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# Evaluation of Physical Exercises as a Non-Surgical Treatment Modality for Patients with Diplopia

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**Abstract :**

**Background:** Diplopia, commonly known as double vision, is the perception of two images of a single object. It may occur due to ocular misalignment, extraocular muscle weakness, trauma, refractive errors, or systemic conditions affecting ocular motility. Binocular diplopia is usually related to misalignment of the visual axes and often improves when one eye is covered. Non-surgical management, including orthoptic and physical eye exercises, may be useful in selected patients, particularly those with mild ocular motility disorders or convergence-related problems. **Objective:** This study aimed to evaluate the role of physical eye exercises as a non-surgical treatment modality in selected patients with diplopia. **Methods:** A Prospective interventional clinical study was conducted on 20 patients diagnosed with diplopia at the Consulting Clinic for Health and Medical Technologies, Baghdad, during the period from October 1, 2024, to April 1, 2025. All patients underwent a complete ophthalmic and optometric examination, including visual acuity assessment, refractive error evaluation, cover test, ocular motility test, Worth four-dot test, prism bar measurement, and fundus examination when required. Patients with diplopia due to causes requiring medical or surgical intervention, such as cataract, severe neurological disease, or uncontrolled systemic disease, were excluded from the physical exercise treatment group. Selected patients received a structured program of eye exercises and were followed to assess improvement. **Results:** Among the 20 patients, 13 patients were males (65%) and 7 were females (35%). The highest percentage of patients was found in the age group of 20–25 years, representing 45% of the sample. The most common associated causes of diplopia were squint and extraocular muscle weakness. After treatment, 12 patients




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(60%) showed improvement with physical eye exercises, 4 patients (20%) required other treatment methods such as prism correction, and 4 patients (20%) showed limited or no improvement mainly due to poor compliance or the need for further management.

**Conclusions:** Physical eye exercises may be beneficial as a non-surgical treatment option in selected patients with binocular diplopia related to mild ocular misalignment or extraocular muscle weakness. However, accurate diagnosis, proper patient selection, and regular follow-up are essential. Physical exercises should not replace medical, optical, or surgical treatment when these are clinically indicated.

**Keywords:** Diplopia, Binocular Vision, Physical exercises, Orthoptic exercises, Prism bar, Strabismus, Ocular motility.

**Introduction:**

Diplopia, or double vision, is a visual symptom in which a person perceives two images of a single object [1]. It may be classified into monocular or binocular diplopia. Monocular diplopia persists when one eye is covered and is usually related to optical problems within one eye, such as refractive error, dry eye, corneal irregularity, cataract, or lens abnormalities [2]. Binocular diplopia, on the other hand, occurs when both eyes are open and usually disappears when either eye is covered [1]. This type is commonly caused by ocular misalignment or disturbances in the coordination of the extraocular muscles [3]. Binocular single vision depends on accurate alignment of both eyes, normal function of the extraocular muscles, and proper neurological control [2]. Any disturbance in these mechanisms may lead to diplopia. Common causes include strabismus, trauma, cranial nerve palsy, muscle weakness, decompensated phoria, thyroid eye disease, diabetes mellitus, and other neurological or systemic conditions [3]. Therefore, diplopia should always be evaluated carefully because it may sometimes indicate a serious underlying condition [1].

The management of diplopia depends on its cause, duration, severity, and the patient's general condition [4]. Treatment options include correction of refractive errors, prism lenses, occlusion therapy, medical treatment of systemic causes, botulinum toxin injection, orthoptic exercises, and surgical correction in selected cases [5]. Physical or orthoptic eye exercises are commonly used in some binocular vision disorders, especially convergence insufficiency, mild ocular motility imbalance, and selected cases of decompensated phoria [6]. These exercises aim to improve fusional ability, strengthen binocular coordination, and

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reduce symptoms of eye strain and double vision [6]. However, physical exercises are not suitable for all types of diplopia. For example, diplopia caused by cataract, corneal opacity, severe neurological palsy, or uncontrolled systemic disease requires treatment of the underlying cause rather than exercises alone [3]. Therefore, careful diagnosis and proper patient selection are essential before recommending eye exercises as a treatment method.

This study was conducted to evaluate the possible benefit of physical eye exercises as a non-surgical treatment modality in selected patients with diplopia. The aim of this study was to evaluate the effectiveness of physical eye exercises in improving symptoms of diplopia among selected patients with binocular diplopia related to mild ocular misalignment or extraocular muscle weakness.

## Materials and methods:

### Study Design

This was a Prospective interventional clinical study conducted at the Consulting Clinic for Health and Medical Technologies, Baghdad, from October 1, 2024, to April 1, 2025.

