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Visual Status among Nepalese Civilian Pilots

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Abstract

Introduction: Vision assessment is a part of medical examination for pilots. Visual acuity and refraction are performed routinely but binocular vision assessment is rarely performed. The aim of this study was to evaluate the visual status of Nepalese civilian pilots, including binocular vision assessment.

Methods: It was a descriptive, cross sectional study conducted among Nepalese pilots. Thirty pilots operating domestic flights and twenty operating international flights, from 7 different airline companies participated in this study. A detailed ophthalmic examination of the pilots was performed by an investigator under the guidance of an Optometrist from January to August 2006. Examinations were conducted at Nepal Airlines Corporation, head office and domestic terminal at Tribhuwan international airport (TIA). The data collected were analyzed to determine presenting visual acuity, refractive error and binocular vision of pilots.

Results: Among 50 pilots, 88% of pilots had presenting visual acuity within normal limits (6/6 binocularly) as normal requirement set by Civil Aviation Authority of Nepal (CAAN). Pilots having significant refractive errors were 32%. Other visual symptoms related were present in 16% of pilots. Only one case had intermittent exotropia (IXT) and exophoria was present in 15 (30%) pilots among which 3 (6%) had deviation between 4-8 prism diopters.

Conclusion: About 90% of Nepalese civilian pilots had normal visual acuity as defined by civil aviation authority of Nepal (CAAN). However, few pilots had some form of binocular vision disorders which could easily be im3proved by vision therapy.

Keywords: Binocular Vision, Nepalese Pilots, Visual Acuity; Vision Therapy; Prism Diopters

Abbreviations: TIA: Tribhuwan International Airport; CAAN: Civil Aviation Authority of Nepal; IXT: Intermittent Exotropia; ICAO: International Civil Aviation Organization; RAF: Royal Air Force; NPC: Near Point of Convergence; PAL: Progressive Addition Lenses.

Introduction

Though technology has assisted to improvise vision related issues associated with flying aeroplanes, the pioneer pilots had to work against physiological limits of eye. A bright lights source at night has led to many aviation accidents. The

majority (57%) of accidents occurred during the approach and landing phase of the flight [1]. The position of the aircraft is difficult to find out especially in higher altitudes where there would be no references to get the clue of depth unlike in lower altitudes where mountain, birds, cloud and other aircraft can give the clue of depth. Chances of accidents get higher with lower stereoscopic acuity while landing the aircraft. A study found that a 25 year old student aviator who was orthophoric previously was found to develop intermittent exotropia (IXT) after continuous flight over 16000 feet for 4 years [2]. Nakagaware VB, et al. [3] found that near vision restrictions was increased by double (13%) in comparison to distant vision restrictions (6%) during 1976 to 2001 [3]. As a result medical examination of pilots as the fitness criteria for flying was introduced of which vision is an important part.

Normal binocular vision is important for safe flying without which accidents can happen especially in a mountainous country like Nepal where some of the runways are located on difficult terrain. According to aviation safety department CAAN, the human factor is responsible for about 80% of the aviation accidents and medical or other factors contribute 20% to accidents in Nepal. Nakagaware VB, et al. [4] reported that majority of the 130 accidents occurred due to exposure to glare from natural sunlight during clear weather and atmospheric conditions (85%) and were associated with landing and take-off phases of flight (55%) [4]. International civil aviation organization (ICAO) requires a medical certification from a clinician verifying that the available amount of stereopsis of pilot does not impair vision for flying. However detailed binocular vision assessment is not performed as part of eye examination. In Nepal, there are reported cases of 3 aviation accidents from 1946 to 1956 whereas during the same length of time (2006 to 2016) the number of aviation accidents went up to 15 [5].

This increasing trend of aviation accidents is a warning sign that aviation safety is deteriorating and indicates that factors causing these accidents should be addressed. One of this being mandatory vision assessment and eye examination for pilots. This study was conducted to assess visual status of Nepalese civilian pilots.

Methods

It was a cross sectional descriptive study of Nepalese civilian pilots. The data for the study was collected during January to August 2006 at Nepal Airline Corporation building and domestic terminal of the Tribhuwan International Airport. All civilian pilots registered with CAAN were eligible for the study and a purposive sampling method was adopted to select study participants. Data analysis was done using excel and SPSS computer software version 14.0. Consent to collect data and analyse it was obtained from the airline companies and CAAN. Permission to conduct the study was obtained from BP Koirala Lions Center for Ophthalmic Studies. A specific performa for eye examination and self-administered questionnaire was designed for this study. A brief history including all possible visual complaints of a pilot during flying were recorded i.e. poor visibility, eye strain, double vision, headache after flight, visual illusion, problem in estimating distance, transient blurring of vision. Use of any glasses, contact lens or protective eyewear (UV filter, Polaroid glasses, and tinted glasses) was also recorded.

