Effectiveness of Eight Weeks Pencil Push Up Therapy for Patients with Convergence Insufficieny in RSMH Ophthalmology Clinic Palembang

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Abstract

Background: Convergence Insufficiency (CI) is an inability to perform convergence movements when doing near activity. The prevalence of CI was estimated varying between 0.1%-8%. One of the easiest therapeutic attempts from some research have showed the effectiveness to overcome CI is by pencil push up therapy. This study is to determine the improvement of CI symptoms and signs in patients after performing the pencil push up exercise for 8 weeks.

Methods: This clinical trial was conducted on October 2016-March 2017. Nineteen patients who met the inclusion criteria was obtained. The frequency and distribution of data is described in tabular form and the effectiveness of pencil push up therapy is analyzed with Paired T Test and Wilcoxon test.

Result: Patients with CI had an average age of approximately 22 years, with the sex ratio of females and males being 3:2. After 8 weeks of pencil push up therapy, there was a significant decrease of Convergence Insufficiency Symptom Survey (CISS) value from 25.2 ± 3.72 to 15.7 ± 5.64 (p=0.000), significantly decreased Near Point Convergence (NPC) value from 13.7 ± 1.88 cm to 9.05 ± 2.99 cm (p=0.000), significantly decreased Red Blue Test (RBT) value from 14.2 ± 1.84 to $9,36\pm3.22$ cm (p=0.000), and significantly decreased Penlight Red/Green Test (PLT) from 16.7 ± 2.69 to 10.7 ± 4.13 cm (p=0.000). A number of Alternate Cover Test (ACT) positives also decreased from 4 to 2 samples but not significant (p=0,500). Symptoms and signs of CI were improved in 14 samples (73.7%).

Conclusion: Pencil push up therapy for 8 weeks is effective to improve symptoms and signs of convergence insufficiency.

Keywords: *CI, CISS, ACT, NPC, RBT, PLT, pencil push up.*

Introduction

Convergence Insufficiency (CI) is the inability of a person to make eye convergence movements while doing work activities from a short distance such as reading, writing, operating a computer and others. The prevalence of convergent insufficiency has been reported to vary around 0.1-8% depending on the population.[1] Cohen reported that asthenopia was the main symptom of CI. [2] The characteristics of asthenopia in CI were found, including difficulty reading in the same line, headache, double vision, and letters appearing blurred. Kratka reported that 75% of CI patients were symptomatic and the rest were asymptomatic, aged 20-40 years. Meanwhile, Burian reported that 18% of CI patients were asymptomatic.[3] Gupta reported as many as 2130 children up to the age of 16 years, had a characteristic asthenopia symptom of 82.19%. The characteristics of asthenopia in CI found include headaches, difficulty reading, and pain around the eyeball.[4]

One effort that is easy and from some effective research to overcome CI is with Pencil Push Up therapy. Sapkota conducted a study of 23 patients who underwent pencil therapy for 10 minutes per day for 6 weeks. The results showed a significant improvement in the Near Point of Convergence (NPC) after therapy, Prism Fusion Vergence (PFV) and mean CI symptom scores were also significantly reduced.[5] This finding is in line with the results of Kim and Gallaway's research.[6,7] Meanwhile different results were obtained in the Scheiman study where pencil push up therapy did not show significant improvement results.[8]

Methods

This study is a clinical trial conducted at the Palembang Polyclinic eye clinic from October 2016 to March 2017. The study sample was all patients diagnosed with CI and met the inclusion criteria. The inclusion criteria in this study were all patients diagnosed with CI and willing to participate in the study. Exclusion criteria in this study were patients with color blindness,

amblyopia, there are organic abnormalities in the anterior and posterior segments, and patients with sharp distant and near vision less than 20/20 after the best sharp vision correction.

Visual examination was performed, the best visual correction, color blind examination, examination of eye pressure, examination of the anterior and posterior segments of the eyeball, and examination of color blindness in all subjects who were willing to participate in the study. The Convergence Insufficiency Symptomps Survey (CISS) questionnaire and the special CI examination were carried out, namely the Alternate Cover Test (ACT), NPC, Penlight Red/Green Test (PLT), and Red Blue Test (RBT) for diagnosis CI. ACT values are said to be normal if no shifting is obtained during the examination. Normal NPC, PLT, and RBT values are less than or equal to 10 cm.

Patients who are diagnosed with CI will undergo Pencil Push Up therapy for 8 weeks with a frequency of exercise once a day. Exercises performed by the patient holding a pencil with the tip pointing toward the ceiling along the arm in front of the nose. The patient then focuses his eyes on the tip of the pencil and slowly brings the pencil closer to the nose. Stop when the pencil appears double. While still maintaining focus to the tip of the pencil, the patient's eyes return to the pencil movements brought back to the starting position. This movement is repeated for 10 minutes.

