

Aero medical problems of photo refractive keratectomy

Wg Cdr GKG Prasad VSM *

ABSTRACT

Refractive surgery for correcting refractive errors is a recent procedure. Radial keratotomy represented the first procedure in this direction followed by photo refractive keratectomy (PRK) in the recent past. Photo ablate keratectomy using excimer laser technology to photo ablate and re-contour the corneal surface emerged as a viable modality. In this paper the aero medical problems associated with PRK are discussed, decreased night visual capacity, increased glare sensitivity, haloes and fluctuation in vision are some of the problems with PRK, which can affect the flying. This paper provides fundamental information required to formulate aero medical decisions.

IJASM 2001; 45(1): 5 to 7

KEY WORDS: LASIK, Refractive surgery, Photo refractive keratectomy

Refractive surgery so as to alter the refractive state of the eye is a recent, accepted method of correction of refractive errors. General acceptance of these procedures depends on the successful results, predictability, safety and stability. However most of these procedures have limited or specialized application in the treatment of refractive errors. This concept was initiated as radial keratotomy where 4-16 radial corneal incision were given from edge of the optical zone to the periphery by a surgical knife, thereby inducing corneal flattening. Later and more recently the photo refractive keratectomy (PRK) has been tried where excimer laser energy is used to ablate and alter the shape of the cornea. The application of laser energy in correcting refractive errors is a new technological

development. PRK for correction of myopia up to - 7.0D has been approved by FDA in October 1995 [1].

Clinical trials in radial keratotomy involved certain disadvantages such as reduced corneal strength, daily fluctuation of vision, glare, unpredictability, progressive hypermetropic shift and altitude induced changes. These disadvantages automatically make the procedure unacceptable to aero medical environment. PRK procedure is also associated with certain undesired effects and requires evaluation of these effects in relation to the aero medical factors. If the procedure is found acceptable to the aero medical community, the relaxation in the medical standards at entry and in serving aircrew personnel can be undertaken.

**Classified Specialist (Ophthalmology) 5 Air
Force Hospital c/o 99 APO**

Keeping this in view, a clinical study was undertaken on a selected group of myopic who had undergone PRK procedure.

PRK-Basic Concepts and Procedure

Excimer laser produces minimal thermal energy effect produced by 193nm wavelength. It produces smooth ablation of corneal surface. This wavelength was selected for its predictability, intended effect, associated complications and minimal effect on surrounding corneal tissue. This wavelength causes disruption in the molecules on the surfaces of cornea with the result that corneal tissue is vaporized with each pulse. By carefully controlling the number of pulses and diameter of each pulse with the help of sophisticated algorithm computers the cornea can be resulted. Corneal layers disrupted by this procedure are epithelium, basement membranes, Bowman's layer and portion of stroma. The resulting flattened corneal plateau reduces the focusing power of the cornea and thus leads to correction of myopia. This procedure offers significant advantage over radial keratotomy in reducing the risk of intraocular surgical perforation, reduced refractive instability and retention of near normal corneal rigidity. The potential complications associated with PRK include (a) Corneal scarring (b) Haze, glare and starbursts (c) Night vision degradation (d) Pain (e) Recurrent erosions (f) Under / over correction (g) Topical steroid complications and decentration.

Review of clinical reports

Colliac [2] stated that corneal healing induced a regression of the expected correction for two to six months after surgery. He ascribed the regression to several possible causes such as increased volume of the sub epithelial stroma and transient hyperplasia of the epithelium which is greater at the periphery of ablation zone than at the centre causing flatter

curvature which may return to normal after six months. Amano et al [3] and Epstein et al [4] noted that epithelial hyperplasia occurred in the early post operative period and was related to regression of refractive correction. Kim et al [5] reported (a) decreased night vision in 78.3% (b) foreign body sensation in 73.8% (c) haloes or glare at night is 43.5% and d) near vision disturbance in 21.7% of their cases, Colliac et al [2] pointed out that blurred night vision was presumably due to the pupil dilatation beyond the ablation zone.

Subjects and Methods

In the present study of the available pool of subjects who had undergone PRK procedure, 10 were selected to voluntarily participate. The aim of study was to find out aero medical problems associated with excimer laser photo refractive keratectomy (PRK). The selection of subject of the study was done on the basis of certain criteria met during the follow up period of six month after laser exposure such as :-

- (a) Simultaneous bilateral procedure
- (b) Pre operative refractive power of not more than - 3.50 D
- (c) Acquired normal visual acuity during the follow up period
- (d) Maintenance of stabilized vision
- (e) No obvious persistent corneal haziness after 6 months of exposure
- (f) Acceptable ocular topography
- (g) Asymptomatic, uncomplicated post exposure period.

The selected 10 subjects were subjected to some specific test from the routine for assessment of their night visual capacity on adaptometer, glare sensitivity and incidence of halos. All the specific tests were done in full dark adaptation state of each subject.

Results

In this study out of 10 subjects, 3 showed decreased night visual capacity, 2 showed increased glare sensitivity and one reported halos. The extent and depth of ablation zone in the 30% subjects who showed the affection was more than in the rest 70% of subjects. The extent and depth of ablation zone was decided on the required correction of refractive error.

Discussion

In the selected group of subjects the pre operative upper limit of refractive error is fixed

- 3.50 D because the maximum permissible limits of refractive error in case of defence air crew is

- 3.50D. Post operative normal visual acuity is essential, in the aero medical evaluation. Complication like corneal scarring compromising or causing fluctuations in the vision make the subject unfit for aircrew duties. In the general population PRK appears effective, safe, accurate, satisfactory and predictable procedure [6]. However, the aircrew requires additional criteria for day and night vision. As the subjects were dark adapted prior to the conduct of specific tests, certain amount of papillary dilatation was associated during the tests contributing to the noticed effects. Incidence of decreased night visual capacity, increased glare sensitivity and reporting of halos seen in the subjects were directly related to extent and depth of the ablation zone. Also when the pupil dilates beyond the ablation zone the resultant optical aberrations can cause these effects. The aetiology of glare and halos include the double pupil effect, which is due to the change in the pupil size relative to the PRK ablation zone. The Stiles Crawford

effects minimize the effect of these factors on visual acuity during the day time, however in the night time under low illumination conditions Stiles Crawford effect fails, contributing to the occurrence of glare, halos starbursts and disturbance in the night vision [1]. Glare is an unacceptable element in the cockpit and can be exaggerated by other factors such as scratches on the windscreen, reflective optical interfaces and light sources. The affections observed in the study are very significant in the aviation environment and can compromise flight safety especially during night operations and indicate certain adverse risk for aviators.

References

1. Ivan DJ, Tredici TJ, Perez - Becerra J et al : Photo refractive keratectomy (PRK) in the military aviator : an aomedical prospective Aviat Space Environ Med 1996; 67, 770-6.
2. Colliac JP, Shammas J, Optics of photorefractive keratectomy, J Cataract Refract Surg 1993; 19; 356-63.
3. Amano s, Shimizer K, Tsubotak Corneal epithelial changes after excimer laser photorefractive keratectomy. Am J ophthalmol 1993; 115; 441-3.
4. Epstein D, Tengroth B, Fagerholm et al. Excimer photorefractive keratectomy for myopia, Ophthalmology 1993, 100; 1605-6.
5. Kim JH, Hahn TW, Lec YC et al, Photorefractive keratectomy for myopia - two year follow up, J cataract Refract surg. 1994; 20; 229-33.
6. Diamond S Excimer laser photorefractive keratectomy (PRK) for myopia - present status Aero-space. Aviat Space Environ Med 1995; 66; 690-3.