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# Near Point of Convergence in Intermittent Exotropia

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## Abstract

**Introduction:** Intermittent exotropia (IXT) is the most common type of exo-deviation. Patients with IXT can maintain binocular single vision (BSV) and the duration of binocular disruption depends upon its severity and the status of convergence mechanism. Those patients with good near point of convergence (NPC) can use BSV most of the time.

**Aim:** To determine NPC in patients with IXT.

**Materials and methods:** It was a hospital based cross-sectional study conducted in BP Koirala Lions Center of Ophthalmic Studies over a period of one year starting from Janaury 2009. All patients with IXT and age ranging from 5-35 yrs were included in this study. Complete ophthalmologic examination was done including measurement of NPC with RAF rule and magnitude of deviation with Synaptophore.

**Results:** Out of 115 patients, majority of patients (58%) were students and headache was found to be the most common complaint (65%). Two thirds of patients had IXT of 10-25 PD at near while half of patients had IXT of < 10 PD at distance. Mean NPC was 13.27 ± 3.46 cm. Two-thirds of the patients had NPC of 10 cm or more. NPC was not associated with age and gender of patients (p ≥ 0.05). 74% of patients had normal near point of accommodation (NPA) according to their age. Four fifths of patients had normal visual acuity in both eyes. Almost all (98%) of patients had positive stereopsis at near but at distance, 77% of patients had positive stereopsis.

**Conclusion:** NPC is poor in two thirds of IXT patients. NPA and visual acuity was normal in majority of cases. Stereoacuity was found better at near than at distance.

**Keywords:** Convergence; Intermittent exotropia; Stereoacuity

## Introduction

Near point of convergence (NPC) means the nearest point up to which visual axes intersect with each other. It is the basis of binocular vision at near. The normal value of NPC in a healthy individual is 8-10 cm from the eyes [1]. The presence of normal value of NPC ensures perfect bifoveal fixation and good binocular vision. In contrary, poor convergence it means NPC beyond 10cm is not enough to maintain good binocular vision. The individual with poor NPC cannot maintain binocular single vision (BSV) at near, consequently symptoms of poor tolerance to near work like diplopia, blurring vision, headache occurs. Poor NPC is mostly associated with exo-type of deviation like high exophoria, intermittent exotropia (IXT) and manifest exotropia. Poor convergence is one of the most common causes of ocular discomfort and the most common cause of muscular asthenopia [2].

IXT is a type of exodeviation in which manifest outward deviation occurs intermittently. There exists alteration between latent and manifest strabismus. It is the most common form of exotropia occurring in approximately 1% of children [3]. Most of the time patients with IXT show crude type of BSV, exophoria with delay recovery and one eye remains deviated until and unless patient voluntarily brings it back for alignment. Duration of binocular disruption depend upon its severity and the status of convergence mechanism. The amount of deviation ranges small to large values but can be controlled by the fusional mechanism at times, which in turns depends upon the value of NPC. Stronger the NPC, longer will be the maintenance of binocularity in intermittent exotropes. Most of the cases of IXT originate from exophoria, then deteriorate into IXT and constant exotropia as suppression deteriorates with age. So, it is considered as a progressive disease [4]. In children with IXT where deviation alternates, significant amblyopia does not exist. If the same eye is always the deviating eye, it can have significant amblyopia.

Three percent of the total patients who had attended BP Koirala Lions Center of Ophthalmic Studies in 2008 had IXT which shows gravity of the problem. IXT can break into constant tropia, if not intervened in time. As the intermittency is maintained by the convergence mechanism, progressive weakening of the convergence leads to inability to align the eyes. NPC can be made stronger by orthoptic exercises [5], so if the patients with IXT is identified and recommended proper orthoptic exercises, tropia would never result.

Maintenance of strong convergence offers good binocular vision, hence enhance the quality of the life of IXT patients, otherwise tropia prevails bringing personal, social and medical burden. So that identification and measurement of magnitude of NPC in IXT patients are quite productive for the patients as well as the clinicians. Similarly, further deterioration of visual acuity can be minimized and efficient binocular vision can be developed.

So a hospital based cross-sectional study was designed to find out the available amount of convergence in these patients. It will give the baseline data for the clinicians to explore appropriate modalities to handle this problem. As this study was first of its kind, the final outcome would open up new guidelines for further researches in this field.

