Open Access

Original Article

Frequency of Argentinian Flag Sign in Intumescent Cataract Using Phacocapsulotomy vs Needle Assisted Capsulotomy

Irshad Hussain, Taimoor Ashraf Khan, Shahid Hamid Mahmud, Muhammad Aamir Arain, Asfandyar Khan, Muhammad Usman Ghani

Department of Ophthalmology, Combined Military Hospital Peshawar/National University of Medical Sciences (NUMS), Pakistan

ABSTRACT

Objective: To compare the frequency of capsulorhexis extension with needle assisted capsulorhexis and phacocapsulotomy in intumescent cataract.

Study Design: Quasi-experimental study.

Place and Duration of Study: Eye Department, Combined Military Hospital, Peshawar Pakistan, from Dec 2021 to Nov 2023.

Methodology: After approval of institutional ethical review committee, all the patients having intumescent cataract planned for surgery were included in the study. Each patient underwent complete outpatient ophthalmological work up. Congenital, developmental and traumatic cataract were excluded. Patients planned for surgery were divided in two groups by consecutive sampling technique. After standard temporal 2.75 mm phaco incision, in Group A, patients underwent two stage capsulorhexis initiated with needle and then mini-rhexis with 23 G micro-capsulorhexis forceps and aspiration of lens cortex with Simcoe cannula after which it was completed with micro-capsulorhexis forceps. While patients in Group B, underwent puncturing of anterior capsule with phaco needle and aspiration of soft lens matter with phaco needle followed by completion of the surgery in the standard manner.

Results: A total of 83 patients were included in the study. Group A included 41 patients while Group B had 42 patients. Five (6%) patients from Group A and 1(1.20%) patients from Group B had peripheral extension of the capsulorhexis which was retrieved with Little's maneuver in all the 6 patients.

Conclusion: Phaco capsulotomy is safe technique to ensure an intact continous curvilinear capsulorhexis in intumescent cataract as compared to the standard two staged capsulorhexis using micro-capsular forceps.

Keywords: Capsulorhexis, Intumescent Cataract, Mature Cataract, Phaco-Capsulotomy.

How to Cite This Article: *Hussain I, Khan TA, Mahmud SH, Arain MA, Khan A, Ghani MU. Frequency of Argentinian Flag Sign in Intumescent Cataract Using Phacocapsulotomy vs Needle Assisted Capsulotomy. Pak Armed Forces Med J 2025; 75(Suppl-2): S221-S225.*
DOI: https://doi.org/10.51253/pafmj.v75iSUPPL-2.11658

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

The blue white blue color pattern of the flag of Argentina had led to the name 'Argentinean Flag Sign' which is the appearance of the stained blue anterior capsule on either sides of central white cataract. Dr Daniel Mario Perrone coined this term.[1] The two blue stripes are due to anterior capsular staining by Trypan Blue dye which are separated by central white cataractous lens.[1] The peripheral extension of the uncontrolled capsular opening may result in involvement of the posterior capsule if the capsular tear involves the capsular bag equator and travels further. This may lead to disturbance of the anterior vitreous, nucleus drops, cystoid macular edema, unstable intraocular lens etc.[2] Anterior capsulotomy is considered ideal if it is round, continuous, well-centered, and overlaps the implanted IOL around its circumference by around 0.5 to 1.0 mm.[3] In white intumescent cataracts, high intra-lenticular pressure may cause extension of the capsulorhexis tear to periphery due to relatively lesser pressure in the anterior chamber. This pressure gradient may lead to capsular opening getting out of control. In these white cataractous lenses, the capsule is more fragile in addition to impaired visibility of red reflex. Leakage of liquefied cortical material can extend capsulorhexis tears to periphery resulting in sudden capsulorhexis radialization.[3] Various methods have been suggested to avoid this complication. One way is by aspirating the soft cortical material by using 27 or 30 gauge needle over a syringe after puncturing the anterior capsule which debulks the lens and helps with further capsulorhexis.[4] An initial small diameter continuous curvilinear capsulorhexis (CCC) which is relatively easy to control and used to debulk to lens with Simcoe cannula or other suitable aspiration device followed by extension to larger 5-6 mm diameter CCC is another technique.[5] Various types of forceps have been used to gain better control of capsulorrhexis.[6] High viscosity cohesive ophthalmic viscosurgical device