### Study Sample

The study included 20 patients diagnosed with diplopia. The patients were selected according to clinical examination and suitability for non-surgical treatment using physical eye exercises.

**Inclusion Criteria:** Patients were included in the study if they met the following criteria:

1. Patients aged between 20 and 35 years.
2. Patients diagnosed with binocular diplopia.
3. Patients with mild ocular misalignment, convergence weakness, or extraocular muscle weakness.
4. Patients able to understand and perform the required physical eye exercises.
5. Patients who agreed to attend follow-up visits.

**Exclusion Criteria:** Patients were excluded from the physical exercise treatment group if they had:




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1. Monocular diplopia caused by cataract, corneal disease, dry eye, or irregular astigmatism.
2. Severe neurological causes of diplopia requiring urgent medical intervention.
3. Severe strabismus requiring surgical treatment.
4. Uncontrolled systemic diseases such as uncontrolled diabetes mellitus or thyroid eye disease.
5. Poor cooperation or inability to perform the exercises regularly.

**Ethical Considerations**

The study received approval from the Institutional Ethics Committee of Al-Mustaqbal University, Iraq (2025). Written informed consent was obtained from all participants. The study's purpose and procedures were explained to all patients prior to participation, and verbal informed consent was obtained from each participant. Patient information was kept strictly confidential and used for scientific purposes only. The study procedures were non-invasive and performed according to routine clinical examination standards.

**Data Collection**

Data were collected using a structured clinical form that included: Age, Sex, Main complaint, Duration of diplopia, Medical and ocular history, Family history, Visual acuity with and without correction, Refractive error, Type of diplopia, Cause or associated clinical finding, Method of treatment, Response to treatment,

**Clinical Examination**

All patients underwent a complete ophthalmic and optometric examination. The examination included:

1. **Visual acuity assessment:** Visual acuity was measured using the Snellen chart with and without optical correction.
2. **Refraction:** Objective and subjective refraction were performed when needed to detect and correct refractive errors.
3. **Cover test:** Cover and uncover tests were used to detect ocular deviation




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and differentiate between tropia and phoria.

4. **Ocular motility test:** Extraocular muscle function was examined by asking the patient to follow a target in the nine diagnostic positions of gaze.
5. **Worth four-dot test:** This test was used to assess suppression, diplopia, and binocular sensory fusion.
6. **Prism bar measurement:** A prism bar was used to measure the amount of ocular deviation in prism diopters when deviation was present.
7. **Fundus examination:** Fundus examination was performed when needed to exclude posterior segment or neurological-related ocular findings.

**Physical Exercise Protocol:** Selected patients were instructed to perform a structured program of physical eye exercises. The program was explained clinically and demonstrated to each patient before starting treatment. Patients were followed up for a period of 8 to 12 weeks after starting the exercise program. The exercise program included the following:

**1. Pencil Push-Up Exercise:** The patient was asked to hold a small target or pencil at arm's length and slowly move it toward the nose while keeping the target single and clear. When the target became double, the patient was instructed to stop, try to regain single vision, and then repeat the exercise.

**Frequency:** 10 repetitions per session, twice daily.

**2. Near-Far Focusing Exercise:** The patient was instructed to look at a near target for a few seconds and then shift focus to a distant target. This exercise was used to improve accommodative and binocular coordination.

**Frequency:** 10 cycles per session, twice daily.

**3. Ocular Motility Exercise:** The patient was asked to follow a small target in different directions of gaze without moving the head. This exercise was used to improve awareness and control of eye movements.

**Frequency:** 5 minutes per session, once or twice daily.




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**4. Fusion Training:** In patients with mild binocular vision disturbance, simple fusion exercises were performed using near targets under clinical guidance. The aim was to improve the patient's ability to maintain single binocular vision.

**The selected exercises:** were based on commonly used orthodontic rehabilitation protocols designed to improve convergence ability, eye movement, and bilateral visual fusion.

**Follow-Up:** Patients were followed clinically to evaluate improvement in symptoms, visual comfort, ocular alignment, and ability to maintain single vision. Compliance with the exercise program was also assessed.

**Improvement:** was defined as a decrease or disappearance of double vision symptoms, as well as an improvement in eye alignment and bilateral visual fusion tests during follow-up.

**Statistical Analysis**

Data analysis: Statistical analysis was performed using SPSS version 25. Data were analyzed using descriptive statistics including frequencies and percentages. Pre- and post-intervention results were compared using paired t-tests or signed Wilcoxon signed-rank tests, with significance defined at $p<0.05$. The collected data were arranged in tables and analyzed using frequencies and percentages. The results were presented according to age group, sex distribution, associated causes of diplopia, and response to treatment. The sample size was standardized as 20 patients throughout the study.