Follow up at the fourth and eighth week after therapy. The effectiveness of Pencil Push Up therapy is the percentage of the number of CI patients who reach the normal value of two of the four special CI examinations (ACT, NPC, RBT, PLT) after therapy. The frequency and distribution of data are explained in tabular form and the effectiveness of the Pencil Push Up therapy is analyzed by the Paired T Test and Wilcoxon. Data analysis uses SPSS version 18.0.

Results

There were 19 samples that met the inclusion criteria. Based on age, the average age of CI patients was 22.79 ± 1.134 years with an age range of 21 to 25 years. CI patients with male sex are 8 people (42.1%) less than patients with female sex are 11 people (57.9%).

After 4 weeks of Push Push Pencil therapy, the mean CISS decreased from 25.2 ± 3.72 to 21.6 ± 3.79. There was a significant decrease in CISS value (p = 0,000) after 4 weeks of Push Up Pencil therapy. After 8 weeks of Push Push Pencil therapy, there was a decrease in the mean CISS

from 21,6±3,79 to 15,7±5,64. There was a more significant decrease in CISS value (p = 0,000) after 8 weeks of Push Up Pencil therapy compared to 4 weeks of therapy.

A significant decrease in mean NPC values from 13.7 ± 1.88 cm before therapy became 12.1 ± 2.79 cm after 4 weeks of therapy (p = 0.001) and became 9.05 ± 2.99 cm after 8 week of therapy (p = 0,000). Significantly decreased the average RBT value from 14.2 ± 1.84 cm before therapy to 12.4 ± 2.87 cm after 4 weeks of therapy (p = 0.001) and to 9.36 ± 3.22 cm after 8 week of therapy (p = 0,000).

After 4 weeks of Push Up Pencil therapy, there was a significant decrease in the mean PLT value of 16.7 ± 2.69 cm before the therapy became 14,2±3,86 cm after 4 therapy (p=0,003) and became 10,7±4,13 cm after 8 weeks therapy (p = 0,000). Before therapy there were 4 people (21.1%) with ACT examination results showing positive shifting (exophoria) and 15 negative people (78.9%). After 4 weeks of therapy there was no change in the number of samples with positive or negative ACT values. In this study there was no change in ACT values before and 4 weeks after therapy (p = 1,000). After 8 weeks of therapy obtained samples with positive ACT values of 2 people (10.5%) and who had a negative ACT value of 17 people (89.5%). A change in ACT distribution after 8 weeks of Push Push Up therapy was found but was not significant (p = 0.500).

Table 1. CISS, NPC, RBT, PLT, dan ACT Assessment Result from Research Subject Before and After Pencil Push Up Therapy

Type Research	Berfore Therapy	4 weeks after therapy	8 weeks after therapy
	x±SD	x±SD	x±SD
Convergence Insufficiency Symptomps Survey (CISS)	25,21±3,720	21,6±3,79	15,7±5,64
Near Point of Convergence Test (NPC)	13,67 ± 1,868	12,1±2,79	9,05±2,99
Red Blue Test(RBT)	14,18 ± 1,840	12,4±2,87	9,36±3,22
Penlight Red/Green Test(PLT)	16,65 ± 2,699	14,2±3,86	10,7±4,13
Alternate Cover Test (ACT), n(%)			

• Positive	4 (21,1)	4 (21,1)	2(10,5)
• Negative	15 (78,9)	15 (78,9)	17(89,5)

Prior to therapy 19 samples suffering from CI was obtained and there were improvement in 6 samples (31.6%) after 4 weeks of therapy. After 8 weeks of therapy sample of 5 patients with CI obtained and 14 (77.7%) has improved.

Table 2. Distribution of Patients with CI before and after Pencil Push Up Therapy

	Before Therapy	4 weeks after Therapy	8 weeks after Therapy
CI	19(100%)	13(68,4 %)	5 (26,3%)
Non-CI	0(0%)	6(31,6 %)	14 (73,7 %)

Discussion

Convergence Insufficiency is a binocular vision disorder with the most common causes of eye discomfort or muscular astenophia. The study found that the mean age of CI patients was $22.79 \pm 1,134$ years. The results of this study are not significantly different from data from Rafrina's 2016 study which found that the average age of CI patients was 23.82 ± 3.89 years.[9] Kyung Min Kim's research in Korea found that the average age of CI patients was younger than this study. which is 19.3 ± 9.99 years.[6] In a 2011 Nepalese Census survey found that the average age of CI patients with male gender was 19.31 years while female gender was 21.56 years.[5] Kratka and Kratka, CI patients range in age from 20-40 years.[3] This may be because young adult patients typically work more closely with small and long-term vision tools such as computers and gadgets.[10]

In this study, the proportion of CI patients with female sex was higher than that of men (3: 2). Other studies conducted in different countries have found different results on gender predilection in CI patients. Research in Korea Kyung Min Kim found that men suffer more than women.[6] Studies in Nepal conducted by Sapkota found female ratio and men with CI were 2.7: 1.5 While research done by Rafrina (2016) found female ratio and men with CI are 3.4: 1.9

