

## Effective Phacoemulsification Time in Femto Cataract in Comparison to Conventional Cataract

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### ABSTRACT

**Background:** Cataract surgery is one of the most commonly performed surgery in the world and the number of individuals with cataracts is predicted to reach 30 million by the year 2020. This number will continue to grow as the population ages. more and more patients pursue surgery at the early stage of cataract in order not to endure visual impairment. Phacoemulsification is the standard surgery procedure for cataract in the developed countries. In recent years, femtosecond laser (FSL) has been introduced into phacoemulsification cataract surgery to perform corneal incisions, capsulorhexis, and nuclear fragmentation. Numerous clinical studies have reported that using FSL to perform nuclear fragmentation before phacoemulsification significantly reduces the amount of ultrasound energy and effective phacoemulsification time (EPT) required in the surgery.

**Purpose:** The goal of the present study is to assess the effect of FSL on effective phaco time in comparison to conventional phacoemulsification procedure. **Patients and Methods:** a comparative study included 40 patients with senile cataract (nuclear cataract grade III or more) based on lens opacification classification system III (LOCSIII). The patients were subdivided into 2 groups; group (A) included 20 patients with senile cataract underwent Femtosecond laser-assisted phacoemulsification (CATALYS FSL system (Abbott Medical Optics)) and group (B) included 20 patients with senile cataract underwent conventional phacoemulsification ( INFINTI phacoemulsification platform (Alcon)). Effective phaco time had monitored and recorded in all patients.

**Results:** As regarding conventional phaco group, mean EPT was  $19.80 \pm 24.33$  and in femto group, mean EPT was  $1.05 \pm 1.28$  with (p-value 0.001) which show highly significant difference between the two groups.

**Conclusion:** Femto-second laser assisted cataract surgery reduce effective phacoemulsification time for grade 3 or more of nuclear cataract in comparison to manual procedure.

**Keywords:** effective phacoemulsification time (EPT).

### INTRODUCTION

Cataract surgery is one of the most commonly performed surgeries in the world and the number of individuals with cataract is predicted to reach 30 million by the year of 2020<sup>(1)</sup>.

Femtosecond laser is utilized to perform 4 steps in modern cataract surgery: primary and secondary corneal incisions, capsulotomy, lens fragmentation, and astigmatic keratotomies<sup>(2,3)</sup>.

The FSL guarantee the stability, precision, length, shape, and width of the corneal incisions. Another unique advantage is the possibility of imaging the cutting process, during and after surgery. This is because the laser process is a three dimensional (3-D) scanning process and the essential 3-D beam delivery for acquiring a 3-D image is already part of the system. Thus, the target tissue can be scanned easily without making room for additional scanning mirror and lenses for imaging using Optical Coherence tomography (OCT) <sup>(4)</sup>.

Reduction in estimated phaco time was found between standard cataract surgery and the optimized

FSL. Another advantage of FLACS is its ability to create a more circular and precise capsulorhexis, which can facilitate Phacoemulsification and intraocular lens (IOL) implantation, and offer more accurate refractive outcomes after surgery <sup>(5)</sup>.

The goal of the present study is to assess the effect of FSL on effective phaco time in comparison to conventional phacoemulsification procedure.

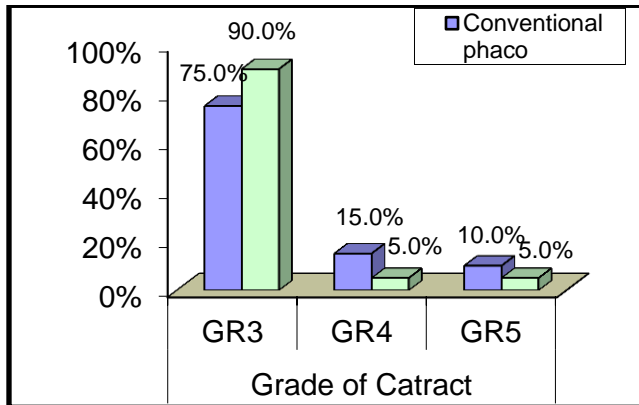
### PATIENTS AND METHODS

A prospective study was conducted on 40 patients with senile cataract (Age above 50) seen at Ain Shams university hospital from October 2016 to march 2017. This study was carried out in accordance to the tenets of the Declaration of Helsinki and ethical approval was obtained from Ain Shams University Research Ethics Committee.

