ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 03 | March - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STEEL SUTURES IN PENETRATING KERATOPLASTY

Ophthalomology

Dr. Shakeen Singh MS Ophthalmology, Professor And Head, Department Of Ophthalmology, SGRD Medical College, Amritsar, Punjab.

Dr. Shivani Chhabra* MS, DNB Ophthalmology, Senior Resident, Department Of Ophthalmology, SGRD Medical College, Amritsar, Punjab. *Corresponding Author

ABSTRACT

Background: Corneal diseases are amongst the common causes of blindness in developing countries. Penetrating keratoplasty (PKP) or corneal transplantation, which involves replacement of diseased cornea with a healthy donor corneal tissue, remains the only treatment option in majority of such cases. A variety of suturing techniques exist for corneal transplant with nylon or mersilene material .However, there is limited insight on steel sutures in penetrating keratoplasty. **Materials And Methods:** We performed penetrating keratoplasty on 15 eyes using 40 micron vanadium stainless steel sutures in this study. Standard technique of PKP was followed. All patients were clinically observed for visual acuity, vascularisation, inflammatory reactions, the presence of infiltrates, graft clarity at follow-up visits post-operatively. **Results:** We faced no complication during the procedure of applying steel sutures. Post-operatively, none of the patient presented with fibrinoid material or any reaction. No vascularisation, no sign of infiltration was observed. None of the eye had loose sutures. 2 patients (13.3%) however complained of irritation which required removal of sutures under slit lamp. **Conclusion:** Steel suture is a viable option for penetrating keratoplasty for long term stability of the graft with minimum suture related complications.

KEYWORDS

vanadium stainless steel, penetrating keratoplasty, vascularisation, steel suture

INTRODUCTION

Corneal diseases represent a major burden and are an important cause of visual disability and blindness.[1] Frequently, the main option for visual rehabilitation of patients with diseased corneas is corneal transplantation.[2] Zirm performed the first corneal transplantation in 1905.[3] Keratoplasty is a well-established surgical procedure to treat different corneal disorders. Well known indications for keratoplasty include keratoconus, corneal opacities and many corneal dystrophies. Penetrating Keratoplasty (PK) involves full-thickness corneal graft transplantation. Effective suturing is the key for successful outcome in corneal surgery. The primary purpose of suture placement is adequate wound apposition and closure in a normal anatomical position. Suture must be easy to handle, easy to knot and strong, and adjustment of a running suture must not cause it to rupture. A variety of suturing techniques exist for penetrating keratoplasty with nylon or mersilene material. However, there is limited insight collating steel sutures in keratoplasty. We report an article performing penetrating keratoplasty with steel sutures at a tertiary care hospital in Northern India.

SUTURE MATERIALS

Currently two main suture materials in use are: Nylon and Mersilene. Nylon sutures are biodegradable in nature, leads to loosening and breakage, resulting in unpredictable astigmatism many years after surgery.[4] Mersilene is a polyester monofilament that is neither hydrolyzed nor degraded by ultraviolet light and is classified as non-biodegradable. Though theoretically, it is more durable; however, use of mersilene is limited because of difficult handling, reported up to 5.5 times increased likelihood of handling complications compared to nylon sutures.[5] Mersilene is also associated with greater risk of complications within two years of surgery, including corneal infiltrates, metaplasia, and cheese-wiring.[6]The use of stainless steel as suture material in ophthalmology was introduced several years ago by J.G.F Worst.[7] This thin 40 micron vanadium stainless steel material is biologically inert with exceptionally high tensile strength. Extreme knot security , good ocular biocompatibility with minimal tissue reactivity are known benefits of steel material.

