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Diagnosis and correction of strabismus in children using eyeglasses

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Abstract
In this research was to examine the relationship between the manifest strabismus and refractive errors by genre both in children from the age of (2-11) years. This study has done in the Al_Fallujah teaching hospital and Al_Hayat optics clinic.
The number of patients (50) includes examining patient refractive error and strabismus by " Autorefractometer, Retinoscope, finger test and Snellen chart " We have examined (50) medical condition by the devices listed previously and found (38) children suffering from esotropia and (12) suffer from exotropia.
All children examined with Cyclo eye drops, and some of the children were examined after using atropine drops, where the examination is done 3-4 days after taking the drops.
Through the aforementioned cases, we found that some children were treated through the use of eyeglasses, and others were treated through surgical operations.
Others have had positive results by using exercises to activate the muscles with the placement of the plug.
Where the healthy eye is closed and the brain is forced to use the lazy eye. The rate of closure depends on the patient's age, refractive error, and visual acuity.

Keywords: Diagnosis, strabismus, eyeglasses

Introductions
Strabismus, a condition characterized by the misalignment of one or both eyes, is a frequently occurring ocular disorder in children. It is estimated to affect between 2.3% to 6.0% of the general population [1, 2, 3]. Strabismus disrupts the coordination between the two eyes, resulting in impaired binocular vision and later development of amblyopia. Amblyopia is recognized as a primary factor in causing one-sided visual impairment in both children and adults, with a twofold increase in the likelihood of experiencing visual impairment in both eyes [5]. Aside from the impact of squint on visual function, there are also psychosocial factors that influence self-image [6, 7, 8], interpersonal relationships [9], and social prejudice [3, 10]. Additionally, it affects school performance [11].
Research has indicated that several risk factors throughout early life contribute to the development of strabismus. These factors include prematurity, maternal smoking during pregnancy, Down's syndrome, family history, gender, and different ethnicities [3, 12, 13]. Moreover, there have been reports or suggestions indicating that refractive errors, including as hyperopia, astigmatism, and anisometropia, are associated with strabismus [3].
Refractive errors can be corrected or modified to reduce the risk of developing eye conditions. Eye care providers should confirm this relationship as it can provide information about the underlying causes of strabismus. Additionally, it can help establish guidelines for managing refractive errors to prevent the development of strabismus and subsequent amblyopia [1, 14]. Detecting amblyopia and initiating treatment at a young age will result in improved visual outcomes [5]. Moreover, the prompt identification and rectification of strabismus will facilitate the attainment of typical socialization.

Squint
Misalignment of the visual axes, often known as strabismus, refers to a condition where the eyes are not correctly aligned with one other. One eye may exhibit either constant or

occasional esotropia (inward deviation), exotropia (outward deviation), hypotropia (downward deviation), or hypertropia (upward deviation). This condition impacts approximately 1.2% of the global population. The condition might manifest from birth or arise suddenly throughout late childhood or adulthood.

Refractive errors encompass myopia (short-sightedness), hypermetropia (long-sightedness), and astigmatism. This results in difficulties in accurately directing the light through the lens in the eye, causing the light to be focused either in front of the retina (myopia) or behind the retina (hypermetropia), rather than on the retina itself. When a youngster with a refractive problem attempts to achieve clear vision by focusing, their eye may undergo a deviation. This form of strabismus typically arises in children who are at least two years old, particularly in those who have hyperopia. Figure (1)

Fig 1: Patient children strabismus

Types of Squint

Esotropia

The condition is characterized by the inward deviation of one or both eyes. This disorder can manifest either persistently or sporadically, resulting in the affected person having a visual appearance of "crossed eyes". Medial strabismus is occasionally mislabeled as "lazy eye," a term that actually refers to amblyopia, a disorder characterized by reduced vision in one or both eyes. However, amblyopia can develop due to childhood esotropia. To alleviate the symptoms of double vision, the child's brain will intentionally ignore or "suppress" the image from the affected eye. If left untreated, this suppression will eventually lead to the development of amblyopia. Figure (2)

Fig 2: Esotropia patient

Infantile Esotropia

This type of solution begins in the first six months of the child's life, when the eye deviates inward (median), and this type of solution is considered one of the most popular types of solutions Congenital in children, in this type, early surgical intervention is necessary to maintain the visual functions of the eye, and to prevent Amblyopia [15]. Figure (3)

Fig 3: Patient Infantile Esotropia

Accommodative esotropia

The cause of this type of solution is hyperopia in children, usually starting from the age of two to four, and it can be It appears gradually or suddenly, and in most cases it disappears permanently when wearing glasses, and does not require surgical intervention except in some cases. In many cases, children's long-sightedness improves, and thus they dispense with glasses and the solutions disappear [16], [17]. Figure (4)

Fig 4: Accommodative esotropia

Acute esotropia

Acute esotropia refers to the abrupt development of convergent strabismus in a school-age or older patient with previously normal binocular vision, without any known cause. The abrupt occurrence of double vision, which typically happens in cases of acute esotropia, might be caused by an underlying and possibly dangerous illness process. Therefore, it necessitates prompt assessment. The beginning of this event can typically be pinpointed to a specific hour on a particular day [17]. Figure (5)

Fig 5: Patient Acute esotropia

Mechanical esotropia

A mechanical esotropia refers to a convergent strabismus that occurs due to a mechanical restriction or tightness of an extraocular muscle, such as fibrosis of muscle tissue or thyroid myopathy, or a physical obstruction of the extraocular muscles. Patients with Duane syndrome may have contraction of the medial and/or lateral recti muscles due to the basic neurological miswiring and co-innervation.

