Contact Lens Wear during Prolonged Military Operations, Is it Safe and Effective or is Refractive Surgery a Better Option?

Dr. A.J.P. Rouwen Col. Surg.
Ministry of Defence MGFB
Central Military Hospital
PO Box 90000
3509 AA Utrecht
THE NETHERLANDS

A.P.J.Rouwen@mindef.nl

ABSTRACT

Some categories of military personnel are not able and not allowed to use spectacles during active duty. The Ophthalmology Department of the Central Military Hospital in the Netherlands has a 5 years experience with the use of a second generation extended wear soft contact lens (Silicone Hydrogels) in Marines of the Royal Dutch Navy. During operations, personnel should be able to wear the lenses day and night for at least 10 consecutive days, without removal or cleaning of the lenses. The purpose of this paper is to answer the question if these special contact lenses are safe, effective and useful in all individuals during prolonged deployments. Recently, military personnel are treated with refractive surgery in order to cure their ametropia and after a military medical re-examination are being declared fit for all duties. This procedure is discussed as an alternative.

1.0 INTRODUCTION

Although military personnel from most NATO members, fit for deployments, should meet certain visual requirements, they will often need spectacle correction for optimal visual acuity. For applicants for duty in the Royal Dutch Marine Corps spectacles are not allowed, but in 1999 it was decided to enter applicants with correctable ametropia between -4.00 and + 2.00 and low to moderate cylinders, only after their suitability to wear extended wear soft contact lenses was evaluated on our Ophthalmology Department during an extended medical examination with fitting of trial lenses.

At that time we already had some experience with the new second generation extended wear soft lenses made from Silicone Hydrogels, with superior oxygen transmissibility (For definition of terms: Table 1.). During exercises and extended operations these marines must be able to wear these lenses continuously, day and night, because of lack of time or sanitary facilities, needed for removal of the lenses. Gas permeable rigid lenses are also suited for extended wear, but these lenses are prone to lens lost or getting small particles behind the lens. Decrease in vision, wearing comfort and ocular health may result, especially in dry and hot climates. Also conventional hydrogel soft lenses, containing up to 80% H_2O of their dry weight, dehydrate in hot and windy circumstances, while these second generation silicohydrogels only contain 36% or less H_2O. Typically, peace-time exercises last 10 days, but these lenses are actually sold on the market as one month disposable lenses, which means the are worn for 30 days continuously and discarded thereafter. In the US these lenses have a FDA approval for continuous 30 day use. However overnight removal of the lenses and storage in disinfecting fluid only prolongs the life of these lenses.

Rouwen, A.J.P. (2005) Contact Lens Wear during Prolonged Military Operations, Is it Safe and Effective or is Refractive Surgery a Better Option? In *Strategies to Maintain Combat Readiness during Extended Deployments – A Human Systems Approach* (pp. 38-1 – 38-12). Meeting Proceedings RTO-MP-HFM-124, Paper 38. Neuilly-sur-Seine, France: RTO. Available from: http://www.rto.nato.int/abstracts.asp.

2.0 PROBLEM

The question was if any kind of contact lens is suitable for military personnel in extreme circumstances and prolonged operations or if refractive surgery would be the better option.

3.0 PURPOSE OF PILOT STUDY

In our own pilot study we tried to identify the efficacy and safety of Silicone Hydrogel Permanent Wear Contact Lens correction of visual acuity in military personnel during extended operations. In this presentation I would also like to present the possibilities of refractive surgery of military personnel not able to wear spectacles.

4.0 RESULTS OF SILICONEHYDROGEL PILOT STUDY

When we first started the range of available powers for the Silico Hydrogel lenses we used was limited from -0.25 to -6.00 without cylinder correction.. We used SL66 Toric® lenses to correct marines with astigmatism up to Cylinder -2.25 D. After a few years these lenses could be replaced by the Purevision Toric® . The hypermetropes were also corrected with PureVision® as soon as these lenses became available in plus powers. Other lenses used very sporadic: ActiFresh 400® , Focus Night&Day®, Acuvue OneDay® and Proclear Toric®, always in order to improve on vision or comfort. The material properties of three Silico Hydrogel contact lenses presently on the market are presented in table 2.