SURGICAL TECHNIQUE

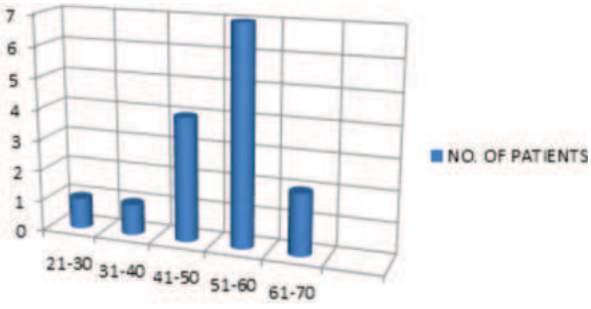
All penetrating keratoplasties were performed by a single experienced surgeon under peribulbar block. Under complete aseptic precautions, eye was painted and draped. Lids were separated using Barraquer wire speculum. Evaluation of the donor cornea was done under microscope. After assuring the quality of donor cornea, it was cleaned with sterile balanced salt solution and few drops of antibiotic eye drops were put on the cornea before trephination. The donor cornea with scleral rim was carefully placed on the teflon block with the endothelial side up. An appropriate size trephine was fixed on the guillotine punch. Size of trephine varied from 7.5, 8.0 and 8.5 mm etc. depending upon the size of opacity. The guillotine punch with trephine was carefully placed over the endothelial side of the donor cornea on the teflon block and was trephined out. The donor corneal button was carefully removed and placed in a sterile bowl. Hydroxy propyl methylcellulose was applied on the endothelial side. Standard technique of keratoplasty was followed. The trephine used for the donor cornea was 0.5mm more than that used for host cornea. The trephine was carefully placed over the recipient cornea and trephined to almost half thickness of cornea. Side port blade was used to make an entry in to the anterior chamber. Using Castroviejo's corneal scissors, full thickness of recipient cornea was cut along the already made trephine grooves. The donor corneal button was placed carefully on the recipient bed and aligned well. Suturing of the donor cornea to the recipient bed was done with 16-18 interrupted sutures with 0.04 mm (40 micron) stainless steel sutures. The first suture was put at 12□o clock for the proper alignment of the donor cornea. The donor cornea was grasped with fine-toothed, double-pronged forceps at the epithelial– stromal junction, and the suture was passed directly under the forceps teeth, through the donor and aligned host tissue. Lims forceps with needle holder was preferred to tye the sutures. Suture depth was approximately 70-80% to prevent wound gape. The suture was tied snugly using a single knot with double throw that opposed both anterior and posterior lip adequately. Additional viscoelastic was placed in the anterior chamber as needed to help maintain proper graft orientation and anterior chamber depth. The second suture was placed 180° away at 6 o'clock. Equal amount of tissue distribution on either side was ensured. The 3 o'clock suture was placed and tied, followed by the 9 o'clock suture. Rest 12-14 sutures were put radially around the donor button to the recipient bed. Following this, the sutures were buried and left in-situ. Anterior chamber was maintained with air or balanced salt solution and was checked for any leaks. Sub conjunctival injection of gentamycin and dexamethasone was given. Eye speculum was removed and the eye was patched till next day. Routine postoperative medication consisted of topical steroids (prednisolone 1%) and antibiotic six times daily along with artificial tears, cycloplegics and anti-glaucoma medication if required. Topical antibiotic was reduced over the subsequent postoperative month and 1% prednisolone tapered down after 6 months with once daily dose lifelong. Following discharge, the patient was seen weekly for first month, biweekly for second month, monthly for 3 to 6 months. In our study, the follow up at 6 months was considered for analysis.

RESULTS

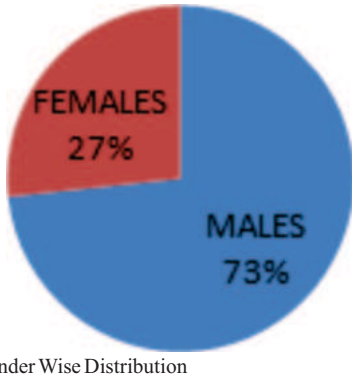
15 eyes of 15 patients underwent penetrating keratoplasty from june 2021 to june 2022 for different corneal pathologies. All eyes underwent penetrating keratoplasty using 0.04 mm atraumatic 160˚ single curve needle stainless steel sutures. We excluded patients with no perception to light, active periocular or ocular infection or regraft. A retrospective and observational analysis was done (visual acuity, inflammatory reactions, vascularisation, the presence of infiltrates,

