasyon ile Biaksiyel Mikroinsizyon Katarakt Cerrahisinde Saydam Korneal Kesi Değişikliklerinin Karşılaştırılması: Kohort Çalışması

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ABSTRACT Objective: To compare the effects of transverse versus torsional phacoemulsification by using the biaxial microincision cataract surgery technique on corneal structures and clear corneal incision (CCI) morphology. **Material and Methods:** We evaluated comparative case series of patients with moderate density nuclear cataracts who underwent biaxial microincision transverse or torsional phacoemulsification. Seventy patients have included in the study and they were divided into 2 groups: transverse and torsional. The main outcome measures included, corrected distance visual acuity, central corneal thickness, central corneal endothelial cell density, endothelial cell loss (ECL), and changes in the CCI morphology. **Results:** Each group comprised 35 (35 eyes) patients. Epithelial misalignment on the CCI morphology was highly significantly meaningful with the transverse group on the postoperative first day (p<0.001). Descemet membrane detachment on the first day postoperatively was high in both groups, especially in the transverse group, but the difference was not statistically significant (p=0.073). In the postoperative 3rd month, the mean ECL was 23.6% in the transverse group, and 19.0% in the torsional group, and there was no statistically significant difference between groups (p=0.187). **Conclusion:** In biaxial microincision cataract surgery, the corneal damage caused by transverse phacoemulsification seems to be higher compared to the torsional mode.

Keywords: Biaxial microincision; phacoemulsification; torsional; transverse

ÖZET Amaç: Transvers ve torsiyonel fakoemülsifikasyon ile biaksiyal mikroinsizyonel katarakt cerrahisinin kornea yapıları ve saydam kornea kesi morfolojisi üzerindeki etkilerini karşılaştırmaktır. **Gereç ve Yöntemler:** Biaksiyel mikroinsizyonel transvers veya torsiyonel fakoemülsifikasyon uygulanan orta yoğunluklu nükleer kataraktlı hastaların karşılaştırmalı vaka serilerini değerlendirdiğimiz bu çalışmada, 70 hasta çalışmaya dâhil edildi ve transvers ve torsiyonel olmak üzere 2 gruba ayrıldı. Her iki grupta düzeltilmiş görme keskinliği, merkezi kornea kalınlığı, merkezi kornea endotel hücre yoğunluğu, endotel hücre kaybı (EHK) ve saydam korneal kesi morfolojisindeki değişiklikler karşılaştırıldı. **Bulgular:** Her grup 35 (35 göz) hastadan oluşuyordu. Postoperatif 1. günde saydam korneal kesi morfolojisindeki epitel yanlış hizalanması transvers grupta istatistiksel olarak anlamlı derecede daha yüksekti (p<0,001). Ameliyat sonrası ilk gün Descemet membran dekolmanı her iki grupta da özellikle transvers grupta yüksekti, ancak aradaki fark istatistiksel olarak anlamlı değildi (p=0,073). Ameliyat sonrası 3. ayda ortalama EHK transvers grupta %23,6, torsiyonel grupta %19,0 idi ve gruplar arasında istatistiksel olarak anlamlı fark yoktu (p=0,187). **Sonuç:** Biaksiyel mikroinsizyonel katarakt cerrahisinde torsiyonel mod ile karşılaştırıldığında transvers mod fakoemülsifikasyonun yarattığı kornea hasarı daha fazla görünmektedir.

Anahtar Kelimeler: Biaksiyel mikroinsizyon; fakoemülsifikasyon; torsiyonel; transvers

After the development of phacoemulsification, cataract surgery became one of the most successful surgeries in the world. However, excessive use of ultrasound and thermal energy during phacoemulsification still damages corneal layers. Technical improvements have been made to minimize this damage, and today we are performing phacoemulsification surgeries using smaller corneal incisions and low ultrasound energy.[1,2]