Term	Definition	Physical Unit
Oxygen permeability Dk	amount of oxygen passing through a contact lens material over a set amount of time and pressure difference*	10-11 (cm3 O2 cm)/(cm3 sec mmHg) OR 1 Barrer
Oxygen transmissibility Dk/t	amount of oxygen passing through a contact lens of specified thickness over a set amount of time and pressure difference*	10-9 (cm ml O2)/(ml sec mmHg)

* under specified conditions

Table 1. Permeability and Transmissibility

Silicone Hydrogel Extended Wear Parameters			
	NIGHT & DAY™	**O2OPTIX™**	**PureVision™**
Manufacturer	CIBA Vision	CIBA Vision	Bausch & Lomb
Polymer	lotrafilcon A	lotrafilcon B	balafilcon A
Oxygen permeability	Dk = 140	Dk = 110	Dk = 99
Oxygen transmissibility	Dk/t = 175	Dk/t = 138	Dk/t = 110
Water content	24% water	33% water	36% water
Lens diameter	13.8mm	14.2mm	14.0mm
Base curve	8.4, 8.6mm	8.6mm	8.6mm
Power	+6.00 to -10.00D	-1.00 to -6.00D	+6.00 to -9.00D
Surface charge	Nonionic	Nonionic	Ionic
Surface treatment	PRO2 Technology	PRO2 Technology	Plasma oxidation
FDA Classification	Group I	Group I	Group III

Table 2. Material Properties.

Their advantage; superior oxygen transmissibility is illustrated in Table 3, Dk/t values for a variety of conventional and silicone hydrogel contact lens materials. The incidence of microbial keratitis has been mainly associated with oxygen transmissibility in extended wear contact lenses.[4] Adhearance of Pseudomonas Aeruginosa e.g. decreases with increasing Dk/L. Figure 1.

