

Effects of Depth of Incision on final outcome in Radial Keratotomy

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Introduction

Radial keratotomy (RK) is a widely accepted surgical procedure to correct myopia. In the operation, sets of 4-12 evenly spaced radial incisions are made in the treated cornea, which extend from the boundary of a central optical clear zone of specified diameter to the outer periphery of the cornea.¹ The intraocular pressure causes the weakened peripheral region of the cornea to bulge outward and flatten the central visual region by stretching it like a drumhead. The central flattening reduces the refractive power of the anterior corneal surface, and the focal point is shifted posteriorly to the surface of the retina producing corneal flattening after the operation. The effectiveness of this procedure depends on the surgeon's ability to select surgical variables that lead to the desired reduction in the refractive power.² Many preoperative and peroperative variables affect the outcome of the surgery such as refractive state of the patient, axial length of the cornea, age of the patient, or systemic disease, depth of incision, as well as extension of the incision.²⁻⁴

Patients and Methods

The study was conducted in the Department of Ophthalmology, Military Hospital, Rawalpindi from January 1999 to December 2001. Fifty-one cases (sixty-five eyes), were included in the study. The subjects were between 21-40 years of age, had stable preoperative refraction for at least two consecutive years, myopia between 2-6 Diopters, and corneal pachymetry between 500-580 micrometers. Patients with history of Diabetes, Collagen vascular disorders, ocular trauma or previous eye surgery, examination finding of a conjunctival, corneal or lenticular pathology, having eyes with high IOP, or irregular astigmatism were excluded from the study. Complete blood count, ESR and fasting blood glucose were done to rule out associated diseases.

All cases were examined thoroughly under slit lamp and cycloplegic refraction was done to confirm the findings and correction required. Preoperative thirty-spot screening Pachymetry was done and the

subjects were then divided into two groups; Group A comprised of twenty-five cases whereas Group-B consisted of forty cases. After signing their consent forms, both of these groups underwent an eight-incision radial keratotomy using the combined approach, with a double edged diamond Knife (Duckworth and Kent), done as an out door procedure.

Preoperatively 0.5% Proparacaine eye drops were used for the local anaesthesia. Intraoperative corneal pachymetry was done at 1.5 mm from the visual center, at the 3 mm central clear zone, and calibration and adjustment of Diamond knife was done accordingly. After applying the selected radial marker for several seconds, the knife was entered at the central corneal margin and a centrifugal radial incision was initiated, penetrating about 530 microns of corneal stroma in Group-A and 560 microns in Group-B, making a cut to 1 mm within the limbus. This procedure was repeated so that eight incisions were made.

Postoperatively the eyes were padded and tab Dicloran six hourly, was given for pain. They were then seen on the following day and advised corticosteroid eye drops (Maxitrol) six hourly for the first week and then eight hourly for one week. Follow-up was done at six weeks, two months, four months, sixth months and finally at one year of surgery. In each follow-up, the unaided visual acuity, hyperopic shift, under or overcorrection was noted by cycloplegic refraction with 1% Cyclopentolate eye drops. Questions were specifically asked about the presence of glare, fluctuation of vision during the day, pain or photophobia and corneal examination was done to look for any signs of infection or wound gap. The significance of difference between the two groups regarding final unaided visual acuity and degree of hyperopic shift was determined at the end of study with chi-square test.

Results

A The mean age of the patients was 29.2 (+7) years. Table 1. Mean results of investigations (n=45).

S No.	Tests (S)	1. Units	Mean results
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1	Blood Complete Picture		Within Normal Range in 87% high total leucocytes in 08% low platelet count in 5%			
2	Blood glucose-fasting (mmole/l)		4.8 + 3.0 (mmole/l)			
3	Blood ESR		12 + 10 mm fall at 1st hour			
Groups	Unaided visual acuity		Spectacle correction		Hyperopic shift	
Depth of corneal	20/20 (6/6)	20/25 (6/9) or worse	Within 1D of emmetropia	Within 2D of emmetropia	Present	Absent
Incision						
A=25 (230microns)	4	21	6	10	2	23
B=40 (560 microns)	33	7	34	36	4	36

Table 3. A comparison of various studies on radial keratotomy.

Study	Perk study ²⁰	Arrowsmith and marks ²¹	Deitz and Sanders ^{22,23}	Our study
Year of surgery	1982-83	1980-81	1982-85	1999-2001
Follow up time	3 years	5 years	1 years	1 years
No of eyes	435	122	972	99
No of incisions	8-16	8	8-16	8
Knife Blade	Diamond (Single edged)	Steel	Diamond (double edged)	Diamond (double edged)
Central clear cornea	3.0-4.0 mm	3.0-4.0 mm	2.7-6.0 mm	3.0
Over corrected 1.0D	16%	33%	12%	9%
Under corrected 1.0D	18%	13%	12%	10%
Uncorrected VA>6/12	76%	76%	88%	98%