The study included 40 patients with mean age of group A  $63.20 \pm 3.91$ , group B  $62.15 \pm 1.50$  with non significant difference between the two groups. The percentage of male to female ratio was equal in group A with 50% each, Group B, females were

80%, males were 20% with significant difference between the two groups (p-value 0.047). The percentage of affected eye in group A was 60%OD, 40%O S, in group B was 55% OD, 45%Os with no significant difference between the two groups.

Grading of cataract (graph 1), group A (GR3 +90.0%, GR4 5.0%, GR5 5.0%), group B (GR3 75.0%, GR4 15.0%, GR5 10.0%) with no significant difference between the two groups (p-value 0.448).



Graph (1): Grades of cataract

**Table (1)** shows mean BCVA was  $0.76 \pm 0.20$  in group A,  $0.70 \pm 0.19$  in group B with no significant difference between the two groups (p-value is 0.311) (table 1).

**Table (1):** Best corrected visual acuity in the two groups.

Best Corrected Visual Acuity	Group A	Group B	Independent t-test	
	No.=20	No.=20	t	P-value
Mean ± SD	$0.76 \pm 0.20$	$0.70 \pm 0.19$	-	0.311
Range	0.3 – 1	0.3 – 1	1.027	NS

**Surgical technique**

All included patients had underwent phacoemulsification using the INFINTI phacoemulsification platform (Alcon). In the Femto group, capsulotomy is by FSL and lens fragmentation using CATALYS FSL system (Abbott Medical Optics). All surgeries were performed by one surgeon. Quick chop technique was utilized in nucleus disassembly in both groups. The femtosecond laser treatment was applied before ultrasound phacoemulsification and IOL implantation. After pupil diltation (Phenyephine 2.5% and tropicamide 0.5%), All patients were placed in reclined built-in bed and positioned supine beneath the system, and each eye received topical

tetracaine (tetracaine hydrochloride ophthalmic solution, 0.5% Bausch + Lomb) eye drops to establish anesthesia.

With the Catalys system, The two-piece Liquid Optics Interface (LOI), which consist of a suction ring and a non applanating immersion lens, was positioned on the limbus and suction applied. Once suction and fixation of the globe were confirmed, the fluid reservoir was filled with balanced salt solution, and the patient was brought under the laser lens and docked to the system. 5.0 mm capsulotomy was done, Lens grades were segmented into quadrants (sextants) and softened with a grid spacing of 350 mm and segmentation softening spacing was 200 mm with segmentation repetition 4 and horizontal spot spacing 10 micrometer, vertical spot spacing 40 micrometer, anterior and posterior capsular safety margin 500 mm.

**Postoperative protocol**

In all cases, the following post-operative medications were given as follows: oral levofloxacin 500 mg tablet once a day for 3 days; topical diclofenac sodium 0.1%, dexamethasone sodium-sulfobenzoate 0.1%, and moxifloxacin hydrochloride 0.5% five times a day for 1 week. After 1 week, diclofenac was reduced to four times a day for 1 month, while the latter two were then replaced with topical fluorometholone 0.1% and ofloxacin 0.3%, prescribed as four times a day, up to 1 month, then discontinued.

**The study was done after approval of ethical board of Ain shams university and an informed written consent was taken from each participant in the study.**

**Statistical analysis**

All data were collected and analyzed statistically using SPSS for windows version 13.0 (SPSS Inc., Chicago, USA). Qualitative data were expressed as mean and standard deviation. Student-t test was used for comparison of quantitative variables between two groups. The significance of the data was determined by the probability (P - value).  $P > 0.05$  was considered insignificant,  $P \leq 0.05$  was considered significant, and  $P \leq 0.01$  was considered highly significant.