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The use of biaxial phacoemulsification has emerged as a result of efforts to reduce corneal damage. The advantage of the biaxial phacoemulsification method over the coaxial method is the prevention of loss of ophthalmic viscosurgical device (OVD). This feature maintains better anterior chamber stability and pupil dilatation. The maneuverability is higher because irrigation and aspiration functions are held in 2 different handles. The surgeon holds a sleeveless phaco handle in one hand and an irrigation chopper in the other. Capsulorrhexis and hydrodissection can be performed more easily and this reduces the possibility of rupture of the posterior capsule. Unfortunately, the disadvantage of the method is that it requires special tools.[3-5]

Torsional and transverse phacoemulsifications have also been developed to perform safer surgery and protect the cornea. In the conventional phaco, the mechanical shear and cavitation effect is generated at a low frequency (38 kHz) by the backward and forward movement of the phaco tip, but this longitudinal movement produces the pushing effect on the end piece. In the transverse phaco cavitation energy is generated by applying longitudinal and transverse motion simultaneously to keep the lens material.[6,7] In the torsional mode the phaco tip moves at a lower frequency (31.6 kHz) and laterally. This side-to-side movement at the tip works by a shearing effect on the lens material without the pushing effect. The mechanical change in both modes resulted in increased surgical efficiency, less ultrasound energy, and less endothelial cell loss (ECL). These advantages also reduce the incidence of clear corneal incision (CCI) damage.[8-10]

In this study, we aimed to compare transverse and torsional phacoemulsification in cataract surgeries using the biaxial microincision technique. The effects of sleeveless minimal invasive technique by transverse and torsional phacoemulsification on endothelial cell density (ECD), central corneal thickness (CCT), corrected distance visual acuity (CDVA), and CCI morphology was evaluated.

MATERIAL AND METHODS

In this randomized observed masked comparative study, consecutive patients who had cataract surgery with the biaxial microincision technique were evaluated. The inclusion criteria were patients with senile nuclear cataracts classified as Grade 4 according to Lens Opacities Classification System III (LOCS III) performed by biaxial microincision transverse or torsional phacoemulsification technique.[11] Exclusion criteria were previous ocular trauma, corneal pathology, zonular weakness, uveitis, diabetes, glaucoma, pseudoexfoliation syndrome, posterior segment pathology, a history of intraocular surgery, or using systemic or topical medications to affect anterior chamber parameters and intraocular pressure. The patients were divided into 2 equal groups using transverse and torsional phacoemulsification. For inclusion in the study, the patients signed informed consent forms. The study protocol was approved by the Local Ethics Committee of Tekirdağ Namık Kemal University Faculty of Medicine (date: September 29, 2016, no: 2016.106.08.01) and the criteria specified in the Helsinki Declaration were complied with.

SURGICAL TECHNIQUE

All surgeries were performed by the same experienced left-handed surgeon. Local ophthalmic anesthetic drop proparacaine hydrochloride 0.5% was applied before surgery. Two 1.1 mm wide CCI were performed at 2 and 11 o'clock in the right eye and 1 and 10 o'clock in the left eye with a 20 gauge (G) micro vitreoretinal knife (Beaver-Visitec International, Waltham, Massachusetts, USA). A cohesive OVD 1.4% sodium hyaluronate (Healon GV, Abbott Medical Optics, Abbott Park, Illinois, USA) was injected. The anterior capsule was perforated and created a flap by a 27 G cystotome (Beaver-Visitec International). Continuous curvilinear capsulorhexis was performed with microcapsulorhexis forceps (Geuder GmbH, Heidelberg, Germany). The lens capsule was separated from the lens cortex by hydrodissection. The sleeveless phaco tip was inserted using CCI at 2 o'clock in the right eye and 1 o'clock in the left eye. The 19 G irrigating chopper (Geuder GmbH) was inserted through the CCI at 11 o'clock in the right eye and 10 o'clock in the left eye. The lens was aspirated using the quick-chop phacoemulsification technique. Cortex residues were removed with a

20 G bimanual irrigation-aspiration system (Alcon Laboratories, Inc. Fort Worth, TX, USA). The anterior chamber and capsular bag were filled with OVD. A temporal CCI was performed with a 2.2 mm slit knife (Beaver-Visitec International) for IOL (intraocular lens) implantation. The hydrophobic one-piece foldable IOL (Tecnis one-piece ZCB0, Advanced Medical Optics-AMO, Santa Ana, USA) was inserted into the cartridge and implanted into the capsular bag and the OVD was removed by bimanual irrigation and aspiration (I/A) method. Side-port incisions were closed by stromal hydration. For endophthalmitis prophylaxis, 0.1 cc moxifloxacin ophthalmic solution 0.5% was injected into the anterior chamber (Vigamox, Alcon Laboratories Inc., Texas, USA), and surgery was completed.

