

Effect of Different Scleral Incisions in Small Incision Cataract Surgery on Post-Operative Astigmatism: A Prospective Study

Dr. Sonal Muley Senior Resident Dept. Of Ophthalmology Datta Meghe Medical College
Shalinitai Meghe Hospital And Research Centre Nagpur-441110 (Datta Meghe Institute Of
Medical Sciences)

Dr. Nikhil Pande Associate Professor Dept. Of Medical Oncology Jawaharlal Nehru
Medical College, Datta Meghe Institute Of Medical Sciences Sawangi (Meghe) Wardha-
442001

Dr. Chetan Saoji Assistant Professor Dept. Of Ophthalmology Datta Meghe Medical
College Shalinitai Meghe Hospital And Research Centre Nagpur-441110 (Datta Meghe
Institute Of Medical Sciences)

Dr. Shruti Sanghavi Senior Resident Dept. Of Ophthalmology Datta Meghe Medical
College Shalinitai Meghe Hospital And Research Centre Nagpur-441110 (Datta Meghe
Institute Of Medical Sciences)

Address For Correspondence

Dr. Nikhil Pande

Associate Professor Dept. Of Medical Oncology
Jawaharlal Nehru Medical College, Datta Meghe Institute Of Medical Sciences
Sawangi (Meghe) Wardha-442001
Email.Id. Nspande@Gmail.Com Mob No. 09867676938

Abstract

To Study The Tunnel Incision Forms (Frown Versus Straight Versus Bluementhal Cuts) In Manual Small Incision Cataract Surgery And Find Out Which Incision Creates More Corneal Astigmatism. Hundred Eyes Of 100 Patients Who Had Assented To Undergo Cataract Surgery After Written Informed Consent In Their Regional Language And To Participate In This Study Were Followed Preoperatively And Through 4 Week Postoperative Period. Values Of Preoperative And Postoperative Corneal Astigmatism For 100 Eyes, Measured With A Topcon Autorefractometer, Were Obtained From The Patients' Cataract Surgery Records. Visual Acuity Was Measured pre-Operatively And At Each Postoperative Visit. Patients Undergoing Sics With Straight Incision Had Significantly Greater Astigmatism Than Frown Incision And Incision With Bluementhal Cuts On All Post-Operative Follow Ups (P Value < 0.0001). The Best Corrected Visual Acuity In Patients With Straight Incision Was Significantly Worse Than Frown And Bluementhal Cuts In All The Post-Operative Visits (P Value < 0.0001).

The Best Corrected Visual Acuity In Patients Undergoing Sics With Frown And Bluementhal Cuts On All Post-Operative Follow Ups Was Not Significantly Different. We Conclude That Frown And Incision With Bluementhal Cuts Provide Lesser Astigmatism And Faster

Rehabilitation Of Vision. Bluementhal Cuts Provide Larger Tunnel And Are Easy To Construct As Compared To Frown Incision And Hence Can Replace Straight Incision.

Keywords: Bluementhal, Sics, Astigmatism, Autorefractometer And Cataract Surgery

Introduction

Cataract Surgery Has Undergone Many Modifications and The Size Of Incision Has Decreased from An Incision Of 12.0 Mm For Intracapsular Cataract Extraction To 2.2–2.8 Mm In Phacoemulsification. However, Phacoemulsification Is An expensive Technique And Requires High Cost Equipment Maintenance Which Cannot Be Employed Widely In Developing Countries. Manual Small-Incision Cataract Surgery (Msics) Offers Similar Advantages And Is Less Time Consuming, Has A Quicker Learning Curve, Is cost effective, And Is A Faster Technique [1].

Quality Of Vision And Early Restoration Of Vision Are Two Factors That Determine The Success Of Cataract Surgery. Newer Innovations In Surgical Techniques, Instruments, And Drugs Have Made Cataract Surgery Almost Risk Free. Kelman, In 1967, Introduced The Technique Of Phacoemulsification Which Revolutionized The Field Of Cataract Surgery.[2]. Other Innovations Of Fry,[3] Kansas And Sax,[4] Rozakis,[5] Bluementhal *Et Al.*, And Anis Have Achieved Similar Results Without The Attendant Technology[6,7] In The Form Of Manual Sics (Msics).

The Effectiveness Of Cataract Surgery Is Measured By How Well The Patient Recovers Both Visually And Functionally. This Has A Lot To Do With The Extent Of The Wound. Phacoemulsification Was The Only Method For Making A Small Incision In The Early 1980s. Alternative Approaches Were Introduced, With Keener[8] Using A Constricting Wire Loop In 1983. Fry[3] Proposed The Phacosandwich Technique, While Peter Kansas[4] Proposed The Phacosection Technique. Kratz[9] Revolutionized Non-Phaco Manual Small Incision Cataract Surgery With The Invention Of The Sclerocorneal Pocket Tunnel Incision. (Msics).

