Original Article

NVG Research, Training and Operations in Field: Bridging the Quintessential Gap

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Abstract

Night operations are envisaged to play an increasingly important role in future combat. In IAF, NVG flying in helicopters commenced in 2002. In absence of previous experience in NVG flying, SOP's laying down conditions for NVG exercises were derived from existing night flying SOP's for helicopter flying. With increasing NVG experience of IAF aircrew, a few anomalies in SOP's have been brought out which may have flight safety connotations. This paper attempts to review and answer the aeromedical issues raised in field by aircrew experienced in NVG operations. It was commented that the inter-pupillary distance (IPD) must be measured, documented and known to the pilot in the field since its variation affects the visual acuity. Findings of a study carried out at IAM indicate that varying the IPD does not affect visual acuity. Hence, it is recommended that although IPD can be recorded, too much emphasis should not be laid on IPD during focussing except to ensure complete circle in visual field. It was brought out that all aircrew should be viewing thorough NVG at 0 diopter setting. This was not agreed and the reasons thereof have been discussed. It was suggested that flying in higher than minimum requisite illumination (0.01 lux) should be permitted even if the elevation is less than 30 degree. This too was not agreed to and the reasons thereof have been discussed. It was also brought out that aircrew resort to subjective assessment of available illumination before proceeding on mission. The need of objective assessment of night light using suitable lux meters is endorsed. The issue of improper helmet fitment due to sharing of helmets and inadequate training has also been addressed. In addition, fresh issues of degradation in NVG visual acuity in mild to moderate hypoxic conditions and of integration between NVG Gallet helmet and aviators Oxygen mask as revealed in a study recently carried out at IAM are also discussed.

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Key Words: NVG, Helmet fitment, Inter-pupillary distance, Eye Relief, Visual acuity, Hypoxia

Introduction

It has been said that "A military that can see at night will always enjoy a distinct advantage over an opponent that can't." Night Vision Goggle (NVG) is a specialized electro-optical device that enables a person to see at night. NVG increase the total available visual energy at night from scotopic to mesopic range by using the near infrared spectrum in addition to the visible spectrum. The image formed is thus clearer than unaided vision. With increased vision at night, the situational awareness increases.

This has made visual flying task at night much easier compared to unaided night flying. Although visual function with NVG is impressively enhanced over scotopic vision in many ways, NVG performance is inferior compared to normal photopic vision. The NVG image is compromised in other aspects of vision and is characterized by poor depth perception, monochromatism (no colour discrimination), contrast reduction, degradation of peripheral vision, etc. These gain tremendous importance in operant conditions of NVG usage. One of the important limitations of the NVG is their restricted field of vision. With the limited field of view of about 30 – 40 degrees, the outside imagery is viewed mainly with the central vision rather than the peripheral vision which is much more intuitive

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for spatial orientation. In addition there are a host of operational issues and human factors concerns like environmental considerations, fatigue and NVG adjustment and focusing which further affect optimal advantage gained with the use of NVG [1]. Therefore, measures employed to keep these aeromedical issues in check should be optimally used to provide the best possible operational scenario.

In IAF, NVG flying in helicopters commenced in a structured manner in 2002. Without prior NVG experience, the initial SOPs on NVG flying were adapted from existing night flying SOPs. Not long after beginning of NVG operations, IAM began conducting operational NVG training in the night vision lab which was later combined with other aspects of Operational Training in aerospace Medicine (OPTRAM) course. IAM has trained 762 aircrew during such structured training. The training broadly involves didactic lectures on functioning and limitations of human eye, working of NVG, NVG adjustment and focussing procedures, indoctrination in different terrain model, in-cockpit chores and visualisation of runway perspective from 300 ft AGL.

Problem statement

After gaining experience in NVG flying and as a feedback for improving NVG OPTRAM training at IAM, the aircrew have brought out certain issues in a service paper, which if addressed could improve safety in NVG operations [2]. In addition, another important aeromedical issue of possibility of degradation of NVG visual acuity in mild to moderated hypoxic conditions in unacclimatized aircrew emerged in a study carried out earlier at IAM. Therefore, following aeromedical issues have emerged:

(a) NVG visual acuity and hypoxia. How does in flight hypoxia affect the visual acuity? Would it have any operational connotation for an aircrew focusing NVG at lower altitude and then flying in to high altitude area? The issue of Oxygen mask integration with the NVG Gallet helmet also emerged during the study.