Correspondence: Dr Taimoor Ashraf Khan, Department of Ophthalmology, Combined Military Hospital, Peshawar Pakistan
Received: 19 Feb 2024; revision received: 05 Sep 2024; accepted: 12 Sep 2024

(OVD) like sodium hyaluronate 1.8%, 3.0% or 5% have been utilized for increasing pressure in the anterior chamber to counter the pressure of the swollen lens for completion of CCC.[7] Femtosecond laser-assisted system has been found to be useful in making a controlled capsulorhexis construction.[8] Precision pulse capsulotomy, commonly known as Zepto, works by changing electrical pulses energy into mechanical energy. This is done in millisecond.[9] Plasma blade capsuolotmy delivers energy which disintegrates the molecular structure of capsule leading to temporary microscopic plasma formation and cavitation bubbles of the intended anterior capsule area. It uses less power. In a maintained anterior chamber there is no bleeding, or surrounding tissue damage.[3] The resulting capsular opening has been found to be less elastic than manual CCC due to few irregularities in the margin.[10] Another technique, phaco capsulotomy, uses phaco probe to puncture center of anterior capsule, and aspirates the soft cortex and sometimes a portion of the soft epinucleus and/or soft nucleus.[1] This decreases the bulk and pressure of the entire crystalline lens complex. This also reduces the chances for the capsule tear to extend outward. Phaco capsulotomy was first mentioned in the Eyeworld and by Mahalingam and Sambhav.[1] In this study, we aim to compare the frequency of capsulorhexis extension with Two staged microcapsular forceps assisted capsulorhexis and phacocapsulotomy in intumescent cataract.

METHODOLOGY

It was a Quasi-experimental study carried out at Eye Department of Combined Military Hospital Peshawar over the period of two years from December 2021 to November 2023. The sample size was calculated using Open Epi Software Online for sample size calculator keeping Odds ratio of 8.33 % for higher pre-operative risk factor score (including Intumescent Cataract) and complicated cataract surgery. A sample size of 36 in each group was calculated.[11] Permission of the hospital ethical review committee was granted vide letter no 00257/24. Informed written consent was obtained from all the participants in addition to routine consent for cataract surgery.

Inclusion Criteria: Patients of both genders from 40 to 90 years of age with intumescent cataract in one eye obscuring the posterior segment view and flat retina/ unremarkable posterior segment on ultrasonography B-scan were included in the study.

Exclusion Criteria: Patients with congenital, developmental, complicated and traumatic cataract were excluded. Patient who had corneal decompensation, pseudo exfoliation, iridodonesis, phacodonesis, posterior segment pathology including vitreous hemorrhage, and retinal/choroidal detachment on ultrasound B-Scan were excluded from the study.

All patients underwent a thorough slit lamp examination and ultrasound B-Scan performed by a consultant Ophthalmologist. Standard workup for cataract surgery included intraocular pressure monitoring, measurement of central corneal thickness, biometry using ultrasound A Scan for Axial Length and Auto-refractometer for Keratometric readings. Patients planned for surgery were divided in two groups randomly to compare the outcomes of both surgical techniques. There were 41 patients in group A and 42 patients in group B. The cataract surgery technique involved the following steps. After standard 2.75 mm phaco incision at 10 'O' clock position, anterior capsule was stained in all the patients with 0.05% Trypan blue dye. The Trypan blue was washed out after 10 seconds with balanced salt solution, the anterior chamber was filled with 1.4% Sodium hyaluronate (cohesive OVD (ophthalmic viscosurgical device). In group A, anterior capsule was punctured with cystotome and a mini capsulorhexis of about 2-3 mm diameter was performed followed by aspiration of cortex with Simcoe cannula, injecting cohesive OVD over the peripheral area of the anterior capsule avoiding direct injection over the capsular opening and a leaflet of the capsule was grasped with Utrata forceps, later completing a larger capsulorrhexis of 5 to 5.5 mm diameter with Utrata forceps. Rest of the phacoemulsification was completed with stop and chop technique followed by coaxial irrigation aspiration and IOL implantation.