A Smaller Incision Benefits Both The Patient And The Surgeon By Allowing For Faster Recovery, Improved Intraocular Pressure Control, And Minimal Or No Postoperative Astigmatism And Complications. Msics's Basic Procedure Takes Into Account A Sutureless And Self-Sealing Incision.

Manual Sics Is A Self Sealing Cataract Surgery Due To The Sclera-Corneal Tunnel Construction. Low Cost Of Instruments In Manual Sics Is A Distinct Advantage[10,11]. Manual Sics Is more appropriate For Advanced And Hard Sclerotic Cataracts Frequently Seen In Developing Countries[12]. In This Incision The Internal Incision In The Anterior Chamber Is Remote From The External Scleral Incision And The Two Are Connected Together By A Sclera Corneal Tunnel. When The Internal Pressure Of The Eye Is Re- Established, The High Intraocular Pressure (Iop), Compared To The Lower Atmospheric Pressure Causes The Tunnel To Collapse And Self Seal.

The Various Incisions Which Are Used In Manual Sics Vary According To Their Site, Dimensions, Design And Architecture. The Site Of Incision Can Be Superior Or Superotemporal Or Temporal. The Dimensions Of The Incision Can Vary From A 3.5mm To A 6mm Or Longer In Case Of Rigid Iols. Other Factors Which Affect Incision Size Are;

Type Of Intraocular Lens – Incision Size Is Small For Foldable Iols And Large For Rigid Iols. (Pmma).

Type Of Cataract – Incision Size Will Be Larger For Hard Brown Cataract
 Technique Of Nucleus Delivery – Small Incision Size Is Enough If Nucleus Is Divided In Anterior Chamber And Removed In Two Pieces.
 Skill Of The Surgeon.
 Design Of The Wound – In The Wound Design, The Internal Incision Is Always Larger Than The External, Giving The Shape Of A Funnel To The Wound. The Inner Lip Of The Wound Normally Has A Width Of 8 To 9 Mm.

Various Configurations Of Incision In Manual Sics Are:

1. Straight Incision
2. Chevron Or Inverted V-Shaped Incision
3. Frown Incision
4. Blumenthal Side Cuts.

Straight Incision

The First Scleral Incision Was Performed By Colvard *Et Al.* In 1980[12] .Straight Incision Is Performed By Making A Straight Line Incision About 2 Mm Away From Limbus With A 15 No. Blade.Mcfarland In 1989 Performed The First Self Sealing Incision By Improvising Wound Architecture[13].

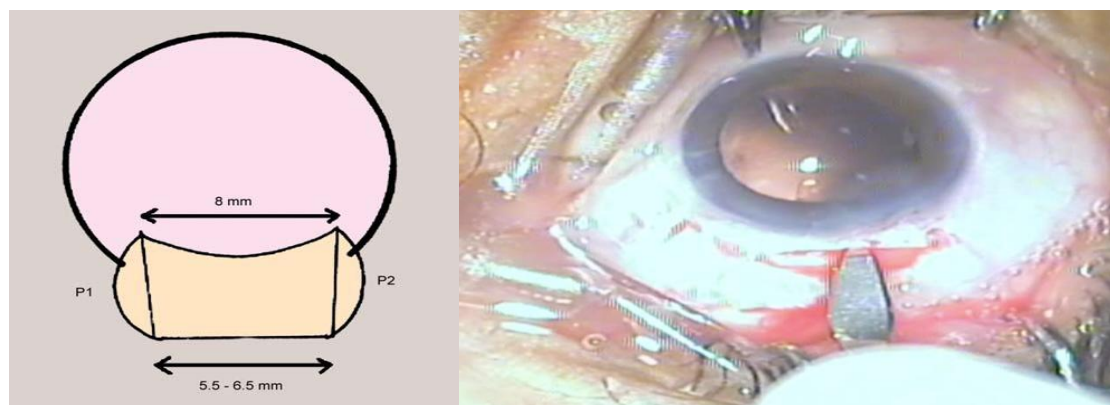


Fig 1 Showing A Straight Incision With A External Incision Of 5.5-6.5mm And A Internal Incision Of 8 Mm With Two Side Pockets (P 1 And P2)[14].Image 1 Showing A Straight Incision Being Made And Dissected.