(b) IPD setting. Aircrew are not aware of their IPD settings Do the aircrew need to know their IPD setting in squadrons and how does approximating the IPD setting as is done at present affect the visual acuity?

(c) Diopter setting. NL 93 NVGs have eyepiece diopter range from -6 to +2 D (dioptres). Once the NVG is well focused, should the aircrew with normal eyesight be flying with 0 diopter setting on NVG and those with spectacles be flying with diopter setting close to the power of their spectacles?

(d) Provision of Lux meters in squadrons. Is there a need to have a lux meter in the squadrons and what should be the operating range of the lux meter?

(e) Flying with < 30 degree moon elevation. If the illumination on lux meter shows 0.01 Lux (adequate) can flying be started even if the moon elevation is less than 30 degrees above horizon?

(f) Helmet fitment. What is the effect of improper sizing helmets on NVG operations?

Review of Literature

The first available study of changes in NVG (AN/PVS-V) VA with acute hypoxia was carried out by Leber et al in 1986 [3]. They studied four trained subjects who were acclimatized to 5350 feet and simulated 15 min of hypoxia using gas mixtures. Their study showed no hypoxic performance decrement up to 13,000 ft (3,962 m) ASL with NVG augmentation. This study had limitations as the VA measurements were carried out on acclimatized individuals and the sample size was small. Another study by DeVilbiss et al [4] carried out with Gen III NVG in 15 subjects showed that visual acuity is significantly reduced at altitudes of 10,000 feet and above, and this reduction is reversed by use of 100% oxygen and 'normal' oxygen (for that altitude). Thus, there is limited literature available on this issue in public domain. This may be possibly because of the fact that the international operational exposure of aircrew using NVG in high altitude is likely to be lesser than that of the Indian military aircrew. Also there is no reported anecdotal experience of the Indian aircrew in this regard in the open literature.

The conflicting results in the reviewed literature and operational relevance in the Indian scenario prompted the study of changes in visual acuity with NVGs in hypoxia. Visual Acuity assessment with NL 93 Gen 2++ NVG and 1951 USAF tri-bar chart was carried out in 30 un-acclimatised subjects at half moon and quarter moon illumination conditions created in the altitude chamber at IAM modified for night vision testing. The subjects were randomly exposed to hypoxia at 8000 and 12000 feet and visual acuity measured on ground and at these altitudes with and without 5 minutes of 100% Oxygen. The findings revealed that in un-acclimatised aircrew the visual acuity through NVG underwent statistically significant deterioration at 12000 feet for illumination of quarter moon equivalent from $6/10.47 \pm 1.51$ to $6/12.23 \pm 2.24$. This decrease in visual acuity was found to reverse with use of 100% Oxygen. The study also revealed that the NVG Gallet helmet presently in use could not be integrated with aviators' Oxygen mask [5].

The NL-93 Gen II++ NVG used by IAF in helicopter operations have fore-aft, up-down, inter-pupillary distance (IPD) and tilt adjustment settings. The aim of adjustment is to align the NVG with the optical viewing axis of the eye. If IPD is incorrect, the view through would be dumb-bell shaped rather than one circle. If goggles are correctly aligned there should be no shading in any part of the image. In a review of performance history of AN/PVS-5 and ANVIS, McLean et all quote that by observing the shading of the circular display FOV, the user can find the optimum sighting alignment point within a few millimeters for all the three axes (fore-aft, vertical and IPD) [6]. Regarding the issue of IPD setting, the anecdotal data from US Coast Guard NVG training manual suggest that incorrect IPD setting adversely affects the resolution of the NVG in the following manner [2]:

Table 1. Effect of IPD error on visual acuity [2]

IPD Error (mm)	Visual Acuity
<1	20/40
2	20/50
3	20/80
4	20/100
5	20/200

Based on this data it was suggested that IPD measurement of all aircrew undergoing NVG indoctrination course (OPTRAM) should be recorded as part of anthropometric data and effect of incorrect IPD setting on NVG resolution must be emphasised [2]. This reference could not be cited in literature search. It could probably be based on unpublished studies of the AN/PVS-5A night vision goggle system conducted at USAARL in the early 1980's. A similar conclusion has been reached by King and Morse about Hickok's early report (1992) that mis-setting ANVIS IPD by 10 mm can produce Snellen acuities of 20/200, or a log MAR score of 1.0. The same authors studied Inter-pupillary and vertex distance effects on field of view and acuity with ANVIS and concluded that visual acuity is relatively insensitive to changes in vertex distance and IPD but was substantially reduced in periphery of field of view and in low contrast [7]. However, the USAF Night Vision Manual for flight surgeon states that proper adjustment of IPD is very important and even small mis-adjustments in IPD can degrade VA and cause eye strain and fatigue. It also mentions that before leaving the eye lane the IPD settings should also be noted along with the diopter settings and later re-checked in the aircraft before donning to ensure that these are not accidentally disturbed in transport [8]. Therefore this issue of IPD setting also revealed conflicting results in literature review and prompted further study in NVG lab at IAM.