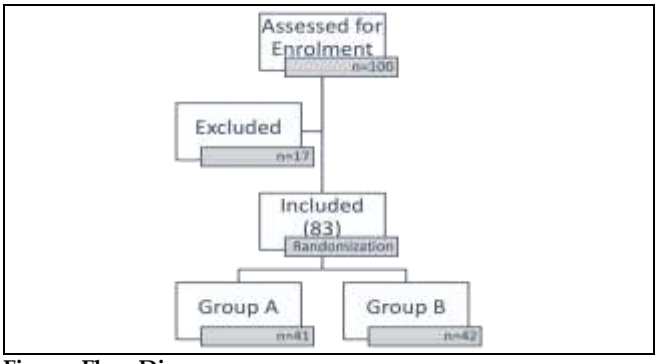

Figure: Flow Diagram

In Group B, anterior capsule opening was made with 19 Gauge phaco needle over a sleeve for 2.8 mm incision. The phaco parameters were maximum phaco power of 20, vacuum of 100 mm of Hg and flow rate of 15 ml/min. Irrigating bottle height was 90 cm. At least 1.5 mm of the tip was exposed from the irrigation sleeve. Phacoemulsification tip was introduced with irrigation off. The phaco tip with bevel down was passed through the center of an intact anterior capsule and aspirated a portion of the cortex. This simultaneously created the initial anterior capsule puncture and removed some of the liquefied/soft cortex. Multiple passes were made through the opened anterior capsule aspirating a part of the cortex every time. Care was taken to avoid touching the irrigating sleeve to the anterior capsule. Once enough of the cortex was aspirated, phaco tip was removed and cohesive OVD was injected over the peripheral area of the anterior capsule avoiding direct injection over the capsular opening and a leaflet of the capsule was grasped with Utrata forceps, and the capsulorhexis of 5 to 5.5 mm was completed. Necessary standard adjustment was made in cases of peripheral extension of the capsulorhexis flap including Little's maneuver for rescue of radialised capsulorhexis.

The main outcome measure was completion of capsulorhexis by avoiding the uncontrollable radialisation of anterior capsular flap. Failure of completion of capsulorhexis resulted in peripheral extension of the capsulorhexis flap. A preformed excel sheet proforma was used for data collection including variables like age, gender of the patients, type of capsulorhexis technique used, presence of peripheral extension of capsulorhexis, or Argentina flag signs. Data was analysed using Social package for Statistical Sciences (version 27). Comparison of means in group A and B was performed and a chi-square test was applied for comparison of means. A *p*-value of less than 0.05 was considered significant.

RESULTS

In our sample population, age ranged from 46 to 84 years with a mean age of 63.82±9.55 years. Out of total 83 patients, 43(51.80%) were males while 40(48.20%) were females. Only 6(7.2%) patients had extension of capsulorhexis in the periphery while performing continuous curvilinear capsulorhexis and were retrieved by Little's maneuver. In group A capsulorhexis extended in 5(12.19%) patients as compared to one (2.40%) patient in group B. Association between two groups i.e. group A and group B in terms of extension of capsulorhexis is given in Table-I. capsulorhexis extension was compared in different age groups with maximum frequency 3(3.60%) of capsulorhexis extension in the age group 71 to 80 years. Association between age groups with extension of capsulorhexis is given in Table-II. Extension of capsulorhexis was found more frequent in male gender i.e. 5(6.00%) vs 1(1.20%) in female gender. Association between gender and extension of capsulorhexis is given in Table-III. All three Association were statistically insignificant however, there was a clinical correlation between the choice of capsulorhexis option and peripheral extension of capsulorhexis i.e., 5 out of 6 cases of this complication were in group A as compared to the single case in group B.