## Material and Methods

This was a descriptive and cross-sectional study carried out in BP Koirala Lions Center of Ophthalmic Studies over a period of one year starting from Janaury 2009. Patients diagnosed with intermittent exotropia at near or distance and age ranging to 5 to 35 were included in the study. Patients with manifest deviation or any ocular pathology were excluded. This research followed the tenets of the Declaration of Helsinki and was ethically approved by Institutional Review Board of Tribhuvan University Teaching Hospital, Kathmandu, Nepal. Patients provided written informed consent prior to testing. Health Insurance Portability and Accountability Act 1996 regulations were followed for all patients involved in this study.

A brief history was taken regarding the chief complaint, associated symptoms and any past history of eye examination and/or optical correction. Visual acuity was measured using internally illuminated standard Snellen chart or E-chart. Cycloplegic refraction was done applying cyclopentolate 1% with Heine CE Streak retinoscope. Fundus examination was done by using Heine CE direct ophthalmoscope to evaluate the fundus. Cover test, cover-uncover test, prism cover test and/or synaptophore test were performed to measure magnitude of deviation. NPC and NPA were measured using RAF rule, Clement Clarke Ltd. Stereopsis was evaluated with the help of TNO stereopsis test for near at a distance of 35 cm and with synaptophore at virtually infinity for distance. Convergence and divergence fusional reserves were calculated with the help of prism bars and synaptophore.

IXT is classified in three types: Convergence insufficiency type (magnitude of IXT at near exceeds by 10 PD than at distance); Basic type (near and distance IXT equals with each other) and Divergence excess (magnitude of distance deviation is more than 10 PD) [6].

All the information was gathered in a standard proforma. Data were analysed using SPSS 13 software and p value less than 0.05 was considered as statistically significant.

## Results

A total number of 115 patients were diagnosed to have IXT after the orthoptic evaluation, who were included in this study. Out of which 53% (61) were females and remaining 47% (54) were males. However, there was no significant difference in the number of two sexes (Chi-Square test, χ2=0.426, p=0.514).

Mean age of patients was 23.7 ± 5.62 years with range 7 to 34 years. As shown in Figure 1, majority of the patients were in the age group of 17 to 25 years. There was no significant difference between the number of males and females in the age group (p>0.05).
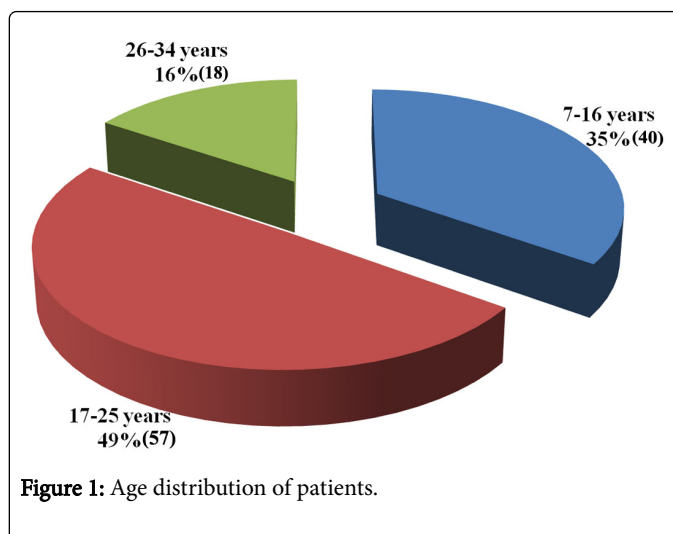


