Effectiveness of pencil push up therapy in patients with convergence insufficiency: a pilot study

K Sapkota[1], D K Sah[2], S Bhattarai[3], A K Sharma[3],
J K Shrestha[3], D N Shah[3]

[1]Nepal Eye Hospital, Tripureshwor, [2]Chhetrapati Nishulka Chikiksalaya, [3]B.P. Koirala Lions Centre of Ophthalmic Studies

Abstract

Background: Convergence insufficiency (CI) is a common ocular morbidity encountered in clinical optometry practice. It decreases the efficacy for near work. Pencil push up therapy (PPT) is frequently used for the treatment of CI. **Aim:** The aim of the study was to determine the effectiveness of pencil push up exercise in convergence insufficiency patients. **Methods:** A hospital based interventional longitudinal prospective study was designed. All patients attending BP Koirala Lions Centre of Ophthalmic Studies (BPKLCOS), Nepal from March 1st 2008 to February 28, 2009 with symptomatic convergence insufficiency were included in this study. Near point of convergence (NPC), prism fusion vergence (PFV) and symptom score were measured with RAF ruler, prism bar and symptom questionnaire respectively before and after PPT. **Results:** Out of 84 patients included in the study, only 23 completed follow up check up. Among them 73% were female and 23% were male. The mean age of patients was 19.93±6.0 years and 73% of the total were students. The improvement in NPC was statistically significant after PPT (p =0.008). The average NPC at first visit was 18.58±7.46 cm while at follow up visit, it was 11±4.6 cm. The PFV and average symptom score were also improved significantly. **Conclusion:** PPT is beneficial for CI patients. It improves the NPC, PFV and reduces the symptom of the patients. However, the compliance of Nepalese CI patients with PPT is poor.

Keywords: NPC, PFV, convergence insufficiency, pencil push up therapy.

Introduction

Convergence insufficiency (CI) is an ocular abnormality in which a person cannot converge eyes up to an extent considered as normal limit. It is one of the most frequently found causes of ocular discomfort and asthenopia.[1] There are several causes due to which CI is supposed to occur. Headaches, eyeache, burning eyes, blurry letters, doubling of images, floating of words on page and watering are some common symptoms seen in the CI persons.

_____
Address for correspondence
Mr Kishor Sapkota
Senior Optometrist
Nepal Eye Hospital, Tripureshwor
E mail: kishorsapkota@gmail.com, kishorsapkota@hotmail.com,

The prevalence of convergence insufficiency is found 7.7% to 51% of the total patients attending optometry practice or orthoptics department.[2,3,4] In an unpublished data, 15.89% of total patients visiting orthoptics department of BPKLCOS in the year 2008 were with convergence insufficiency.

CI is diagnosed by measuring the nearest point of convergence with the help of RAF ruler. Near point of convergence of 6 cm to 10 cm is considered as normal.[5] CI is managed by glasses, pencil push up exercise, prism, physiological diplopia training.[6,7] Pencil push up exercise is a physiological diplopia training in which patient tries to keep the target single as far as possible. It is one of the most common

Sapkota K et al
September-December 2011; Vol 9 (No.3);157-161
Pancil push up therapy in convergence insufficiency

treatment options of ophthalmologist and optometrist for the treatment of CI patients.[8,9]

Since convergence insufficiency is a frequently found condition that has caused decreased visual functioning efficiency at near, it is worthwhile to know the mainstay of therapy and effectiveness of that therapy. Knowing the effectiveness of pencil push up exercise in convergence insufficiency makes eye care practitioners aware about its use and benefits. This can lead to a good protocol formulation for therapy of convergence insufficiency.

Methods

It was a hospital based interventional longitudinal study undertaken in BPKLCOS, Kathmandu, Nepal. All the patients aged 8 to 35 years referred to the orthoptics department for the treatment of convergence insufficiency from March 1, 2008 to February 28, 2009 were included in this study. Patients having any ocular pathology, binocular single vision problem and having best corrected vision less than 6/6 in both the eyes were excluded.