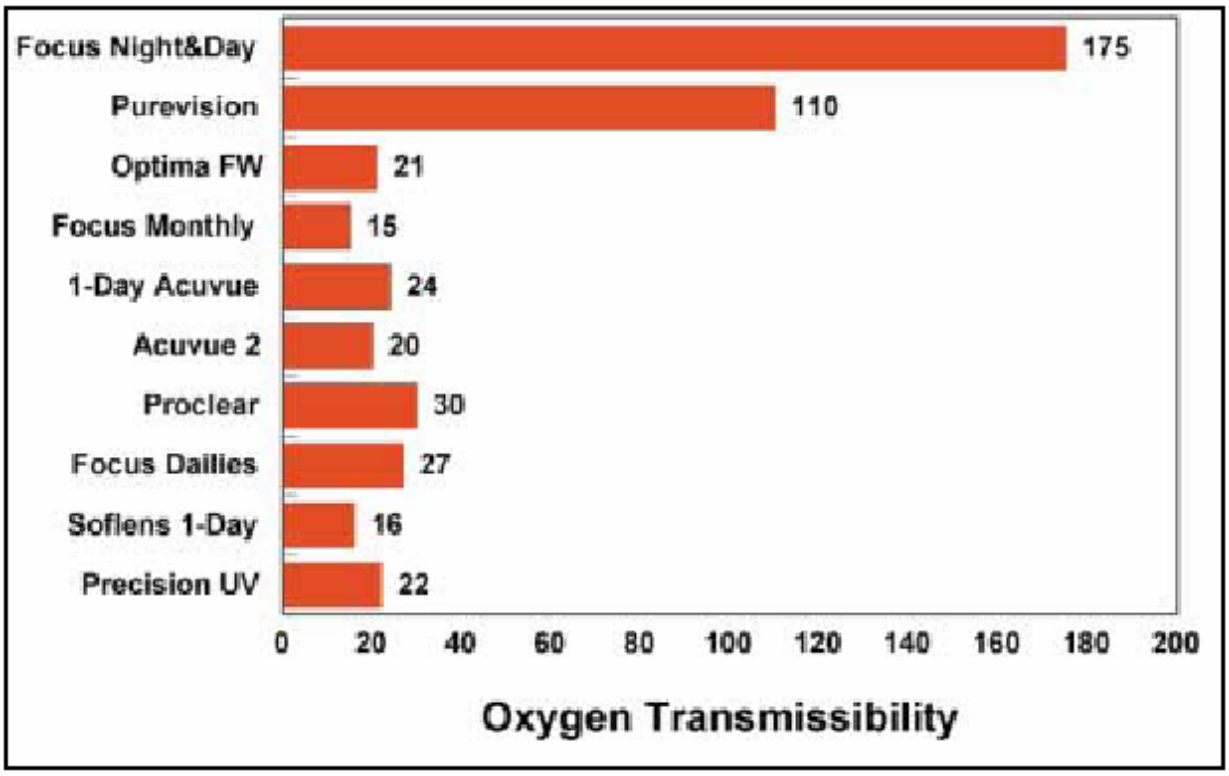

Table 3. Dk/t values for a variety of conventional and silicone hydrogel contact lens materials.