The other important activity conducted in the NVG lab is Focusing of NVG. The NVG has an objective lens and an eye piece lens both of which need to be focused. Focusing of the objective is simple standard procedure and involves turning it to get best image. The eye-piece (back lens) has a refractory power range from -6 to +2 Diopter. This diopteric lens was originally designed to eliminate the need for aviators, with simple myopia or hyperopia, to wear their spectacles when using NVG [8, 9].

The eye-piece focusing adopted and recommended by IAM is the MAX PLUS procedure. In this procedure, one eye is closed, eyepiece for the other eye fully rotated counterclockwise and then rotated slowly clockwise until the clearest vision is just obtained [10]. Kotulak and Morse evaluated this technique using 13 subjects. For a 20 feet viewing distance, the mean eyepiece diopter setting was -1.13 D ± 0.63 D. The mean value of the difference between the eyepiece focus of the right and left tubes was 0.57 D ± 0.47 D. The study also showed that an infinity focus setting of the eyepieces for some of these subjects produced less resolution than the "user adjusted" condition. [11]. Although, theoretically it seems that most aircrew with 6/6 eyesight should be flying with a dioptre setting close to zero, the studies have shown mainly a negative diopter value for best resolution through NVG. This led to examination of this issue in a study at IAM NVG lab.

In NVG operations, the main source of natural illumination is the moon. Without other variables (e.g., atmospheric obscurants, shadows, etc.), it provides the energy that is reflected from objects and then used by the NVG to form an image. The level of natural illumination is normally discussed in terms of high illumination and low illumination. For most NVG operations, high illumination is determined by two factors: how much of the lunar disc is visible, and its elevation above the horizon. For several years, the lower limit of high illumination has been defined as the equivalent energy produced by a 20% moon disc that is 30° above the horizon. This equates to 0.0022 lux. With Gen II NVG, flying is restricted between quarter moon and full moon [1]. The USAF Night Vision manual for the flight surgeon also mentions that the current policy of most military services restricts NVG flights to periods of natural illumination which meet or exceed the lunar conditions of 20% moonlight at 30 degree above the horizon. However, it also mentions that these restrictions can be waived off by the commander. Also, this policy was implemented when only Gen II tubes were available and has not changed with the fielding of the more sensitive III-Gen tubes [8]. The present position of IAM on this issue is clarified in discussion.

It is well accepted, that optimum NVG helmet fitment is a must for obtaining good visual performance from NVG. Too loose a helmet results in degradation of the image by vibrations and also leads to slippage of the NVG forwards and misalignment of visual and optical axes. On the other hand, too tight a helmet is uncomfortable and can precipitate NVG related human factors such as headache, cervicalgia, etc. The Gallet helmet

Table 2. Helmet Sizes and Pad Thickness

	Small			Large		
Size of helmet	XS	S	M	L	XL	XXL
Pad thickness (mm)	15	10	5	15	10	5
Heads circum (cm)	53-54	55-56	57-58	59-60	61-62	63

Pad thickness	
Front pad (3 sizes)	5, 10, 15 mm
Top pad (3 sizes)	5, 10, 15 mm
Neck pad (6 sizes)	XS, S, M, L, XL, XXL
Edge roll (2 sizes)	M, L

sizing schedule used with the NVGs in helicopters in IAF is as follows [1]:

This sizing schedule was studied with respect to head circumference of the IAF aircrew population and its implications in selection of appropriate helmet and pad size is discussed.