Chevron's Inverted V-Shaped Incision

In 1990, Pallin First Performed A Inverted V-Shaped Chevron's Incision.[15] . The Incision Is Made In The Shape Of An Inverted V, With The Apex Near The Limbus And The Limbs Away. It Is Difficult To Produce, But It Results On The Least Amount Of Astigmatism.

Frown Incision

Singer Developed The Frown Incision In 1991, Which Created Less Astigmatism But More Than Chevron Incision Since Each End Of The Incision Is Farther Away From The Limbus[16]. It Has A Curved Pocket Incision In The Opposite Direction Of The Limbus. Fig 2 [14]

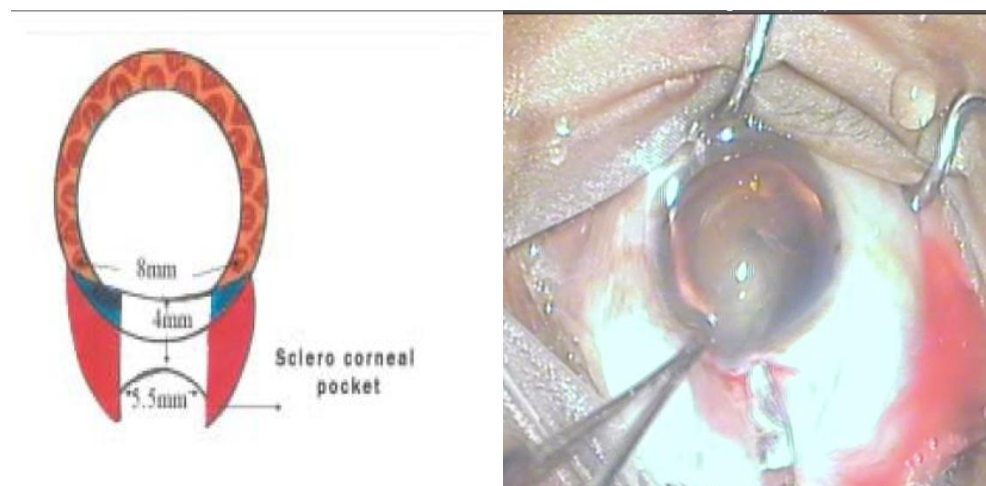
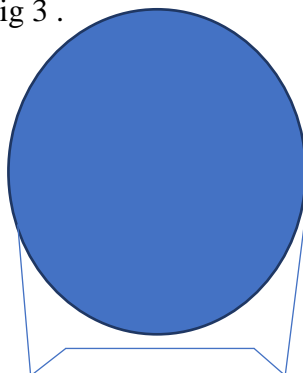


Image 2

Fig 2 Showing A Frown Incision With A External Incision Of 5.5 Mm And A Internal Incision Of 8 Mm After Side Pockets Construction[12]. Image 2 One Showing A Frown Incision Being Made.

Blumenthal Side Cuts

Blumenthal *Et Al.* Created The Blumenthal Side Cuts, A Large Pocket Tunnel With Minimally Induced Astigmatism, In 1993[17]. It Is A 5.5 Mm Straight Incision With Two Oblique Cuts At Its 2 Ends Fig 3 .



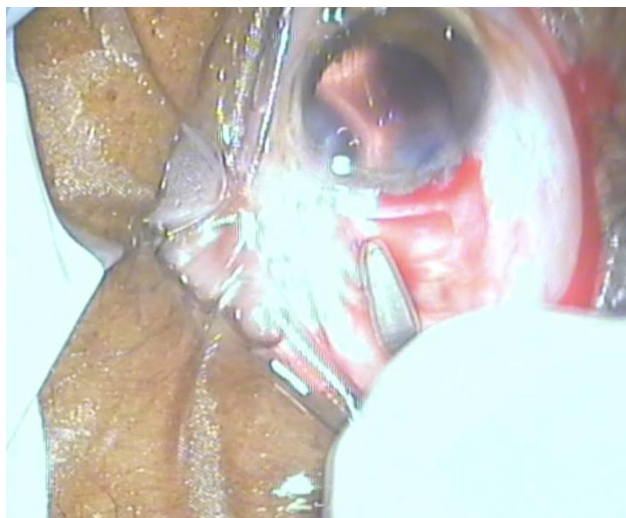


Image 3.

Fig 3 Showing A Straight Incision Of 5.5mm With Oblique Side Cuts Of 1mm , The Internal Incision Is Much Larger Than The External Incision Thereby Providing A Large Tunnel For Easy Nucleus Delivery. Image 3 Showing A Straight Incision With Bluementhal Cuts Being Made.