Balanced saline solution (Endosol 500, Advanced Medical Optics-AMO) was used as an irrigation fluid. In the transverse and torsional group, Ellips FX technology (Whitestar Signature® Phacoemulsification system, AMO) and Ozil IP technology (Alcon Infiniti® Vision System, Alcon Laboratories, Inc.) were used, respectively. In the transverse group, an Ellips FX phaco handpiece with 20 G 30° bevel phaco tips, and in the torsional group, an Ozil torsional handpiece with 0.9 mm 30° Kelman phaco tips were used. The phacoemulsification settings for transverse group were aspiration: 28 mL/min, vacuum: 450 mmHg, phaco power: maximum 30%, bottle height: 100 cm; for torsional group were linear torsional amplitude: 80%, dynamic rise: 0, aspiration flow rate: 30 mL/min, vacuum: 400 mmHg, bottle height: 105 cm, Ozil IP software parameters were 95% maximum vacuum limit, 15 millisecond pulses, and longitudinal/torsional ratio of/1/1. Topical steroid (prednisolone acetate 1%, Pred Forte, Allergan, Inc., Irvine, CA) and antibiotic (moxifloxacin 0.5%, Vigamox, Alcon Laboratories, Inc.) drops were administered to each patient postoperatively and continued for at least 2 weeks.

OPHTHALMIC DATA

CDVA, CCT (Ultrasonic Pachymetry, Pacscan 300P, Sonomed Inc., Tampa, FL, USA), ECD (Endothelial Microscope, SP-02® CSO, Italy), and changes in CCI morphology [Anterior Segment Optical Coherence Tomography (AS-OCT), Cirrus HD-OCT, Carl Zeiss Meditec Inc, Dublin, CA, USA)] were recorded at preoperatively and postoperative day 1, week 1, month 1, and months 3. CDVA was measured on a Snellen chart and converted to LogMAR format. CCI morphology at 2 o'clock in the right eye and 1 o'clock in the left eye was visualized and recorded by AS-OCT. AS-OCT images of the CCI sites were evaluated as endothelial misalignment (EnM), endothelial gap (EnG), Descemet membrane detachment (DMD), epithelial misalignment (EpM), epithelial gap (EpG), and co-adaption loss (CAL). ECL was calculated as: ECL (%)=(preoperative ECD-postoperative ECD)/preoperative ECD)x100 (Figure 1A, Figure 1B, Figure 1C, Figure 1D, Figure 1E, Figure 1F).

Both groups' total ultrasound time (UST) data were recorded. UST shows the total time elapsed in the 3rd position of the foot pedal during surgery and calculated automatically by phaco units software in both groups. Effective phaco time (EFX) and cumulative dissipated energy (CDE) parameters obtained from the transverse and the torsional phaco systems were recorded, respectively.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS Statistics, version 26.0, for Windows software (IBM Corp., Chicago, Illinois, USA). The difference between the groups was evaluated using paired t-test, independent sample t-test, Fischer's exact test, and Pearson chi-square test. $p<0.05$ was considered statistically significant.

RESULTS

Each group included 35 patients. Sixty-two percent of the transverse group was male, while 62% of the torsional group was female (p=0.032). There was no statistically significant difference between groups according to age and operated eye side results (p>0.05) (Table 1). In all patients, no phaco burns were observed on the CCI and no complications occurred. UST was significantly different between the 2 groups and lower in the torsional group (p=0.022). The average EFX (transverse) and CDE (torsional) values were 26.11 and 8.97, respectively (Table 2).