Methodology

The issues were studied as follows:

(a) NVG visual acuity and hypoxia. Visual Acuity assessment with NL 93 Gen 2++ NVG and 1951 USAF tri-bar chart was carried out in 30 un-acclimatised subjects at half moon and quarter moon illumination conditions created in the altitude chamber at IAM modified for night vision testing. The subjects were randomly exposed to hypoxia at 8000 and 12000 feet and visual acuity measured on ground and at these altitudes. The subjects spent 30 min on ground in dark for adaptation before random exposure to altitudes was given. After 30 min of exposure at each altitude and visual acuity testing, the subjects breathed 100% Oxygen by aviators oro-nasal mask for 5 min and visual acuity tested again for changes with oxygen.

(b) IPD setting. The study was carried out at eye-lane in the NVG lab of IAM to assess the effects of IPD and eye relief on visual acuity through NVG. Gen 2++ NL 93 NVG, 1951 USAF tri-bar chart and a moonlight simulator at full moon setting were used in the experiment. Three subjects including two males aged 32 and 33 years and one female aged 32 years participated in the study. All three had corrected visual acuity of 6/6 by Snellen's method. One of the subjects was bespectacled and observations were taken for him with the spectacles. Out of these, two male subjects participated in the first part of the study. They were asked to adjust the IPD to the maximum limit from the optimally aligned and focussed position of NVG keeping the eye-relief constant. IPD was then reduced gradually and visual acuity was measured at each value of IPD.

(c) Diopter setting. All the three subjects participated in the second part of the study i.e. measurement of visual acuity with varying eye relief. In these subjects, after alignment and focussing of the NVG, visual acuity was measured at three positions of eye relief i.e. maximum, optimum and minimum. The subjects were allowed to refocus the objective and eyepiece at each position and the best visual acuity and the diopter setting of the eye piece was recorded.

(d) Helmet fitment. The issue of helmet fitment was analysed using existing head circumference percentile values of the IAF aircrew and sizing schedule of Gallet helmet.

Results

The results obtained in the different lab studies were as follows:

(a) NVG visual acuity and hypoxia. The findings revealed that in un-acclimatised aircrew the visual acuity through NVG underwent statistically significant deterioration at 12000 feet for illumination of quarter moon equivalent from 6/ 10.47 ± 1.51 to 6/12.23 ± 2.24. This decrease in visual acuity was found to reverse with use of 100% Oxygen. The study also revealed that the NVG Gallet helmet presently in use could not be integrated with aviators' Oxygen mask [5].

(b) IPD setting. The best visual acuity of the subjects recorded from the tri-bar chart was as shown in Table 3. It was 6/9.75 for two subjects and 6/12.29 for the third subject. The visual acuity measured as per different IPD setting is shown in Table 4. There was no change in visual acuity in any of the subjects on varying the IPD from 52 mm to 72 mm.

(c) Diopter setting. The visual acuity measured as per different Diopter setting are shown in Table 5 while Table 6 shows Mean Diopter values for the three different Eye Relief setting.

Table 3. Best visual acuity for 3 subjects

Subject	Visual acuity	Visual acuity in Snellen format (m)
1	-3,4	6/9.75
2	-3,4	6/9.75
3	-3,2	6/12.29

Table 4. Visual Acuity for Varying IPD

IPD in mm	Subject-1	Subject-2
72	-3,4	-3,4
70	-3,4	-3,4
68	-3,4	-3,4
66	-3,4	-3,4
64	-3,4	-3,4
62	-3,4	-3,4
60	-3,4	-3,4
58	-3,4	-3,4
56	-3,4	-3,4
54	-3,4	-3,4
52	-3,4	-3,4

Discussion

(a) NVG visual acuity and hypoxia. The findings of the study on NVG visual acuity in hypoxia revealed that in un-acclimatised aircrew the visual acuity through NVG underwent statistically significant deterioration at 12000 feet for illumination

Table 5. Visual Acuity and Diopter Setting for Varying Eye Relief

Subject	Eye relief	Visual acuity	Diopter setting of eye piece (D)	
			Right	Left
Subject -1	Max	-3,4	-0.3	-0.3
	Optimum	-3,4	-1.0	-1.3
	Min	-3,4	-2.0	-1.8
Subject-2	Max	-3,4	-0.9	-0.7
	Optimum	-3,4	-1.0	-0.5
	Min	-3,4	-1.3	-0.8
Subject-3	Max	-3,2	-1.0	-2.0
	Optimum	-3,2	-1.2	-1.0
	Min	-3,2	-3.0	-4.0