graft clarity) at follow-up visits till 6 months postoperatively. Primary outcome was post-operative best corrected visual acuity (BCVA) at 6 months and suture status. Secondary outcome was graft clarity and post-operative astigmatism The Institutional ethical clearance was obtained from the Institutional ethical committee.

The age range in our study was 21-65 years. Average age in our study was 50.83 (±11.2).More number of males underwent penetrating keratoplasty in our study.46.7% of our beneficiaries were from the age group 51-60 years followed by 41-50 years (26.7%). 13.3% of our patients were from the age group 61-70 years,6.7% were from 31-40 years and 6.7% were from 21-30 years [Graph 1]. 11 out of 15 patients were males (73.3%) while 4 (26.7%) were females [Graph 2].



Graph 1: Age Wise Distribution Of Patients



Graph 2 : Gender Wise Distribution

RESULTS OF CLINICAL STUDY:

Indications of penetrating keratoplasty:

Out of 15 eyes, there were 10 eyes (66.6%) which underwent therapeutic penetrating keratoplasty. The most common indication in our study was perforated corneal ulcer (46.7%). Other indications for therapeutic penetrating keratoplasty included non-healing corneal ulcer (13.3%) which were either not responding to the treatment or were impending to perforate and Anterior staphyloma (6.7%). Optical penetrating keratoplasty was done in 5 eyes (33.3%) for indications like Pseudophakic bullous keratopathy (13.3%), Corneal scarring (13.3%), and Graft failure (6.7%) [Table 1] .

Table 1: Indications Of Penetrating Keratoplasty

Therapeutic Penetrating Keratoplasty			Optical Penetrating Keratoplasty		
Perforated Corneal Ulcer	7	46.7%	Pseudophakic Bullous Keratopathy	2	13.3%
Non – Healing Corneal Ulcer	2	13.3%	Corneal Scarring	2	13.3%
Anterior Staphyloma	1	6.7%	Graft Failure	1	6.7%
	10	66.6%		5	33.3%

Post-operative Best Corrected Visual Acuity (BCVA) :

In our study, best corrected visual acuity at 6 months in majority of the patients was satisfactory. 60% (9) of our patients achieved a BCVA of 6/36 or better. Among them, 6.7% (1) achieved a visual acuity 6/12 or better. Only 1 eye (6.7%) did not improve any vision after surgery. One patient (6.7%) had post operative best corrected visual acuity of HM to CFCF. Visual acuity of CF 1/4 m to CF 3m was present in 1 patient (6.7%) postoperatively. BCVA of CF>3m to 6/60 was found in 3 patients (20%) at 6 months follow up [Table 2].

Table 2: Post-operative Best Corrected Visual Acuity (BCVA) At 6 Months Follow-up

Post Operative Best Corrected Visual Acuity At 6 Months	No. Of Eyes	%
PL + PR accurate	1	6.7
HM TO CFCF	1	6.7
CF 1/4m to CF 3m	1	6.7
CF 3m to 6/60	3	20
6/36 TO 6/18	8	53.3
6/12 OR BETTER	1	6.7
	15	100

Sutures:

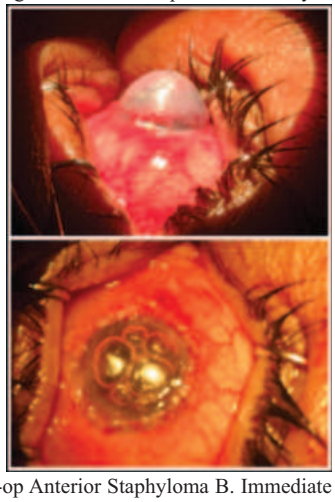
There were no complications during the application of stainless steel sutures. Post operatively, four parameters were looked for in this study: fibrinoid material, vascularisation, infiltrates and loose sutures. Out of 15 patients, none of the patient presented with fibrinoid material or any reaction. No vascularisation, no sign of infiltration was observed. None of the eye had loose sutures. 2 patients (13.3%) however complained of irritation which required removal of sutures under slit lamp.