A consent from having detailed information about the study was signed by each patient before being involved in the study. A standard pro forma was designed to collect the data of the participants.

A complete history was taken about onset, duration and severity of the symptom. Each symptom question was weighted as 0, 1, 2, 3, and 4 as they reported never, infrequently, sometimes, fairly often and always respectively. Symptom score was derived by adding the total symptom weight. Visual acuity was taken with Snellen's chart with maximum contrast both uncorrected and the best most recently prescribed glasses. Near point of convergence was measured with RAF ruler, positive fusional vergence and deviation of the eyes if any were measured with prism bar. Near point of convergence value more than 8 cm, PFV of less than 25 PD, and symptom score of more than 21 were considered to have convergence insufficiency and only these patients were continued for the study. After the initial measurement of mentioned parameters, all the participants were trained for pencil push up exercise. They were advised to do this exercise ten minutes a day daily in the morning and asked for follow up visit on sixth week. Again near point of convergence, positive fusional vergence and symptom score were recorded at the sixth week.

The data were analysed by using SPSS 13 software. The convergence insufficiency was considered as cured if near point of convergence, positive fusional vergence and symptom score were found in normal limit which were considered as less than or equal to 8 cm, more than 25 PD and symptom score of less than 21 respectively. Similarly, it was considered as improved if one or two parameters were found in normal limits. But it was considered as failure if all were found beyond the normal limits.

Results

Out of 84 convergence insufficiency patients involved in this study, only 23 (27%) came for follow up after a complete PPT. The mean age of female patients was 19.31 years and that of male was 21.56 years.

Table1: Age and Gender distribution

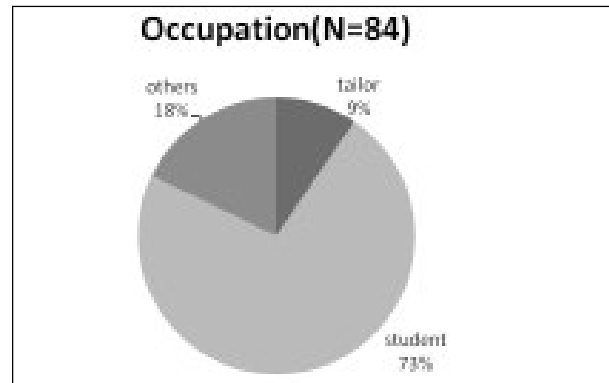| Sex	Mean age (years)	n
Male	21.56	23
Female	19.31	61
Total	20.43	84

Figure 1: Distribution of Occupation in CI patients

Majority of patients with convergence insufficiency were students (73%) followed by tailors (9%).
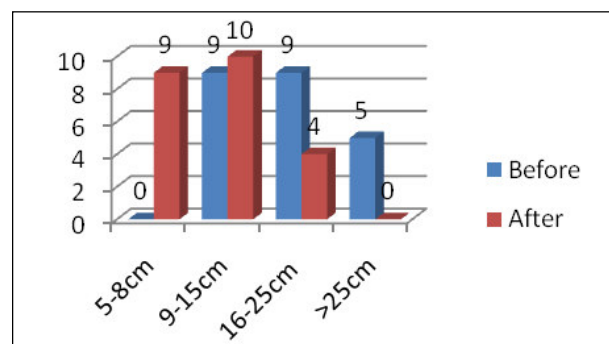

Figure 2. NPC before and after pencil push up therapy

158

Sapkota K et al
September-December 2011; Vol 9 (No.3);157-161
Pancil push up therapy in convergence insufficiency