Table 6. Mean Diopter Values for the three different Eye Relief Setting

Subject	Eye relief	Mean Diopter value (Rt)	(Lt)
Subject -1	Max	-0.7	-1.0
Subject-2	Optimum	-1.1	-0.9
Subject-3	Min	-2.1	-2.2

of quarter moon equivalent. This decrease in visual acuity was found to reverse with use of 100% Oxygen. The operational significance of this laboratory based observation, as a possible aeromedical factor, hence needs to be examined further. It is possible that with increasing expertise, un-acclimatized aircrew of helicopter units located in the foothills of Himalayas may be required to carry out high altitude search and rescue (SAR) missions. In such a scenario visual acuity of the aircrew whilst flying at altitude of 12000ft MSL or so may deteriorate in spite of having focussed the NVG adequately before the flight. Due to presence of multiple concomitant potential factors which could adversely affect image quality with NVG, even minor decrements in visual acuity with hypoxia could significantly affect the overall operational performance of NVG.

During the study, it was also revealed that Gallet helmet available with IAM has no provision for attachment of an Oxygen mask. It is not known if the Gallet helmets in the field have been modified for providing Oxygen mask attachment. If not, the aircrew flying such missions will have to do so without supplemental oxygen. The anecdotal evidence suggests that the scenario in field is same as that in IAM. NVG operations out of high altitude bases by acclimatised pilots, who are required to wear oxygen masks at all times in flight, would also be affected in the absence of suitable mask connectors on the Gallet helmet.

In view of the above, it is recommended that these lab based findings of the above mentioned study be corroborated with the field experience of the aircrew, if any. In the interim, the aircrew may be briefed to be vigilant on the possible deterioration of the visual acuity in such NVG aided missions involving taking off from low altitude base and flying in high altitude areas. Also, to facilitate NVG aided flying in high altitude areas, a study be initiated to examine integration of the existing oxygen masks with the Gallet helmet. The primary considerations for such a study should be development and retrofit of suitable connectors for integrating mask with the helmet, studying physical interference of the mask with NVG and to study the effect of the mask on the eye-relief and instrument readout.

(b) IPD setting. IPD setting was not found to cause any change in the visual acuity of the subjects. If the IPD setting is changed towards the maximum or minimum, the see-through area becomes de-centred with the central part comprising of the overlapping area while the peripheral part comprising of area used independently by each eye for viewing. During the experiment, only best visual acuity, observed naturally from looking through the centre of the 30-40 degree circular field was recorded. It could be argued that visual acuity through the area of the circular field not overlapping with that of the other monocle (area of decentration) might be degraded compared to that observed though the central overlapping area. Studies indicate that there is substantial loss of resolution at the periphery of ANVIS field of view compared to the resolution at the central field of view [7]. The area of nasal or temporal decentration falls in the periphery of field of view. Therefore, the VA is reduced in the decentration area not because of IPD changes but because it falls in the periphery of field of view. However, if the basic dictum of NVG adjustment viz. obtaining a single sharp circular see through area, is adhered to, there are minimal chances that significant part of the outside scene are viewed through the decentration area. The study by King and Morse on 'Inter-pupillary and vertex distance effects on field of view and acuity with ANVIS' also concluded that visual acuity is relatively insensitive to changes in vertex distance and IPD but was substantially reduced in periphery of field of view and in low contrast [7]. Hence, laying too much emphasis on IPD setting measurement and recording the same along with anthropometric data is not warranted. Moreover, OPTRAM experience has shown that the aircrew can easily achieve optimal IPD adjustment while viewing through the NVG.

(c) Diopter setting. It can be seen from the second part of the study that different eye relief required different diopter setting of the eye-piece to maintain the required visual acuity. As seen from the results, as the NVG was brought from the farthest position to the closest position in front of the eyes, the diopter setting required to maintain optimum visual acuity reduced or, in other words, increased towards the negative side. This may seem to indicate that the change of eye relief distance varies the NVG resolution. However, no previous studies suggest this. Rather, studies indicate that varying the eye relief (also known as the vertex distance) has an effect on the field of view [7]. The focusing method used in this study was the Max Plus. With this method, McLean and van de Pol found a mean diopter value of -0.75 at optimal eye relief in 16 student pilots aged less than 30 years [10]. This is similar to the results in our study. Another study by Kotulak and Morse using the same technique found the mean diopter setting in 13 aviators to be -1.13 D ± 0.63 D. It should also be noted that the mean auto-refractive error for 10 pilots among these subjects who were not required to wear corrective lenses for flight was -0.40 diopter [11].