Table-I: Association between Capsulorhexis with Cystotome vs Phaco-Capsulotomy and Extension of Capsulorhexis (n=83)

Type of Technique	Extension of Capsulorhexis		*p*-value
	Yes	No	
Group A (n=41)	5(12.19%)	36(87.81%)	0.09
Group B (n=42)	1(2.40%)	41(97.60%)	

Table-II: Association Between age Groups with Extension of Capsulorhexis (n=83)

Age Group	Extension of Capsulorhexis		*p*-value
	Yes	No	
40 to 50 years	1(1.20%)	8(9.60%)	0.20
51 to 60 years	2(2.40%)	19(22.90%)	
61 to 70 years	Nil	31(37.30%)	
71 to 80 years	3(3.60%)	14(16.90%)	
81 to 90 years	Nil	5(6.00%)	

Table-III: Association Between Gender and Extension of Capsulorhexis (n=83)

Gender	Extension of capsulorhexis		*p*-value
	Yes	No	
Male	5(6.00%)	36(43.40%)	0.37
Female	1(1.20%)	41(49.40%)	

DISCUSSION

The global burden of diseases (GBD), injuries and risk factor study showed that around 220 million people world wide had some form of visual impairment with a large majority of these people residing in low-income countries such as Pakistan.[12] The most common causes of vision loss are uncorrected refracted errors, un-operated cataracts and glaucoma.[13] A significant proportion of the patients presenting with cataract present with mature and hyper mature cataracts which can likely be attributed to the fact that patients often lack awareness

regarding their own health and put off getting seen by a doctor in favor of traditional but ultimately ineffective remedies. Secondly, limited access to healthcare is another leading factor for delayed diagnosis and subsequent management.[2]

A cataract is defined as "mature" if its cortex and nucleus become so opaque that the red reflex usually seen completely disappears and the crystalline lens appears completely pearly white thus the cataract becomes "mature.[14] It is mostly encountered in developing countries reflecting a lack of timely intervention as people do not get themselves seen at earlier stages of the condition. This is concerning as white mature cataract surgery may often be intumescent, associated with a high rate of operative complications such as incomplete continuous curvilinear capsulorrhexis (CCC), anterior capsule radial tears, rupture of the posterior capsule.[15]

Continuous curvilinear capsulorrhexis is the most critical stage in phacoemulsification surgery. It is notoriously difficult to perform in cases of mature cataract as successful implementation of the procedure depends on visualization of the red reflex coming from the posterior segment of the eye. This red reflex is what allows visualization of the anterior capsule. Poor visualization results in increased risk of capsular tears, and crystalline lens and intraocular lens dislocation.[16]

In a study assessing the effectiveness of phacoemulsification for senile white cataract in a hospital in Pakistan, out of 50 cases of some variants of mature cataract treated with phacoemulsification, 5 cases were converted to extra capsular cataract extraction which accounts for about 10% of cases compared to none requiring the conversion in our study out of 83 cases.[2] The trypan blue stain has emerged as an effective tool to allow safe continuous curvilinear capsulorrhexis with rate of conversion to ECCE being as low as 3.85% as compared to 28% without stain.[17]

Another study assessing phacoemulsification for white cataract treatment showed similar rate of radial tears extension occurring in about 3% of patients, compared to 7.2% cases in our study.[15]

Other approaches to a safer capsulorhexis in intumescent cataract include femtosecond laser assisted cataract Surgery (FLACS) and Zepto-rhexis. Both procedures have their own pros and cons, where FLACS being the expensive technique and having reproducibility of results almost similar to manual capsulorhexis. Major complication being incomplete capsulotomy formation especially in intumescent cataracts.[18] Novel technique of two staged femtosecond assisted capsulotomy is also introduced by Shultz *et al*., but this requires docking at femtosecond laser machine twice.[19] Zepto precision pulse assisted capsulorhexis gained recent popularity for its lesser cost and reproducibility.[20] Increased intra-lenticular pressure in intumescent cataract is the major culprit for extension of capsulorhexis, thus, ND YAG Laser assisted Anterior Capsulotomy before the surgery is now documented as a safer preemptive measure before performing cataract surgery in intumescent cataracts.[21] The use of high viscosity OVDs also helps to apply positive anterior chamber pressure and minimizes the risk for capsulorhexis extension/Argentina flag sign.[22] Vacum-rhexis and Vitrecto-rhexis (Vitrector-Assisted anterior Capsulotomy) have also been described as novel but safer alternatives to routine CCC in an intumescent cataract.[23,24]

ACKNOWLEDGMENTS

None.