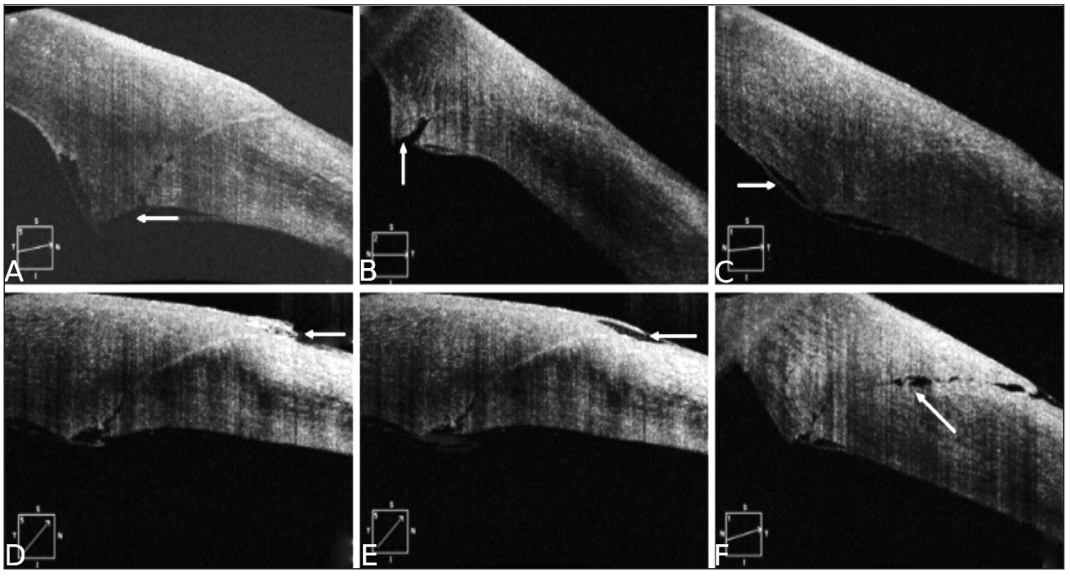

FIGURE 1: Clear corneal incision morphology AS-OCT scan images: **A)** Endothelial misalignment (EnM); **B)** Endothelial gap (EnG); **C)** Descemet membrane detachment (DMD); **D)** Epithelial misalignment (EpM); **E)** Epithelial gap (EpG); **F)** Coadaption loss (CAL).

TABLE 1: Demographic characteristics of patients.

	Group		
Parameter	**Transverse**	**Torsional**	**p value**
Sex, n (%)			0.032
Male	22 (62)	13 (38)	
Female	13 (38)	22 (62)	
Eye, n (%)			0.480
Right	17 (49)	20 (57)	
Left	18 (51)	15 (43)	
Age (y)			0.908
Mean±SD	70.01±8.7	70.03±9.8	
Range	52, 85	54, 92	

SD: Standard deviation.

TABLE 2: Intraoperative phacoemulsification parameters.

	Group		
Parameter	**Transverse**	**Torsional**	**p value**
UST (second)			0.022*
Mean±SD	91.79±98.76	52.24±16.35	
Range	17, 436	21, 101	
EFX			-
Mean±SD	26.11±43.41	-	
Range	5, 138	-	
CDE			-
Mean±SD	-	8.97±13.24	
Range	-	3.1, 16.4	

UST: Total ultrasound time; SD: Standard deviation; EFX: Effective phaco time; CDE: Cumulative dissipated energy, *: Statistically significant.

The mean CDVA was better in the transverse group at preoperative and postoperative 1 week and showed a statistically significant difference (p=0.039). There was no significant difference between postoperative 1st day, 1st month, and 3rd-month CDVA values (p≥0.23) (Table 3). There was no significant difference in CCT measurements in preoperative and postoperative follow-ups (p≥0.082). ECL was 23.6% in the transverse group and 19.0% in the torsional group at 3 months postoperatively (p=0.187). The mean ECD counts did not show a statistically significant difference between the groups in preoperative and postoperative follow-ups (p≥0.092) (Table 3).