Therefore, it is likely that the different diopter values obtained in our study are as a result of variation in the accommodative effort used in focussing. With a fixed eyepiece diopter value of focusing at infinity these variations can be done away with. However, this is likely to lead to suboptimal focussing in aircrew with refractory errors in the permissible range of +2D to -0.5D [12] who do not require to use spectacles. Therefore, given the use of Max Plus focussing technique and available diopter variation from -6 to +2 D, a fixed diopter value of '0' cannot be practiced.

(d) Provision of Lux meters in squadrons. With Gen II NVG, flying is restricted between quarter moon and full moon [1]. Since IAF is currently operating with Gen II NVG, flying should be restricted below 0.01 lux. Subjective assessment of illumination levels is prone to errors, especially during the first and last few days of the moon phase, and when clouding/atmospheric haze reduces the ambient light levels. Therefore, provision of luxmeters capable of illumination measurement in the range of 0.0001 to 0.1 Lux, in the squadrons involved in NVG operations, is hereby endorsed. These lux-meters, as the aircrew have suggested, may also be used to collect data on prevalence of illumination conditions near the border areas or other areas of NVG operations. The data so generated can later be used to plan NVG operations and even predict light levels using appropriate software.

(e) Flying with < 30 degree moon elevation. It was suggested by the aircrew that if light levels can be objectively measured using lux-meters, NVG flying could be continued when measured overall light level is above 0.01 Lux, even when the moon elevation is less than 30 degrees. In mountainous/ hilly regions, flying in less than 30 degree moon elevation results in a phenomenon called 'terrain masking' in which, objects/features located in the areas shadowed by the hilly terrain cannot be picked up by the NVG. Terrain masking can also occur in desert areas by sand dunes and in cities by tall buildings. Hence, flying in hills and city terrain less with than 30 degree moon elevation is not recommended. However, NVG operations in plains, where 'terrain masking' is known to be insignificant, could be considered strictly on case to case basis if the overall illumination levels are more than 0.01 Lux.

(f) Helmet fitment. The NVG Gallet helmet sizing schedule caters for 10th to > 100th percentile of the IAF aircrew [13]. Since, 100th percentile value of head circumference for IAF aircrew is 59.5cm, the XL and XXL sizes of the large shell are not required since these cater for head circumference of 61 to 63 cm. These sizes would be too loose for the IAF aircrew. However, the thickest size of various padding if used may mitigate the looseness to some extent and achieve a good 'fit' in some pilots. However, as per the design philosophy of sizing schedule of helmets it must be noted that the padding are meant to be used only for better fitment of a correctly sized helmet and not as a primary tool of sizing itself.

The minimum head circumference recorded in IAF aircrew is 51 cm. Thus aircrew with circumference of 51 to 53 cm do not have any specific sized shell. These aircrew would select XS size of small shell which would be too loose for them. They would try to fit the shell with large sizes of various padding. Some, but not all of them may achieve a satisfactory 'fit. However, once again, as per the design philosophy of sizing schedule of helmets it must be noted that the padding are meant to be used only for better fitment of a correctly sized helmet and not as a primary tool of sizing per se.

The NVG experienced aircrew suggested that the aviation medicine specialist involved in NVG indoctrination course should help aircrew select correct size of pads for the helmet, and these sizes should be annotated in the medical documents of the aircrew for future reference. The recommendation that aircrew be trained in this aspect is correct and accepted. The training would include the complete process of sizing from measurement of head circumference, determination of shell size, determination of individual pad size requirement and finally assessment of proper fit.

Conclusion

This paper discussed some of the important aeromedical issues in use of NVG raised in field and studied at IAM. Unacclimatized aircrew using NVG in areas of high altitude need to be more vigilant to decline in NVG performance; while the issue of integration of the existing oxygen masks with the Gallet helmet needs to be examined further. The study on visual acuity on IPD and diopter setting showed that minor variations in IPD do not affect visual acuity. The use of current focussing technique and making allowance for permissible refractory errors not requiring use of spectacles does not allow following a fixed eyepiece diopter setting of '0'. Although, the provision of Luxmeters in squadrons to observe the illuminations levels objectively is endorsed, flying with NVG at moon elevation below 30 degree if the illumination is sufficient can only be permitted exclusively on case to case basis provided that the issue of 'terrain masking' is addressed. Selection of proper NVG helmet size and paddings and its fitment should be included as part of NVG indoctrination in OPTRAM courses.

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