LIMITATIONS OF STUDY

There were standard parameters for phaco as oppose to differences in the anterior chamber depth and IOP from case-to-case basis. Also, Intra-lenticular pressure could not be verified for each crystalline lens which could potentially affect the outcome.

CONCLUSION

Phaco capsulotomy is relatively safe, straight forward, cost-effective and easily available technique if patients is undergoing phacoemulsification surgery. It has a very short learning curve and the phaco parameters do not depend much upon the skill level of the surgeon. It is found to be manifold safer technique for prevention of a common complication in white mature cataracts i.e. peripheral extension of capsulorhexis as compared to two staged capsulorhexis with micro capsulorhexis forceps.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

IH & TAK: Data acquisition, data analysis, critical review, approval of the final version to be published.

SHM & MAA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AK & MUG: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Teng CC. Phaco capsulotomy: a technique to prevent the Argentinean Flag Sign. Clin Ophthalmol 2017; 6(11): 1937-1940. https://doi.org/10.2147/OPTH.S138676
2. Gul A, Ahmed S, Ali S, Raza A. Phacoemulsification in Senile White Mature Cataracts. Pak J Ophthalmol 2019; 35(4): 286-292. https://doi.org/0.36351/pjo.v35i4.881
3. Sharma B, Abell RG, Arora T, Antony T, Vajpayee RB. Techniques of anterior capsulotomy in cataract surgery. Indian J Ophthalmol 2019; 67(4): 450-460. https://doi.org/10.4103/ijo.IJO_1728_18
4. Kılıç R, Konuk ŞG, Güneş A, Çomçalı SÜ. A safe and successful capsulorhexis technique for the intumescent cataracts; modified two-stage continuous curvilinear capsulorhexis. BMC Ophthalmol 2023; 23(1): 138. https://doi.org/10.1186/s12886-023-02895-4
5. Ucar F. Spiral capsulorhexis technique with anterior chamber maintainer under continuous fluid pressure in intumescent cataracts and its clinical outcomes. J Fr Ophtalmol 2022; 45(9): 1024-1030. https://doi.org/10.1016/j.jfo.2022.04.013
6. Sharma B, Abell RG, Arora T, Antony T, Vajpayee RB. Techniques of anterior capsulotomy in cataract surgery. Indian J Ophthalmol 2019; 67(4): 450-460. https://doi.org/10.4103/ijo.IJO_1728_18
7. Joshi RS, Naik SR. Intraoperative Evaluation of Phacoemulsification Cataract Surgery with and without the Use of Ophthalmic Viscosurgical Devices. Middle East Afr J Ophthalmol 2020; 27(1): 47-52. https://doi.org/10.4103/meajo.MEAJO_140_19
8. Gamal Ebidalla Elghobaier M, Khalil Ibrahiem MF, Shawkat Abdelhalim A, Mostafa Eid A, Al Said Murad K. Clinical and Surgical Outcomes of Femtosecond Laser-Assisted Cataract Surgery (FLACS) on Hard Cataracts in the Egyptian Population. Clin Ophthalmol 2020; 14: 1383-1389. https://doi.org/10.2147/OPTH.S248670
9. Park MJ, Bang CW, Han SY. Precision pulse capsulotomy in challenging cataract surgery cases. Clin Ophthalmol 2019; 13: 1361-1368. https://doi.org/10.2147/OPTH.S217919
10. Daya S, Chee SP, Ti SE, Packard R, Mordaunt DH. Comparison of anterior capsulotomy techniques: continuous curvilinear capsulorhexis, femtosecond laser-assisted capsulotomy and selective laser capsulotomy. Br J Ophthalmol 2020; 104(3): 437-442. https://doi.org/10.1136/bjophthalmol-2018-313421