Postoperative morphologic changes of CCI sites were evaluated and there was no significant difference between the groups of EnM, DMD, EpG, and CAL (p≥0.057). EnG was significantly lower in the transverse group on postoperative month 1 (p=0.009) and EpM was significantly lower in the torsional group on the postoperative day 1 (p<0.001) (Table 4).

DISCUSSION

To our knowledge, there is no study in the literature comparing the reliability of transverse and torsional

TABLE 3: Comparison of CDVA, CCT, ECD, and ECL between groups.

	Transverse		Torsional		
Parameter	**Mean±SD**	**Range**	**Mean±SD**	**Range**	**p value**
CDVA (LogMAR)					
Preoperative	0.41±0.24	0.3, 2.00	0.54±0.22	0.3, 1.30	0.026*
Postoperative					
1 day	0.44±0.27	0.00, 1.30	0.46±0.24	0.20, 1.30	0.750
1 week	0.13±0.20	0.00, 0.40	0.23±0.19	0.00, 1.00	0.039*
1 month	0.009±0.03	0.00, 0.30	0.02±0.05	0.00, 0.40	0.235
3 months	0.006±0.02	0.00, 0.10	0.009±0.02	0.00, 0.30	0.648
CCT (µm)					
Preoperative	530±38	441, 621	542±40	463, 664	0.706
Postoperative					
1 day	633±73	502, 859	649±62	545, 790	0.319
1 week	595±53	502, 704	599±49	490, 703	0.765
1 month	550±36	489, 620	565±37	485, 641	0.082
3 months	542±34	478, 603	550±34	481, 654	0.314
ECD (cell/mm²)					
Preoperative	2621±320	2041, 3371	2546±438	1711, 3354	0.417
Postoperative					
1 week	2351±385	1454, 3289	2208±406	1437, 2817	0.160
1 month	2153±418	1324, 3094	2079±353	1413, 2723	0.531
3 months	2122±409	1254, 2975	1944±375	1324, 2720	0.093
ECL (%)					
Postoperative					
1 week	10.3±11.1	8.3, 49.2	13.27±14.2	6.3, 58.2	0.094
1 month	17.2±14.2	5.6, 48.9	18.3±17.7	5.4, 48.9	0.284
3 months	23.6±27.0	5.4, 69.0	19.0±22.1	5.9, 74.4	0.187

CDVA: Corrected distance visual acquity; CCT: Central corneal thickness; ECD: Endotelial cell density; ECL: Endothelial cell loss; *: Statistically significant.

modes using the biaxial microincision phacoemulsification technique. In this study, we compared the effects of phaco machine dynamics on the ECD, CCT, and CCI site morphology using the sleeveless biaxial microincision. Since biaxial microincision cataract surgery is performed without a sleeve and the effect of ultrasound power on the cornea would be higher, we thought that a better group comparison by CCI morphology would be made. In the transverse group, intraoperative ultrasound time, needle time, and damage to the cornea were found higher due to high energy released.

Numerous innovations and improvements have been made in phacoemulsification surgery to reduce the ultrasound power used. Torsional OZIL IP and Ellips FX technologies, which use less ultrasound energy, are enhanced phacoemulsification systems for this purpose.[6,12,13] The phaco probe has piezoelectric crystals that produce ultrasonic power at the tip. While the vibrations occur, the resulting energy causes an increase in heat in the anterior chamber and corneal structures.[7] In the Ellips FX handle, both longitudinal and transverse movements are applied simultaneously to generate cavitation energy. Phaco tip movement is formed by adding 1:3 transverse motion to the longitudinal motion to form an elliptical movement. It does not only move transverse; unlike the oscillatory movement of torsional movement, it makes left and right movements in a horizontal plane.[14] The ellipsoid, 3-dimensional tip movement creates a large impact area and increases the cavitation effect. This jackhammer effect and side-to-side movement may increase the efficiency of ultrasound energy and allow shorter surgery.[7,15,16] In the Ozil handle, torsional and longitudinal movement is applied simultaneously. In this way, a better shaving effect occurs

TABLE 4: The comparison of morphological changes on CCI sites between the groups.