**RESULTS**

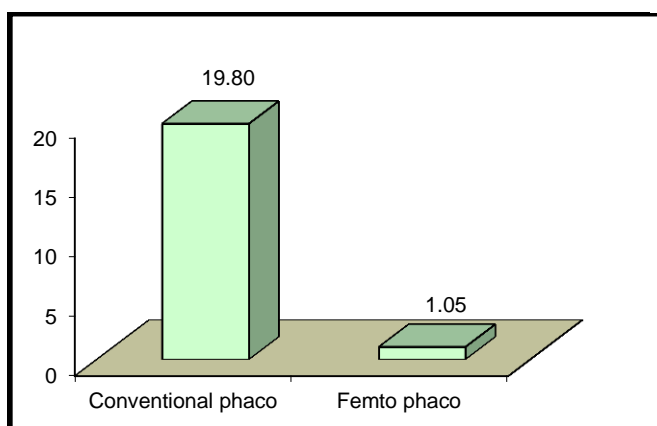
As regarding conventional phaco group, mean EPT was  $19.80 \pm 24.33$  and in femto group, mean EPT was  $1.05 \pm 1.28$  with (p-value 0.001) which show highly significant difference between the two groups graph

(2). These data show a result of significant reduction in EPT in femto phaco group in correlation to conventional phacogroup (table 2).

**Table (2):** EPT in Conventional phaco and Femto phaco

		Group A	Group B	Independent t-test	
		No.=20	No.=20	t	P-value
EPT	Mean ±	1.05 ±	19.80 ±	3.442	0.001 HS
	SD	1.28	24.33		
	Range	0 – 4	1 – 108		

P > 0.05: Non significant  
 P < 0.05: Significant  
 P < 0.01: Highly significant



**Graph (2):** Effective phaco time

**DISCUSSION**

FSL is a new and developing technology for cataract surgery. However, the efficacy and safety of FLACS have not yet been systematically evaluated.

It was found that significant reduction in EPT in femto phaco group (A) in relation to conventional phaco group (B).

**Chen *et al.*<sup>(6)</sup>**, carried out a study in 2015 including three randomized controlled trials (RCTs) conducted on 255 patients comparing the efficacy and safety of FLACS versus CPCS in cataract patients who were at least 18 years old and elected to have routine cataract surgery. That revealed mean phaco energy was much higher in the CPCS group than in the FLACS group, the differences were statistically significant (mean difference=-4.93). There was a statistically significant reduction in the EPT in the FLACS group compared with the CPCS group (mean difference =-1.04s. These results indicate that the use of FSL in cataract surgery leads to a much lower EPT compared to the standard procedure which is consistent with this study.

**Chen X and his colleagues on 2016**, carried out nine randomized controlled trials and fifteen cohort studies comparing FLACS with CPS. The studies included 4903 eyes divided as 2861 in the FLACS group and 2072 in the CPS group. These studies assessed the Endothelial cell loss percentage (ECL%), central corneal thickness (CCT), corrected and uncorrected distant visual acuity (CDVA and UDVA), and mean absolute error (MAE) of refraction were used as primary outcomes. Secondary outcomes included surgically induced astigmatism (SIA), mean effective phacoemulsification time (EPT), phacoemulsification power and circularity of the capsulorhexis.

Regarding to effective phacoemulsification time, There was a significant difference between the two groups in favor of the FLACS group (P < .001)<sup>(7)</sup>.