**Figure 1:** Age distribution of patients.

Majority of the patients were student (58%) followed by housewives (15%) (Figure 2). All the patients were found to have multiple complaints. Headache was the predominant complaint accounting for 65% followed by tired eyes (35%) and eye strain (26%). Double vision was complained by 4% patients. Complaint was not associated with the gender or age of patients (p>0.05).
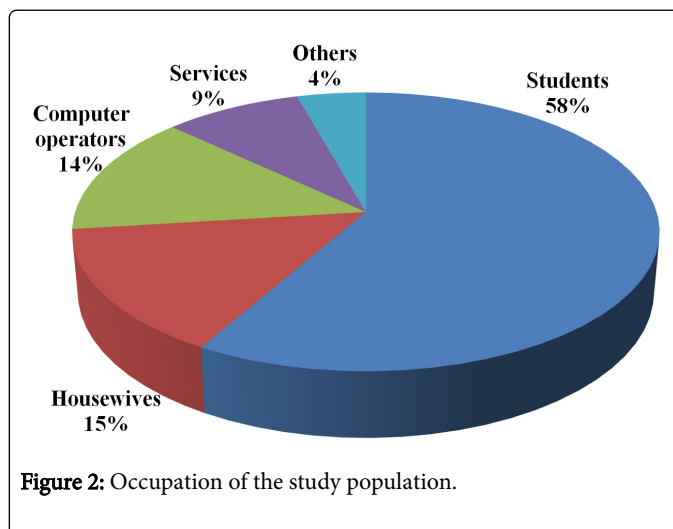


**Figure 2:** Occupation of the study population.

As shown in Figure 3, two thirds of the patients were found to have medium magnitude (10-25 PD) of IXT at near while it was found in 41% of patients at distance. Small amount (<10 PD) of IXT was found to be present in 15% of patients at near while 50% of patients at distance.
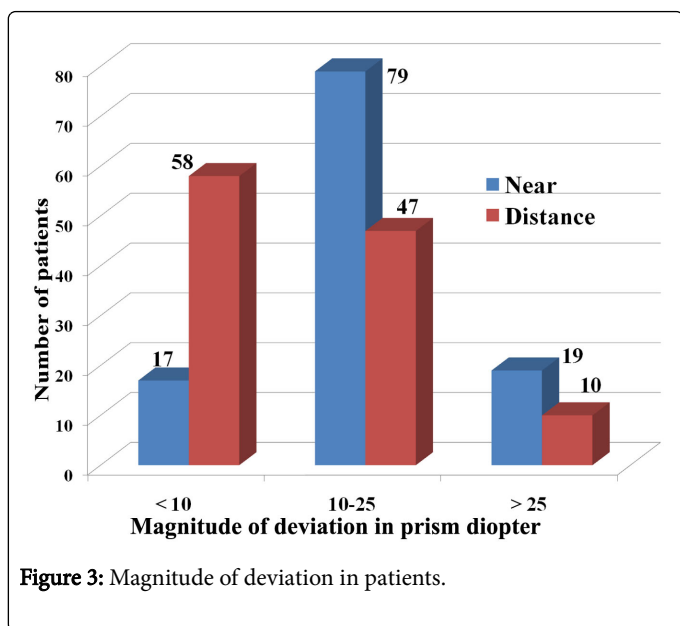
**Figure 3:** Magnitude of deviation in patients.

Table 1 shows NPC of patients. Mean NPC was 13.27 ± 3.46 cm with ranging 6 cm to 28 cm. 63% of patients had NPC of 10 cm or more. In the age group of 26 to 34 years, 44% of patients had NPC of less than 10 PD. NPC was found not to be associated with age and gender of patients (p>0.05).

| Near point of convergence | 07-16 years | 17-25 years | 26-34 years | Total |
|---|---|---|---|---|
| <10 cm | 14 (35%) | 20 (35%) | 8 (44%) | 42 (37%) |
| 10-20 cm | 16 (40%) | 24 (42%) | 5 (28%) | 45 (39%) |
| >20 cm | 10 (25%) | 13 (23%) | 5 (28%) | 28 (24%) |
| Total | 40 (100%) | 57 (100%) | 18 (100%) | 115 (100%) |

**Table 1:** Near point of convergence in different age group patients.

74% of patients had normal near point of accommodation (NPA) according to their age. In age group 7-16 years, 75% of patients had normal NPA, in the age group of 17-25 years, 74% had normal NPA and in the age group of 26-34 years, 72% of patients had normal NPA.

83% of patients had visual acuity of 6/6 in both the eyes and remaining 17% had visual acuity of 6/9 to 6/12 in at least one eye. Overall, 53% of IXT were convergence insufficiency type, 40% of IXT were basic type and 7% of IXT were divergence excess type.

Almost all (98%) of total patients had positive stereopsis at near and 76% (86) of them had normal stereopsis (≤ 60 sec of arc). At distance, 77% (88) had stereopsis present and remaining 13% (27) had negative stereopsis.