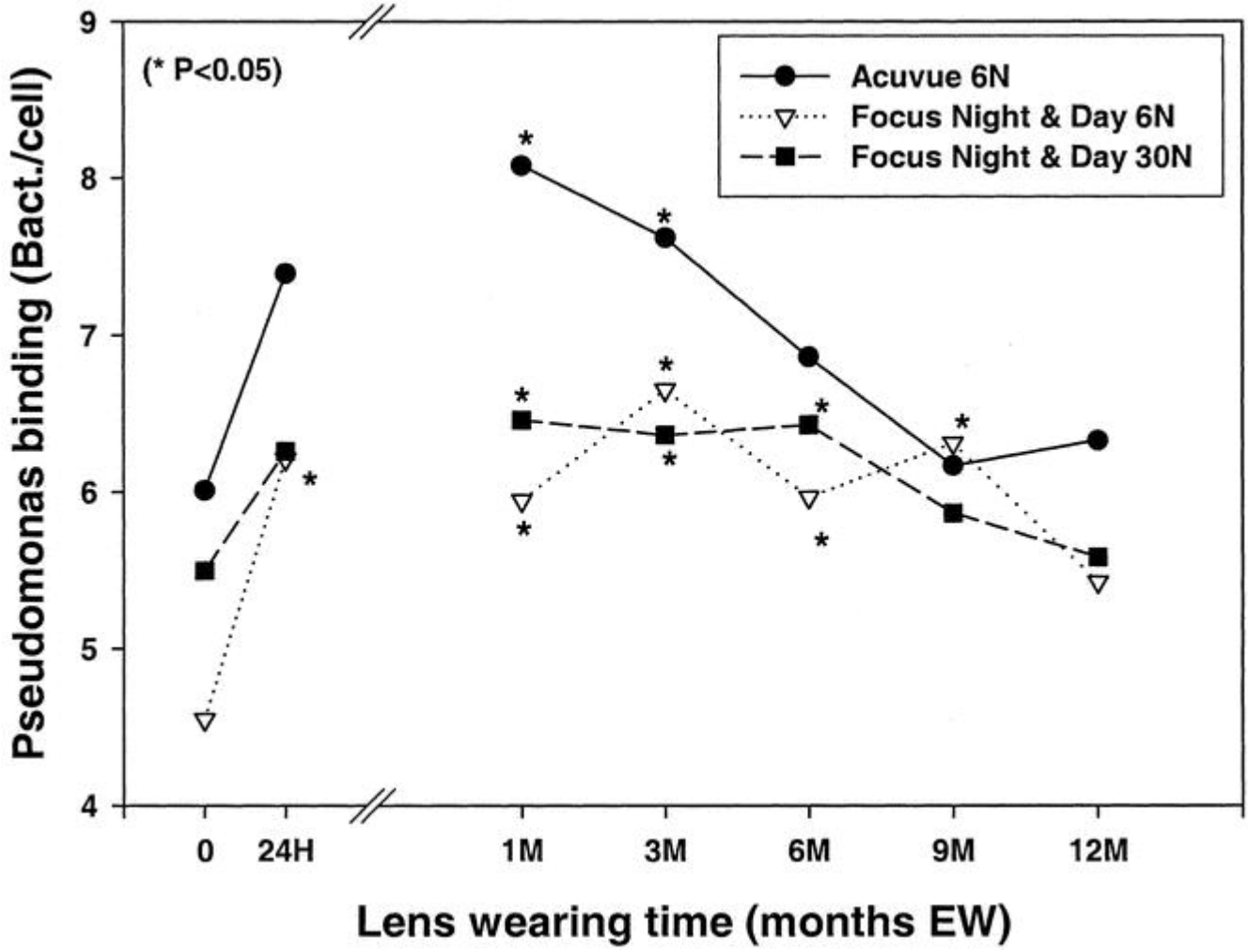

Figure 1.: Contact lens-induced increases in P. aeruginosa binding in extended wear ACUVUE and Focus Night and Day. *Statistically significant (P <0.05). From: Cavanagh: Eye & Contact Lens: Science & Clinical Practice, Volume 29(1) Supplement 1.January

Although we never had any serious complications such as severe microbial keratitis (SK), neither during leisure time wear, nor during short exercises or prolonged operations, some asymptomatic superficial punctate fluorescein staining was seen during control examinations, which could be linked to the care solutions used. Changing these solutions for a new formulation of the Renu Multiplus Solution® or Optifree Express® solved these symptoms. Only once a small infiltrate (Non Severe Keratitis, NSK) was seen in the anterior corneal stroma, treated with lens wear cessation and local antibiotic drops. This marine could restart lens wear in a few days. A very recent study of Morgan et all. disclosed the risks to catch a NSK or SK, comparing different kind of lenses and their wearing modalities.[1] Their findings are summarized in Table 4.In opposition as what we thought after the introduction of daily disposable lenses, these lenses cannot reduce the incidence of severe keratitis. Their annual incidence of NSK in silicone hydrogel lenses is about 1 % (99 per 10000), which means we should have seen more NSK in our population. However other recent studies have shown that professional eye care and regular medical follow up decreases the incidence of keratitis in contact lens wearers.[2] [3] Another finding, unrelated to subjective complaints, was the appearance of so called mucin balls behind the lens and in the corneal epithelium. (Figure 2.)

Figure 2.: Mucin Balls

	Wearers in UK#	Population at risk in study	NSK annual incidence*	SK annual incidence*	Relative Risk NSK**	Relative risk SK**
Rigid daily wear	0.65 %	6996	5.7	2.9	0.4	0.5
Hydrogel daily disposable	1.53 %	16413	9.1	4.9	0.7	0.8
Hydrogel daily wear	2.79 %	29876	14.1	6.4	1.0	1.0
Silicone Hydrogel daily wear	0.02 %	179	55.9	0.0	4.0	-
Rigid extended wear	Nil.	18	0.0	0.0	-	-
Hydrogel daily disposable extended wear	Nil.	0	-	-	-	-
Hydrogel extended wear	0.04 %	415	48.2	96.4	3.4	15.2
Silicone Hydrogel extended wear	0.14 %	1517	98.8	19.8	7.0	3.1

Percentage of total population

* number of cases per 10000 wearers per year

** calculated independently for NSK en SK taking 'hydrogel daily wear' as a reference

- zero incidence or undeterminable because annual incidence is zero

Table 4. Incidence and relative risk in different lens wear modalities. (From Ref [1])

However, we came across another major problem: As most marines fitted with lenses only required small amounts of correction and most of them, as applicants, were not aware of their reduced distance VA, their motivation to wear the lenses was often insufficient. An overview of the powers we corrected with the lenses (given as Spherical Equivalent) is shown in Figure 2.