Our Study Is Aimed To Prove That Frown Incision And Bluemnthal Cuts Provide Minimal Astigmatism And Early Visual Recovery And Stabilisation Of Vision, Frown Incision Is Difficult To Construct And Requires Greater Expertise And Training, Bluementhal Cuts Are Easy To Construct And Also Provide A Larger Tunnel Thereby Facilitating Easy Nucleus Delivery And Better Anterior Chamber Maintenance.

Materials And Methods

This Cross-Sectional Interventional Study Was Carried Out In Ophthalmology Department At Datta Meghe Medical College, Shalinitai Meghe Hospital And Research Centre, Nagpur In Collaboration With Jawaharlal Nehru Medical College, Datta Meghe Institute Of Medical Sciences, Sawangi (Meghe) Wardha, Maharashtra.

100 Patients Were Enrolled To Participate In The Study. Their Written Informed Consent Was Taken In Their Regional Language.

Patients Were Randomly Divided Into 3 Groups .

Group 1 (35 Patients): Straight Incision

Group 2 (36 Patients): Frown Incision

Group 3 (29 Patients): Blue Mentalbackcuts

Keratometry, Best Corrected Visual Acuity(Visual Acuity Was Entered In Logmar Form), Autorefractometer Readings Of All Patients Was Recorded Before The Surgery And On Post-Operative Day 1, Post-Operative Day 7 And Post-Operative Day 1 Month.

All Patients Were Dilated With Tropicamide Eyedrops. All Patients In All The Three Groups Were Administered Peribulbar Block Anaesthesia Employing A Solution Of 1:1 Compounded 2% Lidocaine Plus Adrenaline 1:200,000 (Lox 2%, Neon Laboratories, India) And 0.5% Bupivacaine (Anawin 0.25%, Neon Laboratories, India), With Hyaluronidase (Entodase, Entod Pharmaceuticals Ltd., India).

Surgery Was Done In The Following Steps.

- 1) Speculum Placed.
- 2) Superior Rectus Bridle Suture Was Taken.
- 2) Superior Conjunctival Peritomy Was Taken And A Conjunctival Flap Was Made.
- 3) A 15 No. Blade Was Used To Make The Incision(A Straight Incision Of 5.5mm With 1 Mm Oblique Back Cuts Or A Frown Incision Or A Straight Incision Of 6.5mm), The Tunnel Was Then Formed Using A Creascent Blade, The Creascent Blade Is Used To Form The Scleral Pocket And Then The Dissection Is Continued 1 Mm In To The Cornea And Side Pockets Are Formed So That The Internal Incision Is Larger Than The External Incision, A Microkeratome 2.8 Mm Is Used To Enter Into The Anterior Chamber, The Microkeratome Is Introduced Into The Tunnel Till The Tip Of The Keratome Reaches The End Of The Corneal Tunnel,The Keratome Is Then Tilted Downwards To Enter Into The Anterior Chamber.
- 4) Continuous Curvilinear Capsulorrhexis Is Performed Usig A Cystitome Formed By 26 No. Needle Under Viscoelastic.
- 5) Hydrodissection And Hydrodelineation Is Performed By Injecting The RI Using A Hydro Canula
- 6) Nucleus Is Prolapsed Into The Anterior Chamber With A Dialler Under Viscoelastic Substance.
- 7) Nucleus Is Delivered Witha Wire Vectis.
- 8) Irrigation Aspiration Is Performed Using A Simco Canula To Remove Residual Cortex.
- 9) Rigid Pciol Of 6 Mm Optic Is Inserted Under Viscoelastic.
- 10) Subconjunctival Injection Of Gentamycin And Dexamethasone (0.25 Cc Each).
- 11) Cauterization Of Conjunctival Flap.
- 12) Speculum Is Removed And Ye Is Patched.

In Group 1 Patients, A Straight Scleral Incision Of Size 6.5 Mm Was Made.

In Group 2 Patients , A Frown Incision Was Made , Curved With Straight 1 Mm And Curved Back Cuts.

In Group 3 Patients, Bluementhalcuts With A Straight 5-5.5 Mm With Oblique Backcuts Of 1 Mm.

Results:

This Study Had 45 Males And 55 Females.

Mean Age Of The Patients Was 60.34 With A Standard Deviation Of 5.7.

Group 1 (35 Patients):

Astigmatism And Best Corrected Visual Acuity Results In Group 1 Patients:

Table No 1:

This Table Shows Astigmatism And Best Corrected Visual Acuity In Group 1 Patients When They Are Followed Up From Day 1 Post Operatively Till 1 Month Post Operatively. The Astigmatism On Day 1 Was Found To Be 4.72 ± 0.61 Which Decreased Progressively To 3.2 ± 0.77 1 Month After Surgery. The Best Corrected Visual Acuity Improved Progressively From Day 1 After Surgery 0.922 ± 0.168 To 0.533 ± 0.13 1 Month Post Operatively.