## Discussion

Young adult group was approximately two times greater than paediatric age group. Both age groups presented with similar kinds of complains associated with IXT. The involvement of this age group could be explained by the fact that they were more frequently involved at near work, which could have aggravated the deviation and subsequently the need for medical attention. There was no preponderance of either gender in the incidence of IXT in our study like a study by Jae-Wook and Se-Youp [7]. In contrary to our study, Moore et al. and Nusz et al. found that IXT is common in female [8,9].

More than half (58%) of the patients were students either school or college level. It might be due to that students had to do excessive near work during their studies which could precipitate fusional insufficiency problem giving rise to intermittent type of exodeviation. Similarly, students tend to seek early medical service as the problem directly hampers their studies. After students, the incidence was seen more in computer operators followed by housewives. In the same manner individual performing table work services were also the victims of the symptoms created by IXT. Very few numbers were of miscellaneous occupations including businessmen, drivers, tailors and others.

All the subjects in this study came with multiple symptoms based on the history asked. Among the symptomatic problems, headache was the predominant complain accounting for two-thirds of patients. Besides the headache tiered eyes and eye strain were other major ocular complains. Similarly few people had complained of double vision. Our study was consistent with the study by Jung et al. [7]. They had also found the similar symptoms in the patients with IXT. Extra ocular muscles weakness and poor fusional vergence movements might be positive factors for the complaint revealed.

Among total 115 patients, two-thirds were IXT at near only followed by IXT for both near and distance. The number of patients with IXT only at distance was only 9%. Regarding to the magnitude of deviation, half of the total population had deviation of less than 10 PD for distance while only 15% had less than 10 PD at near. 10-25 PD was the most common magnitude of IXT found in both near and distance. IXT of more than 25 PD was found in least number of patients in both near and distance. This indicates that frequency and magnitude of IXT were high for near than for distance. Our finding was confounding with the results of a study by Kushner [10]. Distance deviation was found higher in that study.

Two thirds of patients had poor NPC. This is extremely high in comparison to the NPC of normal population. In a study by Letourneau et al. only 9% of the study population had poor NPC [11]. Similarly another study conducted by Pickwell and Stephens revealed that 12% of the normal population studied had poor NPC [12]. Our findings did not show variability, dependency and preponderance of convergence insufficiency according to age and gender.

In contrary to the high incidence of poor NPC, the near point of accommodation (NPA) was found normal in majority of patients. 80% of the study population showed normal NPA for their age. There was no age and gender variation regarding NPA. Our finding was consistent with the study by Chen et al. [13].

Buck et al. concluded that visual acuity decreased in IXT patients [14]. In contrary to their findings, visual acuity was not found to be much affected by IXT in our study patients. Both eyes showed about equal dominancy for vision. More than 80% patients had normal visual acuity of 6/6. Among the types of IXT, the case with basic and divergence excess type IXT showed slightly more subnormal visual acuity in comparison to convergence insufficiency type. Our finding was consistent with the study by Walsh et al. [15]. They also found that visual acuity decreases in some cases of IXT.

Our finding was consistant with a study by Stathacopoulos et al. [16]. They concluded that patients with IXT had better near

stereoacuity but had significantly worse distance stereoacuity. In our study, almost all the patients had positive stereopsis, nonetheless most had low degree. Three fourths had good stereopsis finer than 60 secs of arc at near. Only about 1% had negative stereopsis at near. Comparison to near, less number (77%) had positive stereopsis ranging from finer to crude, where as one fourth did not have any degree of stereopsis. These findings resembled with a study done by Stathoseopoulos et al. in California who found that patients with IXT had good near stereoacuity but diminution of stereo acuity for distance compared to normal subjects [16]. The decrease in stereoacuity in IXT can be explained by increased accommodation and decreased distance BVA [15].

## Conclusion

IXT was found to be common in adult working age group patients. Students and other professionals who frequently do near tasks like reading or computer uses are the risk factors of IXT. Headache was found to be the most common symptom of IXT patients. Both frequency and magnitude of IXT were found to be higher at near than for distance. Two thirds of the IXT patients had poor NPC and there was no significant association between NPC and age or gender. Most of the cases had normal visual acuity and normal NPA. Almost all of IXT patients had some stereopsis at near.

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