The mean NPC at first visit was 18.58±7.46 cm (range: 9-40 cm) while it was 11±4.61 cm (5-22 cm) after PPT on follow up visit of 6 weeks. All patients had a poor convergence before the PPT, but 39.13% of the total patients had a normal convergence after PPT. Some amount of convergence was improved in all of the patients, however, convergence was improved by 6-10 cm in about half of the patients. Only 18% got the convergence improvement by more than 15 cm. the mean improvement in convergence was 8.58±7.46cm (range: 2-40 cm)
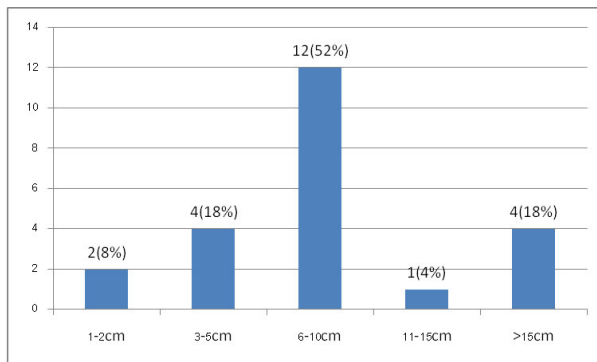

Fig 3: NPC improvement range after ppt.

Thirty nine percent patients had positive fusional vergence in between 15-25pd.The mean of presenting positive fusional vergence was 19.62±9.93 (range: 4-40 PD). Sixty one percent of patients had got PFV in normal limit after exercise. The mean PFV on follow up was 24.35±9.3 pd (range: 4-45). Maximum patients (53%) had got change in PFV after exercise by 2-5 pd. In some patients (17%), PFV improved by more than 15pd.
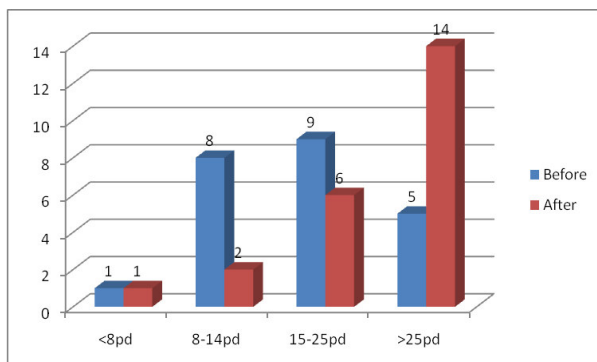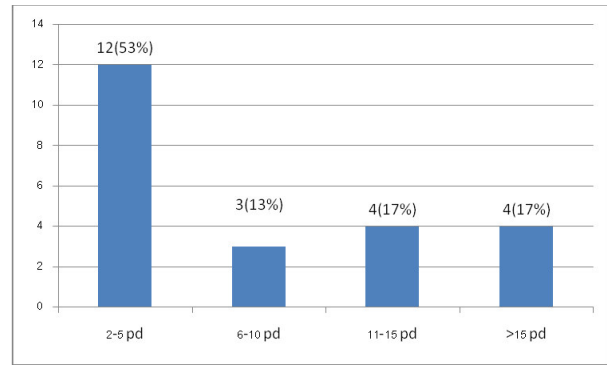

Figure 4. PFR improvement after PPT.

Fig 5: PFV Improvement after PPT.

The most complained (weighted) symptom was headache with total symptom score of 46 followed by "eyes hurt" with symptom score of 194 as shown in figure 6.
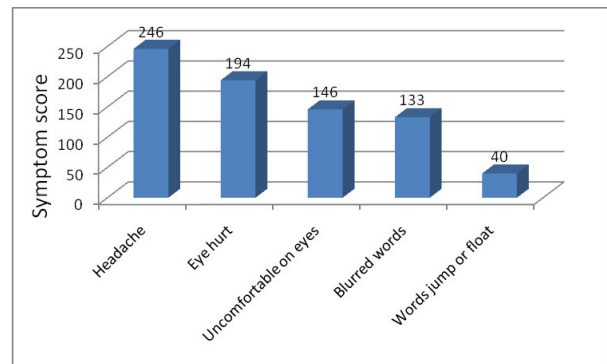

Figure 6: Each symptom's weightage of the participants.

Table 2: Symptom score of the participants before and after study

Symptom score	Before PPT (N = 84)	After PPT (N = 23)
< 21	37 (44%)	22 (95%)
e" 21	47 (56%)	1 (5%)

As shown in the table 2, almost half of the CI patients had symptom score more than 21. But after the 6 week PPT, symptom score was found less than 21 for almost all patients. The mean symptom score at first visit was 20.57±7.41 while it was 7.52±7.5 at follow up visit (p<0.004).