Visual standards issued by civil aviation authority of Nepal (CAAN) and International civil aviation organization (ICAO) Personnel Licensing Annex 1 were used [6]. Static visual acuity for distance (6m), intermediate (100 cm) and near (40 cm) was taken monocularly as well as binocularly, unaided as well as aided. Snellen's letter chart was used to assess visual acuity at distance while reduced Snellen's continuous text chart was used for intermediate and near distance. According to CAAN and ICAO, distant visual acuity requirements for commercial pilot license should not be less than 6/9 in each eye separately, with or without the use of correcting lens and 6/6 (1.0 log mar) binocularly. When the required visual acuity can be obtained only with the correcting lenses, the applicant may be assessed as 'fit', provided that: a) the applicant possesses a visual acuity without correction in each eye separately not less than 6/60 and pilot is able to read N5 size chart or its equivalent for near vision and N14 size chart or its equivalent for intermediate distance. When visual acuity was found less than 6/6 binocularly and less than 6/9 monocularly pinhole visual acuity was taken. With best correction, if near visual acuity for intermediate distance was found less than N14 it was noted as abnormal. Visual acuity for near if found less than N5 even with near correction was also marked as abnormal. Refractive error was determined by retinoscopy followed by subjective refraction using trial lens and trial frame. A pilot who had refractive error and needed correction lenses to meet the requirement was recommended to look over bifocal or perhaps multifocal lenses in order to read the instruments and a chart or manual held in the hand along with the distance correction in place. Single vision near correction significantly reduces distant visual acuity and was therefore not acceptable.

The Royal Air Force (RAF) ruler was used to measure near point of convergence and amplitude of accommodation. Near point of convergence (NPC) less than 10 cm was regarded as abnormal. Accommodative facility of all the participants below 40 years of age was taken with a ±2D lens flipper. Values found below 7 cycles per minute were considered abnormal. Stereopsis was assessed using Titmus stereo tests (Stereo Optical Co.). Confrontation test was performed for both eyes to estimate the peripheral visual field. Amsler grid

test chart type 1 was used to assess the central 10 degree of the visual field at 30 centimeters. Color vision was assessed by using Ishihara's color vision charts (38 plate edition) administered at a distance of 75 centimeters. If 17 or more plates were read normally the color vision was regarded as normal. If only 13 or less plates were read correctly it was regarded as deficient. Anterior segment examination was examined with a focusable torch light (Meglite, USA) and posterior segment examination was performed by pocket direct ophthalmoscope (Keeler Ltd.). Any abnormalities found were recorded and the participants were referred to BP Koirala Lions Centre for Ophthalmic studies for detailed evaluation and management.

Results

A total of 50 civilian pilots working for different commercial companies were examined in the study. Among them, 30 (60%) pilots were operating domestic airlines while 20 (40%) were operating international flights. The age of the participants ranged from 25 to 57 years with the mean age of 40.3±8.4 years. 38% of the pilots (n=19) were of 40-49 years and 96% were males. Of total pilots, 16% had at least one visual complaint. All the symptoms noted were related to flying. The most common symptom was poor visibility during flight (25%) followed by headache after flight and visual illusion. The use of protective eyewear in the form of sunglasses was reported by 17 (34%) pilots. Among the participants, 10 (20%) pilots used UV filters. Others used tinted glasses 6(12%) and polaroid glasses 1 (2%) pilot.

Majority of the pilots, 36(72%) had normal visual acuity of 6/6 and 6(12%) had worse than 6/9 visual acuity. None of the pilots had visual acuity of less than 6/60. In the study population a small number of eyes, (n=4; 8%) had poor unaided visual acuity i.e. 6/24 to 6/60. Of the eyes having unaided visual acuity of less than 6/6 eight pilots improved to 6/6 with their present correction. Intermediate vision was better than N14 in all participants except in one, who had N18 both monocular as well as binocular. The vision improved to N10 with near correction. There were 23 (46%) pilots who had near visual acuity of N5 binocularly, followed by pilots having N6 (24%). Only 2 (4%) pilots were found with N18 and N24 acuity. Among 27 (54%) pilots, having near visual acuity of less than N5, 25(50%) improved to N5 with correction whereas 2 (4%) did not improve better than N8. Thirty percent pilots reported using glasses previously. Six pilots (12%) were using reading glasses only, four pilots (8%) were found to use glasses for distance correction only, while five pilots (10%) were using bifocal glasses. Twenty eight eyes of 16 pilots had refractive errors. Hyperopia was found in 16 (32%) eyes whereas myopia was present only in 12 (24%) eyes. Astigmatism as defined by the spherical equivalent of 0.5diopter or more was not found in any of the pilots. Among 14 pilots, who had unaided visual acuity of less than 6/6 binocularly, 8 (57.14%) improved to 6/6 with correction. Among the total of 22 (44%) pilots, who required correction for near work, only 12 (24%) had near vision spectacle available with them at the time of examination. Near addition ranged from 0.25 to 2.5 diopter with mean power of 1.38 diopter (Table 1).