Graft Clarity:

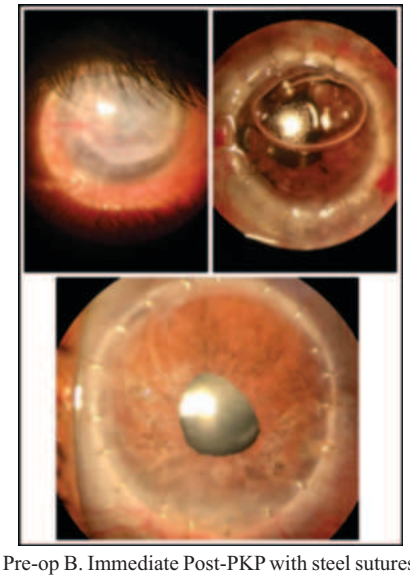
Graft clarity was graded as grade 4 if grafts were optically clear with excellent view of iris details and grade 1 for opaque grafts with poor view of iris and anterior segment details. At 6 months post-operatively, the graft clarity was grade 4 in 53.3% (8), Grade 3 in 26.7% (4), Grade 2 in 13.3% (2) and grade 1 in 6.7% (1) of our patients.

Post-operative Astigmatism:

We observed keratometric astigmatism post operatively at 6 months. Astigmatism ranges from 2 to 6 Dioptres in our study.



PIC 1: A. Pre-op Anterior Staphyloma B. Immediate post-PKP with steel sutures.



PIC 2: A. Pre-op B. Immediate Post-PKP with steel sutures C. Follow up at 6 months post-PKP with clear graft and healthy ,intact steel sutures

DISCUSSION:

Corneal blindness is the third most common cause of irreversible blindness in India and accounts for 0.9% of all causes of irreversible blindness.[8] Penetrating keratoplasty can visually rehabilitate corneal blindness in patients with various corneal pathologies.

Present study on penetrating keratoplasty with 0.04mm stainless steel sutures was conducted on 15 eyes at a tertiary care hospital in Northern India. Stainless steel sutures are non absorbable, known for its inertness and high tensile strength. Steel sutures are safely used without any complications for corneal suturing in humans and rabbits. In this study, steel sutures used in rabbit and human corneas were evaluated at 1.5, 3 and 7 months. After 1.5 months, the suture margins were well covered with tissue containing irregularly shaped endothelial cells, some fibroblastic-type cells and various kinds of collagenous fibre material. After 3 months, it was completely covered with an endothelial cell layer. After 7 months, it was completely covered with normal endothelium. The fixation suture in the human case showed perfect acceptance by the corneal tissue. [9]

A study in 1984 described the use of steel sutures to hold the corneal tissue to Singh's keratoprosthesis firmly.[10] Another study conducted in 2003 described the experience of using vanadium stainless steel in cataract extractions, penetrating injuries, anti-glaucoma surgeries and in removal of pterygium concluded that the suture was efficient, convenient and caused minimal operative and postoperative complications.[11] In 2013, a surgical technique was decribed using steel suture for trans-scleral fixation of posterior chamber intraocular lenses. This technique successfully achieved stable fixation and good centration of IOL after scleral fixation of PCIOL with steel suture.[12]

In this study, average age was 50.83 years.73.3% of our patients were males who underwent penetrating keratoplasty. 10 out of 15 patients underwent therapeutic penetrating keratoplasty. The most common indication in our study was perforated corneal ulcer (46.7%). Most patients were agricultural workers who suffered occupational injuries and corneal ulcers.