159

Sapkota K et al
September-December 2011; Vol 9 (No.3);157-161
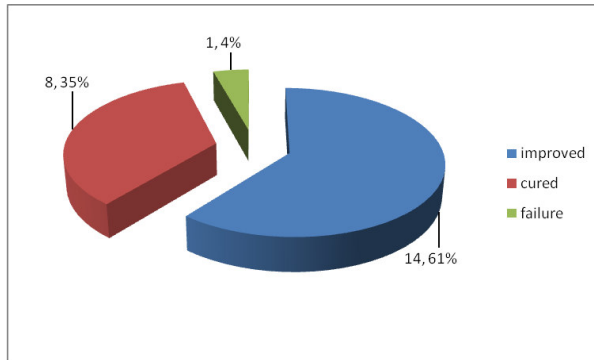*Pancil push up therapy in convergence insufficiency*

Figure 7. Effectiveness of pencil push up therapy (N=23).

As shown in figure 5, out of 23, 8 (35%) of the patients got complete cure of CI with PPT while 61% got improvement and 4% got no improvement at all.

Discussion

Out of 84, only 23 (27%) came for follow up after complete exercise of pencil push up for 6 weeks 10 minutes per day. This is the very low compliance rate in Nepalese population of CI. In a similar pilot study done in USA by Gallaway and Co-workers,[10] the compliance rate was found 48%. This shows that the Nepalese youngsters are less attentive to the ocular health. It may be due to misunderstanding or low confidence level on such therapy in patients. Moreover, CI alone does not cause very severe symptoms if they don't do near work for a long time though they have CI theoretically.

This study shows that about three fourths of the patients were female which indicates more prevalence of female for CI. Similar results were found in other studies[11,12] of CI where the number of females was more than that of males. However, in a study done in Korea by Kim et al,[13] this was just opposite.

Out of total, 73% were students and 9 % were tailors which indicates that convergence insufficiency is seen more in people involved in near work and fine work.

The mean NPC at first visit was 18.58 ± 7.46 cm while that was 11 ± 4.61 cm at follow up with statistically significant difference (p<0.008). It shows improvement in NPC by mean value of 7.58 cm. It has also shown that 39.13 % had got NPC of normal value after exercise in 6 weeks. So it shows that

the pencil push up exercise is beneficial with convergence insufficiency. Although, all showed some improvement in convergence, fifty two percent showed improvement by 6-10 cm with a mean value of 8.5 cm which is clinically significant. Similar results were found in a study done by Kim KM and coworkers[13] in Korean population. The initial mean NPC of 36.3cm was improved to mean NPC of 14.4cm after PPT of 12 weeks. Gallaway and coworkers,[10] in a pilot study, also found that NPC improved in almost all patients with PPT. But a recent multicentre, placebo-controlled, randomized CITT Study Group[14] found that NPC can be improved only by vision therapy / orthoptics. This study revealed that NPC does not improve significantly with PPT and placebo method in CI patients.

The mean PFV at first visit was 19.62±9.93. After pencil push up exercise 61% had got normal PFV (>25PD being Normal) with mean value of 24.35 PD±9.3 (p<0.017). The improvement by 2-10 PD was found in most of the cases. It clearly shows that pencil push up exercise is efficacious in improveming fissional vergence. These findings are similar to the findings of other studies done in USA and Korea by Gallaway et al[10] and Kim et al[13] respectively. However the findings of Scheiman et al[14,15] were totally different from this study. They found that PPT cannot improve the PVR significantly.

The mean symptom score was 20.57 on first visit while at follow up it was 7.52 with p<0.004. It was found that 95% patients brought it within normal limit (< 21) after pencil push up exercise. At first visit, only 44 % had symptom score of <21. The contradictory results were found in other studies[14,15] done by Scheiman and co-workers in USA. They found that symptom score can be improved by vision therapy / orthoptics but not by home based PPT. In our study, most weighted symptom was headache, followed by "eyes hurting" and blurring of letters which tells that a patient with headache on doing near work should arouse suspicion to be analyzed for convergence insufficiency. Doubling of letters has been weighted as very less in comparison to others though it was present in very severe cases of convergence insufficiency. Almost all patients showed improvement or cure of symptomatic CI after six weeks of PPT.