11. Oustoglou E, Tzamalis A, Mamais I, Dermenoudi M, Tsaousis KT, Ziakas N, et al. Reoperations After Cataract Surgery: Is the Incidence Predictable Through a Risk Factor Stratification System? Cureus 2020; 12(9): e10693. https://doi.org/10.7759/cureus.10693
12. Wang W, Yan W, Müller A, Keel S, He M. Association of Socioeconomics With Prevalence of Visual Impairment and Blindness. JAMA Ophthalmol 2017; 135(12): 1295-1302. https://doi.org/10.1001/jamaophthalmol.2017.3449
13. Awan A R, Jamshed J, Khan MM, Latif Z. Prevalence and causes of visual impairment and blindness among school children in Muzaffarabad, Pakistan. Int J Sci Rep 2018; 4(4): 93-8. https://doi.org/10.18203/issn.2454-2156
14. Titiyal JS, Kaur M, Shaikh F, Goel S, Bageshwar LMS. Real-time intraoperative dynamics of white cataract-intraoperative optical coherence tomography-guided classification and management. J Cataract Refract Surg 2020; 46(4): 598-605. https://doi.org/10.1097/j.jcrs.0000000000000086
15. Cetinkaya S, Gurdag T, Akcam N, Dadaci Z, Acir NO, Cetinkaya Y F, et al. Phacoemulsıfıcation in Eyes with White Mature Cataract. Scholars J Applied Med Sci 2015; 3(2): 701-704. https://doi.org/10.1016/s0886-3350(00)00525-3
16. Jhanji V, Chan E, Das S, Zhang H, & Vajpayee RB. Trypan blue dye for anterior segment surgeries. Eye (London) 2011; 25(9): 1113–1120. https://doi.org/10.1038/eye.2011.139
17. Chéour M, Ben Brahim F, Zarrad A, Khémiri N, Mghaieth K, Kraiem A. Phacoémulsification des cataractes blanches en utilisant le bleu trypan [Trypan blue capsule staining for phacoemulsification in white cataract]. J Fr Ophtalmol 2007; 30(9): 914-917. https://doi.org/10.1016/s0181-5512(07)74028-7
18. Issa M, Tong L, Somani S. Argentinian flag sign during refractive laser-assisted cataract surgery - A case report. Am J Ophthalmol Case Rep 2022; 29: 101764. https://doi.org/10.1016/j.ajoc.2022.101764
19. Schultz T, Dick HB. Laser-assisted mini-capsulotomy: a new technique for intumescent white cataracts. J Refract Surg 2014; 30(11): 742-745. https://doi.org/10.3928/1081597X-20141021-05
20. Chang DF. Zepto precision pulse capsulotomy: A new automated and disposable capsulotomy technology. Indian J Ophthalmol 2017; 65(2): 1411-1414. https://doi.org/10.4103/ijo.IJO_737_17
21. Porwal AC, Jethani JN, Porwal KA, Shrishrimal M, Shah PR. Role of Preoperative Nd:YAG Laser Anterior Capsulotomy in Mature Intumescent Cataracts. Asia Pac J Ophthalmol (Phila) 2021; 10(5): 473-477. https://doi.org/10.1097/APO.0000000000000386
22. Hengerer FH, Dick HB, Kohnen T, Conrad-Hengerer I. Assessment of intraoperative complications in intumescent cataract surgery using 2 ophthalmic viscosurgical devices and trypan blue staining. J Cataract Refract Surg 2015; 41(4): 714-718. https://doi.org/10.1016/j.jcrs.2014.06.039
23. Mahajan S, Sood G, Garg R. Vacuum rhexis - A novel capsulorhexis technique for white cataracts. Indian J Ophthalmol 2022; 70(11): 4043-4046. https://doi.org/10.4103/ijo.IJO_1631_22
24. Limon U, Akçay BIS. Capsulorhexis with 23-gauge vitreous cutter in intumescent cataract surgery: Case series. Saudi J Ophthalmol 2023; 37(2): 158-160. https://doi.org/10.4103/sjopt.sjopt_92_22