	Group		
Parameter	**Transverse**	**Torsional**	**p value**
EnM, n (%)			
1 day	32 (91.4)	33 (94.3)	0.643†
1 week	32 (91.4)	26 (74.3)	0.057†
1 month	28 (80.0)	25 (71.4)	0.403†
3 months	25 (71.4)	19 (54.3)	0.138†
EnG, n (%)			
1 day	32 (91.4)	33 (94.3)	0.643†
1 week	24 (68.6)	29 (82.9)	0.163†
1 month	3 (8.6)	13 (37.1)	0.009*§
3 months	0 (0%)	0 (0%)	-
DMD, n (%)			
1 day	31 (88.6)	25 (71.4)	0.073†
1 week	19 (54.3)	17 (48.6)	0.632†
1 month	2 (5.7)	0 (0)	0.493§
3 months	0 (0)	0 (0)	-
EpM, n (%)			
1 day	21 (60)	6 (17.1)	0.000*†
1 week	5 (14.3)	0 (0)	0.054§
1 month	1 (2.9)	0 (0)	1.000§
3 months	0 (0)	0 (0)	-
EpG, n (%)			
1 day	18 (51.4)	19 (54.3)	0.811†
1 week	6 (17.1)	4 (11.4)	0.734§
1 month	0 (0)	0 (0)	-
3 months	0 (0)	0 (0)	-
CAL, n (%)			
1 day	18 (51.4)	23 (65.7)	0.225†
1 week	2 (5.7)	7 (20)	0.151§
1 month	0 (0)	0 (0)	-
3 months	0 (0)	0 (0)	-

EnM: Endothelial misalignment; EnG: Endotelial gap; DMD: Descemet membrane detechmant; EpM: Epithelial misalignment; EpG: Epitelial Gap; CAL: Coadaption loss; †: Pearson chi-square (2 sided); §: Fischer's exact test; *: Statistically significant.

without the pushing effect and the nucleus is better followed. This torsional mode is an efficient and safe phaco that generates less energy.[8,9,17]

With shorter phaco time and less energy, both modes allowed to minimize complications such as ECL compared to the longitudinal modes.[7,8,15,18] Assil et al. compared transverse and torsional phacoemulsification modes in standardized density cataracts by using Ellips FX and Ozil IP and found the effective phaco time shorter for Ellips FX and claimed that the transverse phaco was safer.[19] In our study, on the contrary, we found UST higher in the Ellips FX group and thought that comparing this UST alone was not sufficient to compare safety and efficacy. Christakis et al. evaluated high-grade cataracts in their studies, compared transverse, torsional, and longitudinal phacos found the UST shorter in the torsional phaco than both other modes and claimed that the torsional phaco was more effective.[6]

The EFX and the CDE parameters are not equivalent. While the average percentage of ultrasound power in the torsional mode is shown as CDE, EFX is a calculation of transverse motion with the specific coefficient of the Ellips FX handle. Because system algorithms are configured differently in the 2 devices, a one-to-one comparison cannot be made.[6,13,15] We believe that comparing UST during surgery, postoperative clinical evaluations, and corneal and endothelial changes may be beneficial in achieving more objective results. Ataş et al. also reported that it was not correct to use the EFX and CDE to compare the reliability or effectiveness of the 2 modes. They argued that if a comparison of intraoperative parameters is desired, can only be done via needle time, also called UST. Although we found the UST to be statistically significantly lower in the torsion group, we think it is not appropriate to emphasize the superiority because the UST in 2 different mode algorithms is different. Ataş et al. found the mean ECL of the postoperative first month as 7% in the transverse and 6% in the torsional group in lower density cataracts with coaxial phacoemulsification (2.8 mm).[13] In our study, we found ECL results for the 3rd month as 23.6% in the transverse and 19.0% in the torsional group using biaxial microincision.

The main corneal incision, in the coaxial method, is applied 2.8-3.5 mm and 2.2 mm in the microcoaxial method. In the biaxial microincision method, CCI width decreases to less than 1.5 mm and we applied from a 1.1 mm.[20-22] Intraocular lens (IOL) implantation can be performed in 3 different methods such as expanding the original incision, opening the 3rd incision, or inserting the suitable IOL from the microincision. Some authors have reported that creating a 3rd incision is more reliable for incision site morphology in IOL implantation.[5,21-23] We completed phacoemulsification from a 1.1 mm incision, a 3rd temporal CCI was created for IOL implantation.