Results of investigations are shown in Table 1. The mean follow up time was one year. At two months of follow-up, twenty eyes (80%) of Group-A had attained an unaided vision of 20/20 in the operated eye, whereas this vision was achieved in thirty-three eyes (82.3%) of Group-B. Refraction showed that 94.11% cases of Group-A to be within 1 diopter of Emmetropia as compared to 93.75% cases in Group-B. Similarly, 98.03% cases of Group-A were within 2 diopters of Emmetropia as compared to 95.83% cases of Group-B. After three months, however, seven eyes (28%) of Group-A had reverted back to their preoperative refractive state, and in six months time this percentage had risen to twelve eyes (48%). At the end of the study, a total of sixteen eyes (64%) of Group-A showed nullified effect of surgery, whereas this was seen in only two eyes (5%) in Group-B ($p < 0.05$). Hyperopic shift occurred in two eyes (8%) in Group-A and four eyes (10%) of Group-B ($p > 0.05$). Refraction showed that only 24% cases of Group-A were within 1 diopter of emmetropia as compared to 85% cases in Group-B. Similarly, 40% cases of Group-A were within 2 diopters of emmetropia as compared to 90% cases of Group-B. These results are summarized in the Table 2. Among the complications, the most common was night-time glare, seen in eighteen eyes (27.69%) that gradually cleared itself with the passage of time. The frequency of complications is given in Figure. Failure of surgical response was seen in sixteen cases (64%) of group-A and two cases (05%) in group-B. Similarly, induced astigmatism was seen in six cases (24%) in Group-A and three cases (7.5%) in Group-B. Night-time glare disturbed seven cases (28%) in group-A and eleven (27.5%) in group-B.

Discussion

Modern radial keratotomy technique is based on multiple radial incisions of 85%-95% stromal depth

that terminate 01 mm or more inside the limbus.⁵ It was adapted for use by the ophthalmic professional community in 1978-8 and the multicenter, PERK study (Prospective evaluation of Radial Keratotomy) done over a ten-year period in USA has contributed much to the current understanding of the predictability and stability of the refractive result after radial keratotomy.⁹ It is a safe and effective method to correct low myopia upto -6.00 diopters¹⁰, the technique offers various advantages; clinical experience of more than 15 years, fast visual rehabilitation, minimal discomfort postoperatively and low cost and technical requirements.^{11,14} Nevertheless, the final refractive outcome could be variable from individual to individual due to difference in response to injury among the population, resulting in over corrections and under corrections in a certain percentage of patients.¹⁵ Possible complications include glare and fluctuation of vision¹⁶, hyperopic shift, infectious keratitis, and endophthalmitis.¹⁷ It neither weakens nor causes increased susceptibility of cornea to trauma than a normal eye.¹⁸ The role of depth of corneal incision in the results of radial keratotomy has been mentioned earlier as well.¹⁶ We undertook our study with the aim to find out the results in our population. Sixty- five cases with low to moderate degrees of myopia (-1.5 to -6.0D) were included in the study. The results were evaluated by comparing a patient's refractive error and uncorrected vision before and after surgery at three months, six months and finally at one year. As shown in the results, the difference in outcome of surgery between the two groups was statistically significant, as sixteen eyes (64%) of Group-A showed reversion back to their preoperative refractive state after one year of follow-up, indicating failure of surgery, whereas this was seen in only two eyes (5%) in Group-B ($p < 0.05$). The incidence of adverse effects was low but improvements in the future should further reduce complications, thus increasing the safety of refractive procedures. Night-time glare disturbed seven cases (28%) in group-A and eleven (27.5%) in group-B, that gradually subsided with the passage of time. There were no sight threatening complications of surgery. Induced astigmatism was seen in six cases (24%) in Group-A and three cases (7.5%) in Group-B. A comparison between our results and studies done abroad is given Table 3.

Considering the results of our study, it can be emphasized that depth of corneal incision during radial keratotomy significantly affects the outcome of surgery if central optical zone is kept the same especially in cases of low to moderate degrees of myopia. Accurate determination of the corneal

thickness is very important for desired results.

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Abstract

Objective: To assess the effect of depth of incision on the final outcome of radial keratotomy for correction of myopia.

Methods: Sixty-five eyes with preoperative uncorrected myopia between 2.5-6.0D in subjects with a mean age of 29.2 (+7) years underwent radial keratotomy between Sept 1999--July 2002 in department of Ophthalmology, Military Hospital, Rawalpindi. Based on their preoperative depth of incision the eyes were divided into group-A (twenty-five eyes), with an incision depth of 500-530 μ m, and Group-B (forty eyes), with an incision depth of 531-560 μ m. The comparison between the postoperative visual acuity of two groups was made at the end of study after one years' follow up.

Results: A total of Sixteen eyes in Group-A (64%) that were within one diopter of emmetropia at first follow-up reverted back to their preoperative myopic state after one year of surgery as compared to only two eyes (5%) in Group-B ($p < 0.05$). Hyperopic shift occurred in two eyes (8%) in Group-A, as compared to four eyes (10%) of Group-B ($p > 0.05$). After one year, refraction showed that only 24% cases of Group-A were within 1 diopter of emmetropia as compared to 85% cases in Group-B. Similarly, 40% cases of Group-A were within 2 diopters of emmetropia as compared to 90% cases of Group-B. Glare and variation of vision in the initial four weeks were the most frequently reported complications in both groups.

Conclusion: Depth of corneal incision significantly affects the outcome of surgery, if central optical zone is kept the same in cases of low to moderate degrees of myopia (JPMA 54:361;2004).