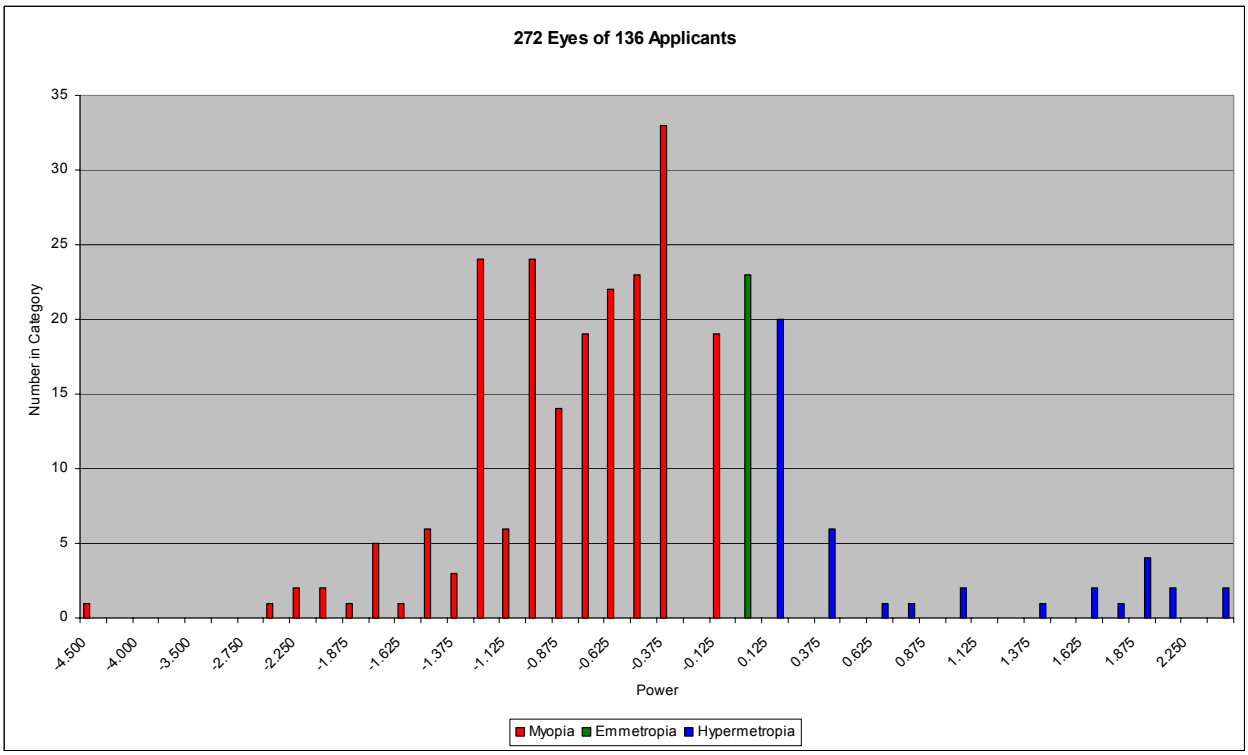

Figure 2.: Correction needed in 272 Eyes.

Another unexpected factor was the psychology of lens wear in a thight-lipped society such as in a marine battalion: some lens wearing marines chose to have laser surgery, because they were teased with their visual handicap.

5.0 ALTERNATIVE: REFRACTIVE SURGERY

Presently we have a 5 year experience in LASIK (Laser in situ Ketatomileusis) , PRK (Photo-ablative Refractive Keratectomy) and LASEK (Laser Sub-Epithelial Keratectomy) procedures for military personnel (in the range of + 6.00 to -8.00 Diopter) in our Refractive Surgery Centre in Utrecht. These techniques reshape the anterior cornea with the use of the excimer laser, either superficially (LASEK and PRK) or in the anterior stroma (LASIK). Our results (Uncorrected Visual Acuity, UCVA, postop, compared to BCVA preop) without recent treatment modalities such as wavefront customized correction and improvement in creation of the corneal flap with newer microkeratomes, were already sufficient for this particular military population with their limited powers to correct. (Fig3 & 4.) Loss of best corrected visual acuity was rare, and again almost always associated with higher powers preop to correct.