We did not encounter any intra operative complication while applying steel sutures but for the beginners application of the steel suture might get a bit difficult. For nylon or other suture, routine tying forceps is used while for steel, Lims forceps with needle holder is preferred to place and tighten it. Steel sutures require trimming by Vanna's scissors. Point to note is that you have to sit on knot to cut it or by holding one end you strongly pull the other end , that will automatically break from the knot itself.

Status of the sutures was noted post operatively till 6 months follow up. Post operatively, four parameters were looked for in our study: fibrinoid material, vascularisation, infiltrates and loose sutures. The sutures remained healthy, intact with no infiltrates, no fibrinoid reaction. No vascularisation was observed in any patient. Irritation inflicted by the suture ends were registered in 13.3% of the cases (2 patients).These sutures were removed under Slit lamp for the comfort of the patient. Similar results were observed in a study done on patients after applying steel sutures in various eye surgeries. This study reported small bullae in the corneal surface near the suture in few cases which disappeared spontaneously in 3-4 days. Irritation and post-op astigmatism were other complications faced in this study. [11]

We propose the use of steel sutures in penetrating keratoplasty. Steel suture with a good ocular biocompatibility and durability will ensure long-term stability of the graft and minimum suture related complications. As in our study, most of the patients were from therapeutic indications but if steel sutures are used for optical indications, the results would be better. However, the current study had few limitations , there is a learning process to apply steel sutures. Steel sutures are not easily available and we need a large study group for future references.

REFERENCES:

1. Flaxman SR, Bourne RRA, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV et al., Vision Loss Expert Group of the Global Burden of Disease Study. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. Lancet Glob Health. 2017 Dec;5(12):e1221-e1234.
2. McColgan K. Corneal transplant surgery. J Perioper Pract. 2009 Feb;19(2):51-4.
3. Zirm EK. Eine erfolgreiche totale Keratoplastik (A successful total keratoplasty). 1906. Refract Corneal Surg. 1989 Jul-Aug;5(4):258-61.
4. Landau D, Siganos CS, Mechoulam H, Solomon A, Frucht-Pery J. Astigmatism after mersilene and nylon suture use for penetrating keratoplasty. Cornea. 2006 Jul;25(6):691-4.
5. Bertram BA, Drews-Botsch C, Gemmill M, Guell J, Murad M, Waring GO 3rd. Complications of Mersilene sutures in penetrating keratoplasty. Refract Corneal Surg. 1992 Jul-Aug;8(4):296-305.
6. Bartels MC, van Rooij J, Geerards AJ, Mulder PG, Remeijer L. Comparison of complication rates and postoperative astigmatism between nylon and mersilene sutures for corneal transplants in patients with Fuchs endothelial dystrophy. Cornea. 2006 Jun;25(5):533-539.
7. J.G.F. Worst; Demonstration of Instruments. *Ophthalmologica* 1 February 1962; 143 (2): 87–91.
8. Jose R. Present status of the national programme for control of blindness in India. Community Eye Health J Indian. 2008;21:103-104
9. Jongebloed WL, Rijneveld WJ, Cuperus PL, van Andel P, Worst JG. Stainless steel as suturing material in human- and rabbit corneas: a SEM-study. Doc Ophthalmol. 1988 Oct-Nov;70(2-3):145-154.
10. Singh D. Keratoprosthesis. Indian J Ophthalmol. 1984 Sep-Oct;32(5):405-407.
11. Kumar Vinod DN. Klinicheskiĭ opyt primeneniia metallicheskogo shva v mikrokhirurgiii glaza [Clinical experience in using a metallic suture in eye microsurgery]. Vestn Oftalmol. 2003 Sep-Oct;119(5):16-20. Russian.
12. Ram J, Gupta N, Chaudhary M, Verma N. A new surgical technique using steel suture for trans-scleral fixation of posterior chamber intraocular lenses. Indian J Ophthalmol. 2013 Dec;61(12):749-751.