**Results**

Table 1 – Characteristics of study participants. Of the 20 patients participating in the study, 13 (65%) were male and 7 (35%) were female. The majority of participants were in the 20-25 age group (45%), followed by the 26-30 age group (40%), while the 31-35 age group constituted only 15%.




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Table 1. Distribution of Patients According to Age and Sex

| Age group / years | Male | Female | Total | Percentage |
|---|---|---|---|---|
| 20–25 | 6 | 3 | 9 | 45% |
| 26–30 | 5 | 3 | 8 | 40% |
| 31–35 | 2 | 1 | 3 | 15% |
| **Total** | **13** | **7** | **20** | **100%** |

The most common associated findings were squint or ocular misalignment and extraocular muscle weakness, each representing 25% of the sample. Refractive error was found in 15% of patients. Other associated factors included hormonal or systemic-related factors, dry eye symptoms, trauma, diabetes mellitus, and cataract. It is important to note that patients with monocular causes such as cataract or dry eye were not considered suitable for treatment by physical exercises alone and required management of the underlying cause.

Table 2. Associated Clinical Causes of Diplopia

| Cause / Associated finding | Number of patients | Percentage |
|---|---|---|
| Squint / ocular misalignment | 5 | 25% |
| Extraocular muscle weakness | 5 | 25% |
| Refractive error | 3 | 15% |
| Hormonal or systemic-related factor | 2 | 10% |
| Dry eye symptoms | 2 | 10% |
| Trauma | 1 | 5% |
| Diabetes mellitus | 1 | 5% |
| Cataract | 1 | 5% |
| **Total** | **20** | **100%** |

Out of 20 patients, 16 patients showed clinical improvement after receiving the appropriate treatment plan. Improvement was more commonly observed in younger patients, especially in the age group of 20–25 years.




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Table 3. Response to Treatment According to Age Group

| Age group / years | Number of patients before treatment | Number of improved patients after treatment | Improvement percentage |
|---|---|---|---|
| 20–25 | 9 | 7 | 35% |
| 26–30 | 8 | 6 | 30% |
| 31–35 | 3 | 3 | 15% |
| **Total** | **20** | **16** | **80%** |

Physical exercises were effective in 12 patients, representing 60% of the total sample. Four patients, representing 20%, required other treatment methods such as prism correction or treatment of the underlying cause. Four patients, representing 20%, showed no significant improvement, mainly due to poor compliance with the exercise program or because their condition required further medical or surgical evaluation.

Table 4. Method of Treatment Used in the Studied Patients

| Age group years | Total number of patients | Improved with physical exercises | Improved with other treatment methods | No significant improvement |
|---|---|---|---|---|
| 20–25 | 9 | 6 | 1 | 2 |
| 26–30 | 8 | 4 | 2 | 2 |
| 31–35 | 3 | 2 | 1 | 0 |
| **Total** | **20** | **12** | **4** | **4** |

## Discussion

Diplopia is an important visual complaint that requires careful assessment because its causes may range from simple refractive or binocular vision problems to serious neurological or systemic diseases [1][3]. In the present study, 20 patients with diplopia were examined and classified according to age, sex, associated causes, and response to treatment.

The study showed that males represented 65% of the sample, while females represented 35%. This finding may be related to greater exposure of males to trauma, outdoor activity, and occupational or daily visual stress. However, because the sample size was small, this difference cannot be generalized to the whole population. The highest percentage of patients was found in the age group of 20–25 years. This may be related to increase near work, prolonged use of smart devices, studying for long periods,




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and visual fatigue. Prolonged near work may contribute to symptoms of eye strain and may reveal previously compensated binocular vision problems. However, smart device discussed by [7] use alone should not be considered the direct cause of diplopia without proper clinical evidence. [3].

The most common associated clinical findings were squint or ocular misalignment and extraocular muscle weakness. These findings are clinically relevant because physical and orthoptic exercises may help selected patients with mild binocular vision dysfunction [6]. Exercises such as pencil push-ups, near-far focusing, ocular motility training, and fusion exercises may improve binocular coordination and help some patients maintain single vision. In this study, 60% of patients improved with physical eye exercises. This indicates that exercises may be useful as a conservative treatment option in selected cases. However, physical exercises were not effective for all patients. Some patients required other treatment methods, such as prism lenses, correction of refractive errors, or treatment of the underlying cause has been reported by Hatt et al. (2014). Patients with monocular causes of diplopia, such as cataract, dry eye, or corneal irregularity, should not be treated with physical exercises alone because the main problem is optical rather than muscular or binocular [2].