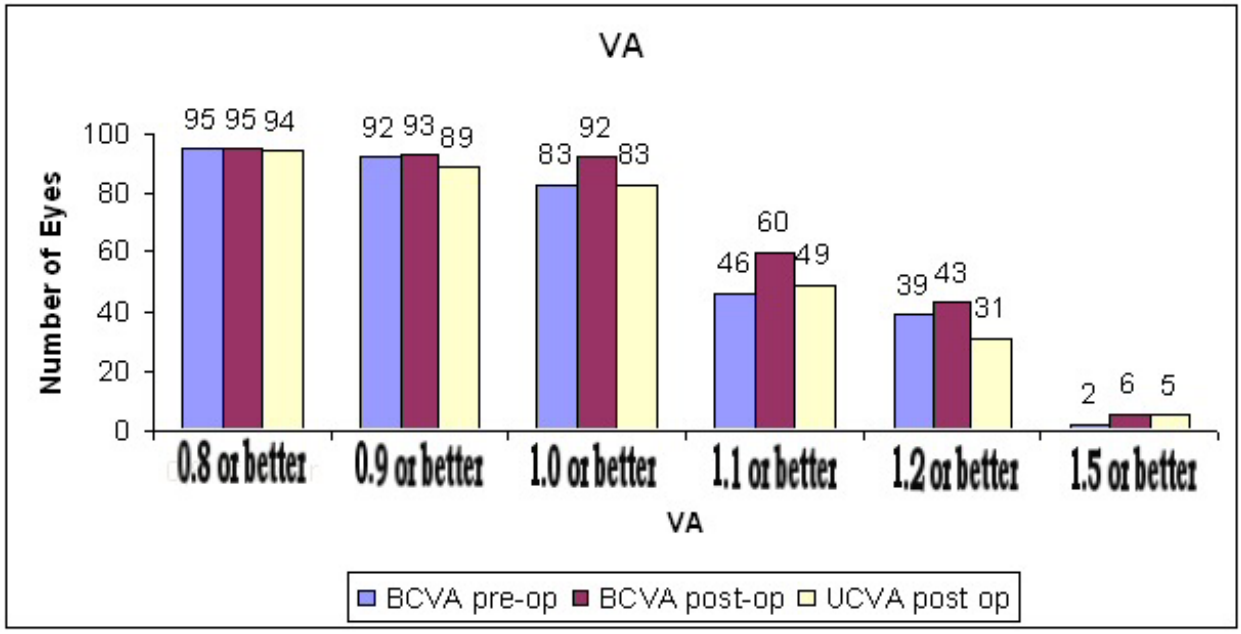

Figure 3. Visual Acuity, Follow up one year after treatment, 95 eyes done with the Visx S3 in the Refractive Surgery Centre Utrecht NL.

Refractive surgery in the form of PRK, LASEK and LASIK are probably superior to the use of lenses for military personnel because, with good results, we do not see the disadvantages of the use of contact lenses such as lens lost, corneal damage or even permanent scarring after infections, acute wearing discomfort due to dust, hot and or dry climate. US military optometrist have stated in the past that they expect that 22% of all contact lens wearing military personnel will not tolerate lens wear during their military career. Whenever extended wear is not possible the lenses are difficult to maintain in the field and in the eye the might be problematic in chemical environments. But one of the main advantages would be the fact that military personnel would profit from their optimal visual acuity all the time, while the low power Silicone Hydrogel lenses we use for the Marines are often not in their eyes but in the lens container in their barracks.