Corneal edema and postoperatively high CCT are mostly associated with ECD after surgery. Another reason for the increase in CCT is edema in the corneal matrix layer secondary to the intraoperative temperature increase.[24,25] Hayashi et al. reported that senility, small pupil diameter, cataract density, excessive infusion use, total ultrasound energy dissemination, and IOL material were independent causes of higher CCT and ECL.[12] Pirazzoli et al. reported that prolonged phaco time and applied chop technique was associated with high CCT and ECL postoperatively.[1,26] Assaf et al.; as in our study, compared the effect of transverse and torsional modes on the corneal endothelium. Unlike us, the microcoaxial phaco method was used instead of a microincision. Their 139 case series study, found the mean ECL as 1.7% and 2.0%, respectively, and this was not statistically different.[16] In our study, ECL was 23% for transverse and 19% for the torsional group. In their study, the reason for the extremely less ECL is including eyes with low-density nuclear cataracts.

The reduction in the amount of energy used in the torsional and transverse modes also reduces the energy transmitted to the cornea. These features reduce damage to CCI sites during surgery. Chen et al. compared the corneal thickness in the CCI region on postoperative day 1 using torsional and longitudinal modes and found that the torsional phaco caused less edema.[26,27] We could not find any study in the literature on CCI site damages comparing torsional and transverse modes.

According to CCI site morphological change measurements; the EpM and EpG can be caused by direct trauma of surgical instruments, IOL implantations, ultrasound power heat, or stromal hydration. The EpM is the failure of the CCI wound site epithelium to lie along a straight line at the cornea epithelial level. The EpG, which means a space between the corneal stroma and the epithelial layer, disables the epithelial barrier mechanism and increases the risk of endophthalmitis.[2,28] In our study, EpM was found to be significantly higher in the transverse group on postoperative day 1 ($p<0.001$).

Sleeveless biaxial microincision surgery causes more damage to the CCI due to the energy released from the phaco tip, heat, and mechanical trauma. Dupont-Monod and Berdahl et al. reported that the EnG and EnM ratio of the biaxial microincision method was higher than the coaxial methods.[10,22,28,29] In our study, the presence of EnG was found to be more than 90% of the first postoperative day in both groups, and at 3 months, endothelial healing was observed in all cases of both groups.

Sleeveless phaco causes a high rate of DMD, but stromal hydration, that performed in all cases, is another important cause of DMD. The lamellar corneal stroma and Descemet membrane have different physical properties. Swelling by stromal hydration leads to the separation of the stroma from the Descemet membrane. This detachment can not be detected by biomicroscopic examination usually. It is detected mostly by using AS-OCT and separation of the Descemet membrane from the stroma occurs in at least 50% of cases of literature.[2,29] In our study, the first day DMD rate was over 70% in both groups and the difference was not significant. DMD was observed in 2 patients in the transverse group at month 1, while all cases healed in the torsional group at month 1 and in the transverse group at month 3.

The most important limitation of our study is the limited number of cases left for comparison after the eligibility criteria were applied. The dispersive feature of OVD, which we use at every stage of phacoemulsification, is not sufficient for corneal protection. This may be one of the reasons for high ECL. Another limitation was that CCI site morphology evaluation, we used anterior segment imaging of the retina-specific OCT device, while there were AS-OCT devices developed specifically for the anterior segment.

CONCLUSION

In conclusion, evaluating the transverse and torsional phacemulsification with sleeveless microincisional cataract surgery, and imaging direct damage to the cornea with AS-OCT gave us an advantage for comparison. Therefore, a one-to-one comparison of surgical parameters may not be appropriate. Although the ultrasound time, EFX and CDE were at different values for the 2 modes, we could not use them to

get superiority over each other. We used postoperative corneal changes for comparison and observed more damage to corneal structures with transverse mode.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

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