The most important limitation of this study was the small size of the participants and was without any

control group. Moreover, we did not use masked observer and there was potential bias in having NPC measured repeatedly by the same examiners.

Conclusion

CI is common in young age girls, mostly students with headache as a major complaint. PPT is easier and low cost therapy efficacious for symptomatic CI patients. It improves the NPC, PFV and reduces the symptoms of the patients. However, the compliance of Nepalese CI patients is poor.

Acknowledgement

References

1. von Noorden GK, Campos EC. Binocular vision and ocular motility: theory and management of strabismus. 6th ed. St Louis: Mosby; 2002. pp. 502–503.
2. Deshpande SB, Ghosh RK. Study of primary convergence insufficiency. Indian J Ophthalmol. 1991;39(3):112-4.
3. Rouse MW, Borsting E, Hyman L, Hussein M, Cotter SA, Flynn M, Scheiman M, Gallaway M, De Land PN. Frequency of convergence insufficiency among fifth and sixth graders. The Convergence Insufficiency and Reading Study (CIRS) group. Optom Vis Sci. 1999;76(9):643-9.
4. Rouse MW, Hyman L, Hussein M, Solan H. Frequency of convergence insufficiency in optometry clinic settings. Convergence Insufficiency and Reading Study (CIRS) Group. Optom Vis Sci. 1998;75(2):88-96.
5. Hayes GJ, Cohen BE, Rouse MW, De Land PN. Normative values for the nearpoint of convergence of elementary schoolchildren. Optom Vis Sci. 1998;75(7):506-12.
6. Lavrich JB. Convergence insufficiency and its current treatment. Curr Opin Ophthalmol. 2010;21(5):356-60.
7. Scheiman M, Convergence Insufficiency Treatment Trial (CITT) Study Group. The convergence insufficiency treatment trial: design, methods, and baseline data. Ophthalmic Epidemiol. 2008;15(1):24-36.
8. Scheiman M, Cooper J, Mitchell GL, de LP, Cotter S, Borsting E, London R, Rouse M. A survey of treatment modalities for convergence insufficiency. Optom Vis Sci. 2002;79(3):151-7.
9. Patwardhan SD, Sharma P, Saxena R, Khanduja SK. Preferred clinical practice in convergence insufficiency in India: a survey. Indian J Ophthalmol. 2008;56(4):303-6.
10. Gallaway M, Scheiman M, Malhotra K. The effectiveness of pencil pushups treatment for convergence insufficiency: a pilot study. Optom Vis Sci. 2002;79(4):265-7.
11. Aziz S, Cleary M, Stewart HK, Weir CR. Are orthoptic exercises an effective treatment for convergence and fusion deficiencies? Strabismus. 2006;14(4):183-9.
12. Dragomir M, Truº L, Chirilã D, Stîngu C. [Orthoptic treatment efficiency in convergence insufficiency treatment]. Oftalmologia. 2001;53(3):66-9.
13. Kim KM, Chun BY. Effectiveness of Home-Based Pencil Push-ups (HBPP) for Patients with Symptomatic Convergence Insufficiency. Korean J Ophthalmol. 2011;25(3):185-8.
14. Scheiman M, Mitchell GL, Cotter S, Cooper J, Kulp M, Rouse M, et al. A randomized clinical trial of treatments for convergence insufficiency in children. Arch Ophthalmol. 2005a;123(1):14-24.
15. Scheiman M, Mitchell GL, Cotter S, Kulp MT, Cooper J, Rouse M, Borsting E, London R, Wensveen J. A randomized clinical trial of vision therapy/orthoptics versus pencil pushups for the treatment of convergence insufficiency in young adults. Optom Vis Sci. 2005b;82(7):583-95.