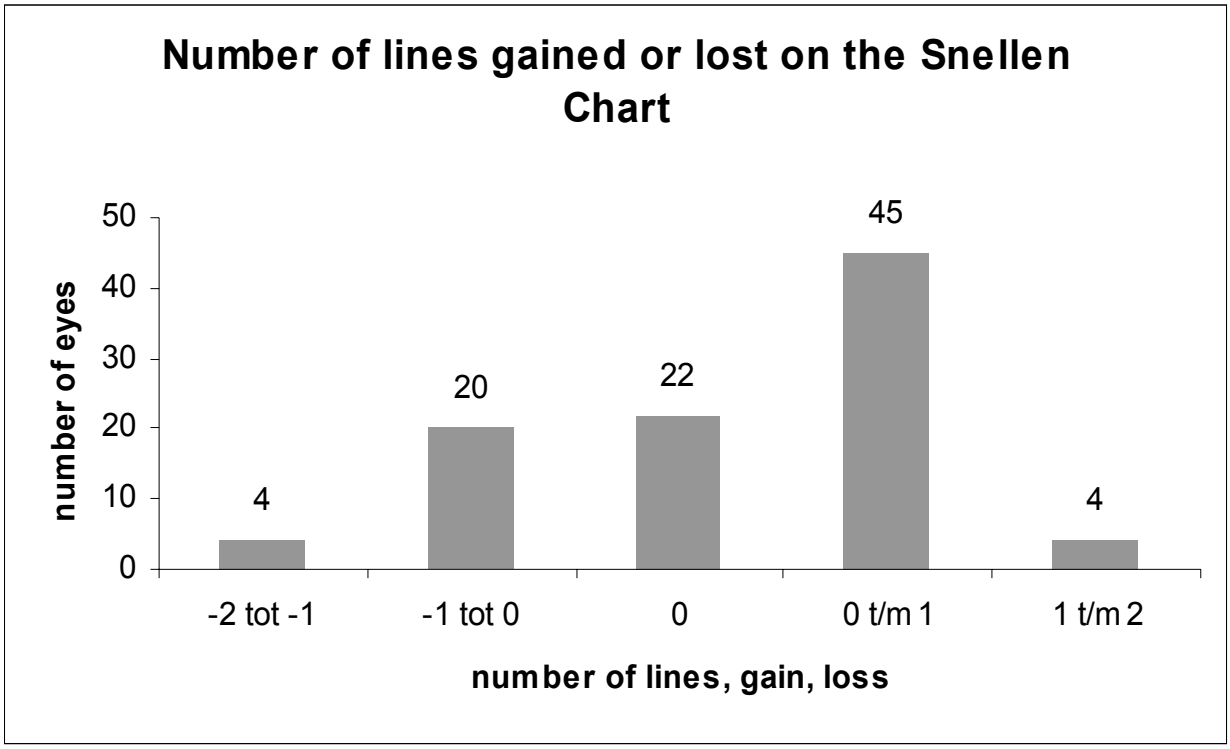

Figure 4. Gain or loss of BCVA (Best Corrected Visual Acuity). Results of Visx S3 treatments, follow up one year, Refractive Surgery Centre Utrecht NL.

6.0 RECOMMENDATIONS

Especially during extended deployments all lens wearing military personnel should wear silicone hydrogel soft contact lenses as these lenses show adequate wearing comfort in extreme circumstances, are suited for occasional extended wear (up to 30 nights) and induce less ocular complications, some of which may result in visual loss and hence unfit personnel.

In the future refractive surgery should be considered as a better alternative for the correction of ametropic military personnel, especially those involved in jobs with a high demand on their visual functions and personnel often sent abroad for longer periods, because this personnel cannot easily seek professional care or follow up for their lens wearing eyes.

Refractive surgery should be provided by the military health care system, in order to have influence on the quality of the treatments. The quality of the treatment is reflected in the UCVA and decrease in UCVA again will result in unfit personnel.

Ref.:

[1] **Incidence of keratitis of varying severity among contact lens wearers,** Morgan PB, Efron N, Hill EA, Raynor MK, Whiting MA, Tullo AB, *Br J Ophthalmol* Apr 2005; **89(4)** :430-6

[2] **Evaluation of surveillance methods for an epidemiological study of contact lens related microbial keratitis**. Keay L, Edwards K, Brian G, Naduvilath T, Stapleton F, *Clinical & Experimental Ophthalmology* Aug2005*;* **32(4)**: 349-353.

[3] **The Incidence of Contact Lens Related Microbial Keratitis in Australia**. Stapleton F, Edwards K, Keay L, Naduvilath T, Dart JKG, Brian D, Sweeney D, Holden BA*, Invest Ophthalmol Vis Sci* 2005;**46**: E-Abstract 5025.

[4] **Effects of daily and overnight wear of Hyper-Oxygen Transmissible Rigid and Silicone Hydrogel Lenses on Bacterial Binding to the Corneal Epithelium: 13 Month Clinical Trials**. Cavanagh, HD, Ladage PB, Yamamoto K, Li SL, Petroll WM, Jester JV. *Eye & Contact Lens: Science & Clinical Practice* January 2003; **29(1):** 14-16