Group1(Straight Incision)	Post Op Day 1	Postop Day 7	Post Op Day 1 Month
Astigmatism(In Diopres)	4.72 ± 0.61	3.63 ± 0.86	3.2 ± 0.77
Best Corrected Visual Acuity(Logmar)	0.922 ± 0.168	0.77 ± 0.067	0.533 ± 0.13

Table No 2:

This Table Shows Astigmatism And Best Corrected Visual Acuity In Group 2 Patients When They Are Followed Up From Day 1 Post Operatively Till 1 Month Post Operatively. The Astigmatism On Day 1 Was Found To Be 2.27 ± 0.57 Which Decreased Progressively To 1.16 ± 0.377 1month After Surgery. The Best Corrected Visual Acuity Improved Progressively From 0.6 ± 0.02 Day 1 After Surgery To 0.22 ± 0.1 1 Month Post Operatively.

Group 2(Frown Incision)	Post Op Day 1	Post Op Day 7	Post Op Day 30
Astigmatism(In Diopres)	2.27 ± 0.57	1.27 ± 0.45	1.16 ± 0.377
Best Corrected Visual Acuity(Logmar)	0.6 ± 0.02	0.68 ± 0.3	0.22 ± 0.1

Table No. 3:

Group 3(Blumenthal Cuts):This Group Comprised Of 29 Patients. This Table Shows Astigmatism And Best Corrected Visual Acuity In Group 2 Patients When They Are Followed Up From Day 1 Post Operatively Till 1 Month Post Operatively. The Astigmatism On Day 1 Was Found To Be 3.89 ± 0.3 Which Decreased Progressively To 1.1 ± 0.3 1month After Surgery. The Best Corrected Visual Acuity Improved Progressively From 0.6 ± 0.04 Day 1 After Surgery To 0.21 ± 0.03 1 Month Post Operatively.

Group 3(Blumenthal Cuts)	Post Op Day 1	Post Op Day 7	Post Op Day 1 Month
Astigmatism(In Dioptries)	3.89 ± 0.3	2.1 ± 0.4	1.1 ± 0.3
Best Corrected Visual Acuity(Logmar)	0.6 ± 0.04	0.6 ± 0.07	0.21 ± 0.03

Group 1 Patients Had Significantly Greater Astigmatism Than Group 2 And Group 3 Patients On All Post-Operative Follow Ups (P Value < 0.0001).The Best Corrected Visual Acuity In Group 1 Patients Was Significantly Worse Than Group 2 And Group 3 Patients In All The Post-Operative Visits(P Value<0.0001).

The Astigmatism On Post-Operative Day 1 In Group 3 Patients Was Significantly Higher Than In Group 2 Patients(P Value<0.0001).On Post-Operative Day 7, The Astigmatism In Group 3 Was Significantly Higher Than Group 2(P Value<0.0001).On Post Op Day 30, The Astigmatism In Group 2 And Group 3 Was Not Significantly Different.

The Best Corrected Visual Acuity In Group 2 And 3 Patients On All Post-Operative Follow Ups Was Comparable(Not Statistically Significant).

Discussion

Cataract Surgery Has Improved Dramatically In Recent Years,Primarily To Meetpatients' Expectations Of Early Visual Rehabilitation And Minimal Surgical Induced Astigmatism. Present Day Cataract Surgery Aims Not Only Forrestoration Of Sight And Reduction Of Economic Blindnessbut Also Onearly Restoration Of Optimum Visual Acuity And Thus, A Reduction In Induced Astigmatism.

It Is Reported From Previous Studies That Patients Undergoing Manual Sics Have An Early Rehabilitation Of Vision[18-20].

Phacoemulsification Has Become The Most Favoured Procedure For Cataract Surgery In Industrialized Countries. In Developing Countries, Considering The Lower Cost And Lesser Instrumentation, Manual Sutureless Self-Sealing Small Incision Cataract Surgery Is The Most Favoured Procedure.

Hence, Modern Cataract Surgery, In Its Quest For Providing The Best Uncorrected Visual Acuity To The Patient And Minimizing Surgically Induced Astigmatism Has Become A Refractive Surgery Today. With The Goal Not Only To Remove The Cataract But Also To Minimize Astigmatism Induced By Surgery And To Reduce The Preoperative Astigmatism, If Any, In The Patient.