**Robert *et al.*<sup>(8)</sup>**, carried out Randomized controlled prospective studies which included 90 eyes of 45 patients aged between 61 and 86 years with mean age of 73.2 years. 22 males (48.9%) and 23 females (51.1%). All eyes underwent bilateral cataract surgery assisted with femtosecond laser technology. Two different doctors performed the surgeries. Eyes were randomized to one of two different femtosecond laser platforms: Catalys Precision system (Abbott Medical Optics Inc., Santa Ana, CA, USA) (Catalys group), and LenSx system (Alcon-LenSx Inc., Aliso Viejo, CA, USA) (LenSx group). Several intraoperative parameters and changes in corrected distance visual acuity and corneal endothelial density were evaluated and compared. The study revealed statistically significant differences between surgeons with both groups (Catalys group and LenSx group) in patient interface preparation (P = 0.035), nucleus removal time (P, 0.001), ultrasound time (P = 0.001), CDE (P = 0.001), EPT (P = 0.001), average phacoemulsification power (P =0.001. There is no statistically significant differences were found preoperatively in nuclear sclerosis grade (P0.064) between the eyes operated on by each surgeon with each laser system which is consistent with our study<sup>(8)</sup>.

**Katheyn *et al.*** carried out a consecutive prospective comparative study including 240 eyes which were classified into 4 groups, 60 eyes in each group. Groups 1 and 2 contained eyes with LOCSIII grade nuclear opalescence (NO) 3 cataracts treated with standard cataract surgery and femtosecond laser-assisted cataract surgery respectively. Groups 3

and 4 cataracts with LOCSIII grades NO5, treated with standard cataract surgery and femtosecond laser-assisted cataract surgery respectively. The Catalys precision laser system (Abbott Medical Optics, Inc.) was used for the femtosecond laser assisted surgeries. The range of patient age is between 50-58 with no statistically difference between Groups 1 and 2 ( $p=.854$ ) or between Groups 3 and 4 ( $p=.344$ ). The difference in EPT between Groups 1 and 2 was statistically significant ( $p<.001$ ). The difference in EPT between Groups 3 and 4 was statistically significant ( $p<.001$ ). A comparison between EPT in Groups 1 and 4 showed EPT for Group 4 was also statistically significantly lower than that of Group 1 ( $p=.013$ )<sup>(10)</sup>.

*This is in contrary with Huseynova et al.*<sup>(10)</sup> (2015), who revealed no significant difference in the EPT between the Complete and Quadrant Groups for Grade 1 cataract subgroup ( $P=0.16$ ), but there was a significant difference in the phaco power ( $P=0.03$ ).

They evaluated Seventy-one eyes of 71 patients based on the femtosecond laser-assisted lens fragmentation pattern in terms of EPT and power. The mean age of all patients was  $60\pm 6.66$  years (range: 45 to 75 years) for 27 males and 44 females. All enrolled subjects underwent standard preoperative examinations. Two groups were created based on the femtosecond laser-assisted lens fragmentation pattern: Group I, with Quadrant fragmentation pattern and Group II, with Complete fragmentation pattern. Each group was divided into subgroups. All the patients cataracts were either grade 1 or grade 2, each group included only two subgroups (Grade 1 and Grade 2). All laser surgeries were performed using the Catalys® Precision Laser System (OptiMedica, Sunnyvale, CA, USA).

The surgery had a double set-up procedure – the first part included the femtosecond laser surgery and the second part subjected the patient for phaco. Laser capsulotomy and lens fragmentation were carried out by the CATALYS (Catalys™ Precision Laser System; OptiMedica, Sunnyvale, CA, USA) machine. Femtosecond laser-assisted cataract surgery was performed in one eye of each patient<sup>(10)</sup>. The mean EPT was 28.96 seconds in the Quadrant Group and 16.31 seconds in the Complete Group. The mean phaco power was 8.07% in the Quadrant Group and 4.77% in the Complete Group. Using the complete pattern, there was a 44.7% reduction in EPT and a 40.9% reduction in phaco power when compared to the Quadrant Group.

But this study in agreement with our study as showed significant differences in the EPT ( $P=0.01$ ) and phaco power ( $P=0.003$ ) with the Grade 2 subgroup of both groups with the different patterns<sup>(10)</sup>.

## CONCLUSION

Femto-second laser assisted cataract surgery reduce effective phacoemulsification time for grade 3 or more of nuclear cataract in comparison to manual procedure.

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