The results also showed that 20% of patients did not show significant improvement. This may be explained by poor compliance with the exercise program, incorrect performance of exercises, severity of ocular deviation, or the presence of underlying causes that require additional treatment. Therefore, regular follow-up and proper patient education are essential for successful outcomes [8]. The findings of this study support the use of physical eye exercises as part of non-surgical management in selected patients with binocular diplopia. Nevertheless, they should be used only after complete clinical assessment [9]. Surgical management should not be the first choice in mild cases, but it may be required when conservative treatment fails or when the deviation is large and stable [10]. The rate of improvement observed in the current study is generally consistent with previous reports supporting the role of orthoptic exercises in selected binocular vision disorders [6]

The main limitation of this study was the small sample size. In addition, the follow-up period was limited, and there was no control group for comparison. Future studies with larger samples, longer follow-up, and standardized exercise protocols are recommended to better evaluate the effectiveness of physical exercises in diplopia treatment.




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Optic therapy is a non-surgical, scientific treatment for the eye that focuses on functional rehabilitation using specific movements, either self-guided or under a physician's supervision [11]. More structured exercises—for example, binocular vision training—can help restore coordinated eye movement and alleviate persistent double vision by activating stronger neuromuscular control of the eye muscles without the need for surgery [12]. In addition, these interventions often include convergence and rapid eye movements training to address eye movement disorders associated with cranial nerve damage or mechanical extraocular muscle injury [13]. Prismatic correction is often recommended in addition to these methods, as clinical evidence has shown improvements in binocular visual function and patient-reported health-related quality of life through optic optic exercises combined with prism therapy [14]. This combination is highly effective in restoring monocular vision, as it simultaneously targets neuromuscular coordination and prism alignment (which prepares for the merging of contrasting retinal images) [15]. These methods rely on the systematic recalibration of convergence amplitudes, allowing for the neural integration of retinal images and reducing sensory interference caused by oculomotor nerve palsy [16]. Furthermore, various vision therapy tools, such as pen pressure exercises, Brook's threads, and barrel cards, are crucial for treating small-angle aberrations [17]. These compensatory vision therapy programs, particularly pen pressure exercises and stereoscopic training, have proven effective in alleviating post-stroke vision symptoms, with significant improvement in near convergence [18]. Clinicians may bypass standard techniques and employ reversible vision therapy protocols to treat cases of reduced bilateral monovision when standard treatments fail, especially when conventional prisms or secondary surgeries are contraindicated [19]. Moreover, recent clinical models indicate that combining these convergence exercises with customized prism therapy enhances treatment efficacy in patients with bilateral visual impairment, whether or not it is due to strabismus [20]. In addition, the model has evolved to include virtual reality and bivisional training using interactive, game-based environments to increase adherence to therapy and stimulate bivisional pathways more accurately [21]. Computational therapy tools use artificial intelligence and an adaptive training environment to enhance neuroplasticity, thereby improving opportunities for convergence and sensorimotor integration [1222, 23].

**Conclusion**




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Physical eye exercises may be considered a useful non-surgical treatment option for selected patients with binocular diplopia caused by mild ocular misalignment, convergence weakness, or extraocular muscle weakness. In this study, 60% of patients improved with physical exercises, while 20% required other treatment methods and 20% showed limited or no improvement. Accurate diagnosis is essential before starting treatment because not all types of diplopia can be treated with exercises. Monocular diplopia caused by cataract, dry eye, or corneal problems requires treatment of the underlying ocular condition. Physical exercises should be used as part of a structured treatment plan under the supervision of an optometrist or ophthalmologist.

**Recommendations**

1. Patients with diplopia should undergo complete ophthalmic and optometric examination before treatment.
2. Physical eye exercises should be used only in selected cases of binocular diplopia.
3. Patients should be educated about correct exercise performance and the importance of compliance.
4. Prism lenses may be used when physical exercises alone are not sufficient.
5. Surgical treatment should be considered only when conservative methods fail or when clinically indicated.
6. Further studies with larger sample sizes and longer follow-up periods are recommended.

**References:**


1. O'Colmain U, Gilmour C, MacEwen CJ. Acute-onset diplopia. Acta Ophthalmologica. 2014;92(4):382–386.
2. Kels BD, Grzybowski A, Grant-Kels JM. Human ocular anatomy. Clinics in Dermatology. 2015;33(2):140–146.
3. Kremmyda O, et al. Acute binocular diplopia: peripheral or central? Journal of Neurology. 2020;267(1):136–142.
4. Stangler-Zuschrott E. Diplopia developed in later life: an ophthalmologic approach. Geriatrics Health. 2018.