Several Studies Have Found That Cataract Surgery Alters The Power Of Preoperative Astigmatism[21-26]. The Average Age Of Our Study Participants Was 64.34 ± 15.64 Years. This Is Consistent With What Many Literature Sources Say That Cataract Is Still A Common Condition Among People In Their Fifth And Beyond Decades Of Life. Metabolic Diseases Are A Frequent Occurrence In Old Age Patients, This Also Leads To An Increased Incidence Of Cataract In This Age Group[27].

Our Study Demonstrates That Group 1(Patients With Straight Incision) Patients Had Significantly Greater Astigmatism Than Group 2(Patients With Frown Incision) And Group 3(Patients With Bluementhal Cuts) Patients On All Post-Operative Follow Ups (P Value < 0.0001).The Best Corrected Visual Acuity In Group 1 Patients Was Significantly Worse Than Group 2 And Group 3 Patients In All The Post-Operative Visits(P Value<0.0001).

The Astigmatism On Post-Operative Day 1 In Group 3 Patients Is Significantly Higher Than In Group 2 Patients(P Value<0.0001).On Post-Operative Day 7, The Astigmatism In Group 3 Was Significantly Higher Than Group 2(P Value<0.0001).On Post Op Day 30, The Astigmatism In Group 2 And Group 3 Was Not Significantly Different.

The Best Corrected Visual Acuity In Group 2 And 3 Patients On All Post-Operative Follow Ups Was Not Significantly Different.

Many Previous Studies Have Demonstrated The Benefits Of Frown Incision Over Straight Incision In Reducing Astigmatism In Small Incision Cataract Surgery And Early Rehabilitation Of Vision[28,29,16].On The Other Hand, A Study By Angela Amedo Et Al Established That Straight Incision Gave A Greater Residual Astigmatism Than Frown Incision But Did Not Find A Statistically Significant Differences In Best Corrected Visual Acuity Between The Two Incision Groups[30].Daigavane Et. Al. Compared Visual Outcomes And Complications Of Scleral-Fixated Intraocular Lens And Iris-Claw Lens In Aphakic Patients[31]. Muley Et. Al. Reported On The Effect Of Intracameral Adrenaline Bolus Injection On Pupil Size, Pulse Rate And Blood Pressure During Small Incision Cataract Surgery[32]. Shekhar And Tidake Compared Visual Outcome, Astigmatism, And Complications Between Conventional Extracapsular Cataract Extraction And Manual Small Incision Cataract Surgery [33]. Bajpayee Et. Al. Compared Visual Acuity And Astigmatism Determination Between Small Incision Cataract Surgery And Phacoemulsification By Corneal Topography[34]. Few Relevant Studies On Cataract Were Reported By Bele Et. Al. [35], Nimbalkar Et. Al. [36] And Gu Et. Al. [37].

Our Study Establishes That Frown Incision And Bluementhal Cuts Have Similar Results With Respect To Astigmatism And Early Stabilization Of Visual Acuity. Bluementhal Cuts Are Also Easy To Perform As Compared To Frown Incision And Provide A Larger Tunnel As Compared To Frown Or Straight Incision Thereby, Facilitating Easy Nucleus Delivery With Better Intraocular Pressure Control And Anterior Chamber Maintenance.

Conclusion

All These Incisions Produce Less Astigmatism If Placed Posteriorly On The Sclera. Cataract Surgery Is Soon Turning Into A Refractive Procedure , With Aims For Early Restoration Of Vision And Inducing Lesser Astigmatism.

Further Studies With Bigger Sample Size And Longer Follow Up Periods Are Needed On This Subject ,Also Further Studies With Corneal Biomechanics And Topography Are Needed To Throw Further Light On This Subject.