Visual Acuity	Right Eye N (%)	Left Eye N (%)	Both Eyes N (%)
06-Jun	36 (72)	34 (68)	36 (72)
<6/6-6/9	8 (16)	8 (16)	6 (12)
<6/9-6/12	2 (4)	2 (4)	1 (2)
<6/12-6/18	1 (2)	1 (2)	2 (4)
<6/18-6/24	1 (2)	1 (2)	1 (2)
<6/24-6/60	2 (4)	4 (8)	4 (8)
Total	50 (100)	50 (100)	50 (100)

Table 1: Distance visual acuity in pilots.

Ocular motility was in full range, in all cardinal positions of gaze, in all pilots. Cover test for near revealed that about two-thirds (n=34; 68%) of the pilots had orthophoria whereas 15 (30%) pilots had exophoria. Only one case had intermittent exotropia (IXT). At distance, exophoria was present in 15 (30%) pilots among which 3 (6%) had deviation between 4-8 prism diopters whereas others had deviation less than 4 prism diopters. Of the study population, 6 (12%) pilots had decreased amplitude of accommodation. Twenty eight pilots were found to have abnormal convergence. Almost two-third (64%) pilots had stereo acuity of less than 40 seconds of arc whereas 2% had stereo acuity more than 100 seconds of arc. Out of 24 pilots, 19 (79%) were found to have normal value of accommodative facility whereas 5 (21%) pilots had abnormal accommodative facility. There was no abnormality detected on anterior and posterior segment examination. Visual fields were normal for all the pilots as they passed confrontation and Amsler grid tests. Color vision was found normal in all pilots (Table 2).

Near Visual Acuity	Right Eye N (%)	Left Eye N (%)	Both Eyes N (%)
N5	23 (46)	23 (46)	23 (46)
N6	10 (20)	10 (20)	12 (24)
N8	5 (10)	6 (12)	4 (8)
N10	4 (8)	4 (8)	4 (8)
N12	5 (10)	4 (8)	3 (6)
N18	1 (2)	1 (2)	2 (4)
N24	2 (4)	2 (4)	2 (4)
Total	50 (100)	50 (100)	50 (100)

Table 2: Near visual acuity distribution in pilots.

Discussion

Most of the pilots (96%) included in this study were men. The majority of the pilots (54%) in this study were presbyopic with mean age was 40.3±8.4 years which might further increase as the industry gets older. Nakagawara VB, et al. [3] reported that the average age rose from 36.8 years to 42.3 years during 1976 to 2001. During flight especially at high altitude pilots experience visual symptoms. A study reported that the source of accidents was the exposure to bright light at night [1]. In our study, 16% pilots reported that they experienced some form of visual symptoms during flight. Though it is mandatory for pilots to undergo eye examination every 6 months for their license renewal, these complaints seem to remain unaddressed. Optometric vision examination should be a part of medical examination so that the visual symptoms of the pilots could be addressed properly and flight safety is ensured. About two-third pilots were not using any form of filters during flight probably because they did not experience any form of visual symptoms while flying. A study found that 130 accidents occurred in which glare was found to be a contributing factor [4]. Selection of proper filter or sunglasses for flying is very important to avoid glare. Glare was associated with impairment of pilot's ability to see their instrument and fly their airplane [7,8].

The near visual acuity did not improve in a small proportion (4%) of pilots in comparison to distant vision (2%). This finding was similar to that reported by Nakagawara VB, et al. [3] where near vision restriction was more than double (13%) than distant vision restrictions (6%). Those requiring near and distant correction were using bifocal glasses, though there are options like progressive addition lenses(PAL) that are popular among aviators elsewhere. A study by Markovits AS, et al. [9] found that compared to a standard bifocal (ST-25), a PAL correction significantly lowered the time needed to locate static targets at a cockpit instrument after viewing distance. Though, 54% required to use spectacles to meet the near correction requirements, only half (24%) were using it probably due to the attitude of young presbyopes denying or deferring near addition.

Considerable proportion of pilots had abnormal near point of convergence (28%), amplitude of accommodation (12%) and accommodative facility (21%) which could easily be corrected with binocular vision assessment and vision therapy. These data show that visual problems of the pilots that could be improved by vision therapy remain unaddressed. High degree of heterophoria and heterotropia found could be the source of headache during or after flight compromising performance of a pilot. Ali HM, et al. [2] found that intermittent exotropia (IXT) was reported in an aviator who was flying over 16000 feet for 4 years. One pilot had just gross positive binocularity with stereo-acuity less than 100 seconds of arc suggesting either stereo acuity test was missed during routine eye examination or the pilot developed reduced stereo acuity as a result of flying for a long time. One pilot who complained of occasional floaters in the right eye, 4-5 in number in the last 2 weeks was referred to BP Koirala Lions Center for Ophthalmic studies for further examination and management. It is recommended that all pilots operating domestic as well as international flights should undergo binocular vision assessment on a routine basis. There are few limitations of this study. We could not measure various factors that are important like dynamic visual acuity, dark adaptation, glare, visualization and scanning techniques. We also did not measure the severity of convergence and accommodative insufficiency.

Conclusion

Presenting visual acuity of all pilots was within the normal limits as defined by CAAN. Appropriate types of color filters should be encouraged to avoid glare and visual discomfort. Some of the pilots had some form of binocular vision disorders which could easily be improved by vision therapy.

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