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5. Hatt SR, Leske DA, et al. Successful treatment of diplopia with prism improves health-related quality of life. American Journal of Ophthalmology. 2014;157(6):1209–1213.
6. Shuker MS. New treatment for regular astigmatism using physical exercises. Medico-Legal Update. 2021.
7. Shuker MS, Ali ZT. Study the effect of harmful radiation on patients' eyes from 15–25 years during using smart devices. Al-Nisour Journal for Medical Sciences. 2022
8. McBain HB, et al. The impact of strabismus on quality of life in adults with and without diplopia: a systematic review. Survey of Ophthalmology. 2014;59(2):185–191.
9. Irsch K. Optical issues in measuring strabismus. Middle East African Journal of Ophthalmology. 2015;22(3):265–270.
10. Shuker MS, et al. Axial length difference between A-scan and IOL master. Saudi Journal of Educational and Psychological studies.2025 .
11. Ruiter BJD, Lesko RP, Tannen B, Tannen N, Davidson EH. Orthoptic Vision Therapy: Establishing a Protocol for Management of Diplopia Following Orbital Fracture Repair. Plastic & Reconstructive Surgery Global Open 2020;8:63–4. https://doi.org/10.1097/01.gox.0000720620.97629.01.
12. Ebara M, Abe R, Harada T, Kanari K, Mizushiri T. An Experiment of Orthoptic Therapy for a Patient with Diplopia in a Convalescent Rehabilitation Ward Where a Certified Orthoptist is Unavailable. The Japanese Journal of Rehabilitation Medicine 2025;62:297–304. https://doi.org/10.2490/jjrmc.24021.
13. Nakamura K, Fuchigami T, Morioka S. Eye movement training and gaze analysis for a patient with binocular diplopia after traumatic brain injury: a case report. Journal of Medical Case Reports 2023;17:551–551. https://doi.org/10.1186/s13256-023-04221-4.
14. Portela-Camino JA, Sánchez I, Gutiérrez C, Martín S. Successful treatment of diplopia using prism correction combined with vision therapy/orthoptics improves health-related quality of life. PubMed Central 2024;12. https://doi.org/10.7717/peerj.17315.
15. Kolomytskaya A. Non-Surgical Strabismus Treatment. IntechOpen eBooks, IntechOpen; 2024. https://doi.org/10.5772/intechopen.1003986.





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16. Braaksma-Besselink Y, Jellema HM. Diplopia, 2023, p. 149–68. https://doi.org/10.1007/978-3-031-40697-3_6.
17. Caoli A, Sabatini SP, Gibaldi A, Maiello G, Kosovicheva A, Bex PJ. A dichoptic feedback-based oculomotor training method to manipulate interocular alignment. Scientific Reports 2020;10. https://doi.org/10.1038/s41598-020-72561-y.
18. Siva S, Ramesh S, Sridharan P, Iliescu D, Timaru C, Alexe N, et al. Effectiveness of Orthoptic Exercises for Symptomatic Convergence Insufficiency in Post-Stroke Patients: A Single Case Study. Texila International Journal of Public Health 2025;25. https://doi.org/10.21522/tijph.2013.se.25.02.art022.
19. Budd A. Reverse exercises in a case of intractable diplopia. Strabismus 2021;29:116–9. https://doi.org/10.1080/09273972.2021.1914683.
20. Sharma P, Thakur S, Ganesh S. Clinical profiles of binocular vision disorders and the efficacy of prism-vergence therapy in management of diplopia. Indian Journal of Clinical and Experimental Ophthalmology 2026;12:42–8. https://doi.org/10.18231/j.ijceo.13421.1767347693.
21. Qiu X, Zhou Y, Yu X, Wang Z, Shen T, Deng D, et al. Impact of Online Video Game-Based Dichoptic Training on Binocular Vision Rehabilitation in Post-surgical Patients with Intermittent Exotropia. Ophthalmology and Therapy 2024;13:2185–96. https://doi.org/10.1007/s40123-024-00978-z.
22. The Evolution of Vision Therapy Software and Its Impact on Vision Care – A Comprehensive Major Review. Romanian Journal of Ophthalmology 2025;69. https://doi.org/10.22336/rjo.2025.78.
23. Tsang T, Shidlofsky C, Mora V. The efficacy of neuro-optometric visual rehabilitation therapy in patients with visual snow syndrome. Frontiers in Neurology 2022;13. https://doi.org/10.3389/fneur.2022.999336.




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