Bibliography

1. Singh K, Misbah A, Saluja P, Singh Ak. Review Of Manual Small-Incision Cataract Surgery. *Indian J Ophthalmol*. 2017;65(12):1281-1288. Doi:10.4103/Ijo.Ijo_863_17
2. Kelman Cd. Phaco-Emulsification And Aspiration. A Report Of 500 Consecutive Cases. *Am J Ophthalmol*. 1973;75:764–8. [PubMed] [Google Scholar]
3. Fry Ll. *The Phaco Sandwich Technique*. Thorofare, N.J: Slack; 1990. Pp. 91–110. [Google Scholar]
4. Kansas Pg, Sax R. Small Incision Cataract Extraction And Implantation Surgery Using A Manual Phacofragmentation Technique. *J Cataract Refract Surg*. 1988;14:328–30. [PubMed] [Google Scholar]
5. Rozakis Gw. *Cataract Surgery Alternative Small-Incision Techniques*. Thorofare, N.J: Slack; 1990. Pp. 71–110. [Google Scholar]
6. Blumenthal M, Ashkenazai I, Assia E, Cahore M. Small Incision Manual Ecce Using Selective Hydrodissection. *Ophthalmic Surg*. 1992;23:699–701. [PubMed] [Google Scholar]
7. Anis Ay. Understanding Hydrodissection The Term And Related Procedures. *Oculsurg News*. 1990;8:142–3. [Google Scholar]
8. Keener Gt., Jr . The Nucleus Division Technique For Small Incision Cataract Extraction. In: Rozakis Gw, Anis Ay, Editors. *Cataract Surgery: Alternative Small Incision Techniques*. Indian Ed. Jaypee Brothers; 1995. Pp. 163–95. [Google Scholar]
9. Bryant Wr. The Scleral Pocket Incision. In: Rozakis Gw, Anis Ay, Editors. *Cataract Surgery: Alternative Small Incision Techniques*. Indian Ed. Jaypee Brothers; 1995. Pp. 1–43. [Google Scholar].
10. Pershing S, Kumar A. Phacoemulsification Versus Extracapsular Cataract Extraction: Where Do We Stand? *Curropinophthalmol*. 2011;22(1):37–42.
11. Gogate P, Deshpande M, Nirmalan Pk. Why Do Phacoemulsification? Manual Small-Incision Cataract Surgery Is Almost As Effective, But Less Expensive. *Ophthalmology*. 2007;114(5):965–968.
12. Colvard Dm, Kratz Rp, Mazzocco Tr, Davidson B. Clinical Evaluation Of The Terry Surgical Keratometer. *J Am Intraocul Implant Soc*. 1980;6:249–51. [PubMed] [Google Scholar].
13. Mcfarland M. *Small Incision Cataract Surgery, Foldable Lenses, One Stitch Surgery Sutureless surgery*. Thorofare, N.J: Slack; 1990. Pp. 107–16. [Google Scholar]
14. Malik Kp, Goel R. Techniques Of Non Phaco Small Incision Cataract Surgery (Sics) In: Dutta Lc, Editor. *Modern Ophthalmology*. 3rd Ed. Jaypee Brothers; 2005. Pp. 376–86.
15. Pallin Sl. Chevron Sutureless Closure: A Preliminary Report. *J Cataract Refract Surg*. 1991;17(Suppl 1):706–9. [PubMed] [Google Scholar]