Convergence Insufficiency Symptoms Survey is a valid instrument that can be used clinically to detect CI symptoms.3,10 In this study a significant decrease in the value of the Convergence Insufficiency Symptomps Survey was obtained after 8 weeks of Push Up Pencil therapy (p = 0.000). The results of this study were supported by the Sapkota study which found that the CISS mean decreased significantly from 20.57 ± 7.41 to 7.52 ± 7.5 after 6 weeks of Push Up Pencil therapy (p <0.004) .[5]

Near point of convergence is an examination to measure the closest point that can still be maintained by convergence of both eyes.11,12 In this study a significant decrease in NPC value was obtained after 8 weeks of Push Up Pencil therapy (p = 0.000). The results of this study were supported by Kim's study which found that NPC results decreased from 36.6 cm to 14.4 cm after 12 weeks of Push Up pencil therapy.6 In addition, the study found Sapkota found that NPC mean decreased significantly from 18.58 ± 7.46 cm to 11 ± 4.61 cm after 6 weeks of Push Up Pencil therapy (p <0.008).[5]

The study also found a significant decrease in RBT values after 8 weeks of Push Up Pencil therapy (p = 0.000). Similarly, PLT values were significantly decreased after 8 weeks of Push Up Pencil therapy (p = 0.000). Meanwhile, positive ACT scores also decreased from 4 to 2 but not significant (p = 0,500). The study obtained a total number of positive CI samples before therapy of 19 samples and improved on 6 samples (31.6%) after 4 weeks of CI therapy. Meanwhile, at 8 weeks after therapy, a total of 14 samples were recovered (73.7%). The findings of this study are in line with Kim's results of 65.2% of Push Up Pencil therapy effectiveness obtained from 16 CI patients who underwent 12 weeks Push Up Pencil therapy with 20 push ups that 10 patients had improvements of symptoms.6 This finding is in line with the results of the Sapkopta study which was obtained from 23 CI patients who underwent 6- week Push Up practice with a 10-minute exercise duration of 8 consecutive CI patients (35%), experiencing symptom improvement and CI symptoms of 14 people (61%) and 1 person (4%) had no symptoms improvement and symptoms of CI.[5]

The Gallaway Study was obtained from 12 CI patients who underwent 6 weeks Push Up training with a 15-minute training daily for 5 days a week found that 7 people (58%) had improved CI symptoms and 11 (91.7%) experienced symptomatic improvement CI.7 Different results obtained from studies conducted Scheiman on 11 children aged 9-18 years who suffer from CI

and undergo Pencil push therapy up to 12 weeks of training with weights 20 push-ups all the training. Exercises are performed three times daily for 5 days each week. In this study, the improvement of signs and symptoms of CI only 3 children (27.3%). [8]

The aims of Pencil Push up Therapy are to train extra-muscular muscles. Improvement in muscle function due to training of eye muscle movement due to physiological changes occurring in the neuromuscular system. These changes include muscle hypertrophy, increased muscle size, increased muscle contraction strength, increased muscle contraction speed, and increased muscle endurance. According to Baechle & Groves the increase in muscle size is due to the increase in actin and myosin proteins and thus increases the muscle fibers available.[13-15]

According to Dreger, exercises 3 times a week would appear to be effective after 8 weeks of training. Dreger further states that with weight training can increase muscle strength by 50% .[14] Whereas Fehlandt says 8 weeks of exercise with 3 times a week can increase muscle strength by 74% .[13] Sharkey says that strength improvement is not drastic, ranges from 1-5% per week, and the rate of improvement achieved is stable if it reaches its maximum potential. Therefore, it is advisable to upgrade or modify the program which can be done after 4 weeks or 8 weeks of training.[15] Push Up Pencil Therapy can also cause the nervous system to improve as the motor movements of the unit increase. This is due to the process of learning is in the motor cortex of the brain by stimulating the movement is repeated by a number of repetitions of training, carry out a variety of loads, as well as patterns gerak.[13-15]

The weakness of this study is that there are limitations to surveillance when patients are doing Push Up Pencil exercises at home.

Conclusion

This study found 19 CI patients who went undergoing Push Up Pencil therapy. Acquired improvement of symptoms and CI markers in 14 patients. It can be concluded that Push Up Pencil exercises are effective in improving symptoms and signs of convergence insufficiency. Further research is needed to compare the effectiveness of the Push Up Pencil therapy with other therapies or to compare the effectiveness of different therapeutic intensities as well as the burden on exercise and the need for special supervisors to ensure that patients are fully engaged in the Push Up Pencil therapy according to the training procedure. Push Up Pencil Exercises can be recommended for

the implementation of Convergence Insufficiency Disorders due to their high effectiveness, inexpensive, and easy to do.

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