16. Singer Ja. Frown Incision For Minimizing Induced Astigmatism After Small Incision Cataract Surgery With Rigid Optic Intraocular Lens Implantation. *J Cataract Refract Surg.* 1991;17(Suppl 1):677–88. [PubMed] [Google Scholar]
17. Blumenthal M, Ashkenazi I, Fogel R, Assia Ei. The Gliding Nucleus. *J Cataract Refract Surg.* 1993;19:435–7. [PubMed] [Google Scholar].
18. Jha Kn, Vats Dp. Manual Small Incision Cataract Surgery: Experience At A Military Hospital. *Mjafi.* 2006;62(3):212–215.
19. Yorston D, Foster A, Wood M. Does Prospective Monitoring Improve Cataract Surgery Outcomes In Africa? *Br J Ophthalmol* 2002; 86: 543-7.
20. Roman Sj, Auclin Fx, Chong-Sit Da, Ullern Mm. Surgically Induced Astigmatism With Superior And Temporal Incisions In Cases Of With-The-Rule Preoperative Astigmatism. *J Cataract Refract Surg* 1998; 24: 1636-1641.
21. Behndig A, Montan P, Stenevi U, Kugelberg M, Zetterström C, Lundström M. Aiming For Emmetropia After Cataract Surgery: Swedish National Cataract Register Study. *J Cataract Refract Surg.* 2012;38(7):1181–1186. [PubMed] [Google Scholar]
22. Yao K, Tang X, Ye P. Corneal Astigmatism, High Order Aberrations, And Optical Quality After Cataract Surgery: Microincision Versus Small Incision. *J Refract Surg.* 2006;22(9 Suppl):S1079–S1082. [PubMed] [Google Scholar]
23. Elkady B, Alió JI, Ortiz D, Montalbán R. Corneal Aberrations After Microincision Cataract Surgery. *J Cataract Refract Surg.* 2008;34(1):40–45. [PubMed] [Google Scholar]
24. Achar A, Kadri R, Hegde S, Kudva A, Devika P, John V. Surgically Induced Astigmatism Following Cataract Surgery: A Comparative Study. *Int J A.J. Inst Med Sci.* 2013;2(1):44. [Google Scholar]
25. Cho Yk, Kim Ms. Perioperative Modulating Factors On Astigmatism In Sutured Cataract Surgery. *Korean J Ophthalmol.* 2009;23(4):240–248. [Pmc Free Article] [PubMed] [Google Scholar]
26. Jauhari N, Chopra D, Chaurasia Rk, Agarwal A. Comparison Of Surgically Induced Astigmatism In Various Incisions In Manual Small Incision Cataract Surgery. *Int J Ophthalmol.* 2014;7(6):1001–1004. [Pmc Free Article] [PubMed] [Google Scholar]
27. Khurana Ak. *Diseases Of The Lens Comprehensive Ophthalmology.* 4 Ed. India: New Age International®, Limited; 2007. Pp. 167–200. [Google Scholar].
28. Chourasia P, Kumar G, Kumar S. Comparison Of Surgically Induced Astigmatism In Manual Small Incision Cataract Surgery Following Straight Versus Frown Incision. *International Journal Of Research And Review.* 2019; 6(9):328-336.
29. Jauhari N, Chopra D, Chaurasia Rk, Agarwal A. Comparison Of Surgically Induced Astigmatism In Various Incisions In Manual Small Incision Cataract Surgery. *Int J Ophthalmol.* 2014;7(6):1001-1004. Published 2014 Dec 18. Doi:10.3980/J.Issn.2222-3959.2014.06.16
30. Amedo Ao, Amoah K, Koomson Ny, Ben Kumah D, Osae Ea. Assessment Of Corneal Astigmatism Following Frown And Straight Incision Forms In Sutureless Manual Small Incision Cataract Surgery. *Clin Optom (Auckl).* 2016;8:47-52. Published 2016 Apr 22. Doi:10.2147/Opto.S98920.
31. Daigavane, S., V. Shende, And M. Prasad. “Comparison Of Visual Outcomes And Complications Of Scleral-Fixated Intraocular Lens And Iris-Claw Lens In Aphakic Patients.” *Journal Of Datta Meghe Institute Of Medical Sciences University* 14, No. 4 (2019): 326–29. https://doi.org/10.4103/Jdmimsu.Jdmimsu_171_19.
32. Muley, S., C. Saoji, And S. Daigavane. “The Effect Of Intracameral Adrenaline Bolus Injection On Pupil Size, Pulse Rate And Blood Pressure During Small Incision

- Cataract Surgery.” International Journal Of Current Research And Review 12, No. 14 Special Issue (2020): 114–18. <https://doi.org/10.31782/Ijcr.2020.114118>.
33. Shekhar, S., And P.K. Tidake. “Comparative Study Of Visual Outcome, Astigmatism, And Complications Between Conventional Extracapsular Cataract Extraction And Manual Small Incision Cataract Surgery.” Journal Of Datta Meghe Institute Of Medical Sciences University 15, No. 2 (2020): 215–22. https://doi.org/10.4103/Jdmimsu.Jdmimsu_201_20.
 34. Bajpayee, N., P.K. Tidake, And P.M. Palsodkar. “Comparative Study Of Visual Acuity And Astigmatism Determination Between Small Incision Cataract Surgery And Phacoemulsification By Corneal Topography.” International Journal Of Current Research And Review 12, No. 22 Special Issue (2020): 65–68. <https://doi.org/10.31782/Ijcr.2020.Sp82>.
 35. Bele, A., P. Tidake, And P.S. Patil. “A Comparative Study Of Visual Acuity And Surgically Induced Astigmatism After Phacoemulsification By Temporal Clear Corneal And Superior Clear Corneal Incision.” International Journal Of Pharmaceutical Research 11, No. 4 (2019): 2006–12. <https://doi.org/10.31838/Ijpr/2019.11.04.501>.
 36. Nimbalkar, G., V. Wagh, A. Gaidhane, K.G. Chhabra, S. Deolia, And A. Ingole. “A Study To Determine The Role Of Different Types Of Intraocular Lenses In The Management Of Traumatic Cataract In A Tertiary Healthcare Centre.” European Journal Of Molecular And Clinical Medicine 7, No. 7 (2020): 2035–39.
 37. Gu, A., S. Daigavane, And P.M. Palsodkar. “Effect Of Heparinised Irrigating Solution During Cataract Surgery On Postoperative Inflammation.” International Journal Of Pharmaceutical Research 11, No. 2 (2019): 1800–1803. <https://doi.org/10.31838/Ijpr/2019.11.02.200>.