There is a restriction or lack of outward eye movement, resulting in a progressive inward deviation of the eye.

During adduction, the palpebral fissure constricts. Furthermore, the patient may have an upward or downward movement when the eye moves inward.

Secondary Esotropia

An esotropia that result from a primary sensory deficit or as a result of surgical intervention is classified as a secondary esotropia [17].

Sensory esotropia

A convergent strabismus resulting from visual deprivation or trauma. It may result from any number of conditions that limit visual acuity in one eye (e. g., uncorrected anisometropia, unilateral cataract, corneal opacity, optic atrophy, macular disease).

It occurs most frequently in persons under 5 years of age [18]. Approximately 4 percent of those with esotropia have sensory esotropia [19].

Exotropia

It is distinguished by the deviation of one eye outward. This form of strabismus typically manifests after the initial year. The squint may be persistent, indicating that the youngster experiences constant strabismus. Alternatively, it could be transient, indicating that the youngster experiences a squint intermittently. Transient strabismus occurs when the infant averts their gaze, and reduces or ceases when the child directs their attention to an object nearby. This strabismus is evident, particularly when the youngster is fatigued, unwell, or experiences a loss of capacity to concentrate. One of the defining features of this form of strabismus is the occurrence of closing one eye in response to sunlight. Occasionally, amblyopia can transition from one eye to the other.

This type of strabismus may cause symptoms such as: headache, blurry vision, and excessive tear production [20], [21].

In basic – type exotropia, the angle of deviation is within10 PD at distance and near [22]. Figure (6)

Fig 6: Patient Exotropia

Methods of treating strabismus in children

Spectacles: They are usually used to repair some cases of strabismus by, while the repair of the other section requires surgery. Also, there are cases of strabismus, the treatment of which calls for a combination of the use of glasses and the surgical operation together.

It is important to know that the operation is not considered a substitute for glasses, but rather it repairs the remaining strabismus that the glasses were unable to repair. Therefore, even after the operation, in most cases, the use of glasses will be required. Figure (7)

Fig 7: Treating strabismus by use of glasses

Exercising and covering the eye

It is usually used in the presence of weak eyesight in one eye than the other in children. Where the doctor covers the healthy eye for limited periods, determining the coverage periods depends on the age of the patient and the degree of laziness of the eye, and he does this to force the weak eye to work, and to allow the retinal cells to grow, with the need to pay attention to early treatment because the growth of eye cells is completed at the age of six. Figure (8)

Fig 8: Exercising and covering the eye

Prism: It is a pair of glasses used to correct double vision. Figure (9)

Fig 9: Prism Bar

Surgical operations: Some cases of strabismus require surgery to straighten the eye muscles, and in these cases, surgery is the only effective treatment solution from the beginning, where the doctor either tightens the eye muscles - the six external ones responsible for the movement of the eye in all directions - or Relax it, according to the patient's condition, and the patient needs to continue to use eyeglasses after the operation.

In conclusion, we emphasize that the treatment of strabismus cases is simple and easy, only if the strabism is noticed early.
The chances of success of the operation in correcting the strabismus, as there is a small probability between (10 – 15 %) that the patient suffers from a certain percentage of strabismus after the operation, and in some rare cases, the patient may still have a noticeable strabismus after the operation, which requires additional surgery.

The aim of the research
Diagnosis and correction of strabismus in children using good glasses when seeing any reason that leads to the suspicion that the child may have strabismus.
And early detection, as early fissure helps children get better and faster results.
Try to get 6/6 children's vision in both eyes.
Obtaining an aesthetic appearance for the child when treating strabismus.

Examination of refraction
Auto refractometer
An auto-refractor or automated refractor (optometry) is a computer controlled machine used during an eye examination to provide an objective measurement of a patient's refractive error and prescription for glasses or contact lenses. The majority of auto-refractors calculate the vision correction a patient needs (refraction) using sensors that detect reflection. Herein, the reflection of the lights is used to determine the size and shape of a ring in the retina which is located in the posterior part of the eye.
Automated refraction is particularly useful upon dealing with non- communicative patients such as young children or those with disabilities. Figure (10)

Fig 10: Auto refractometer

Principle
The scientific principle of the device: This device is based on several principles, including:
1. The fixation target: fixing a target for the patient to give the eye a degree of visual relaxation.
2. The fogging technique: used to increase or decrease eye comfort before eye measurements are taken, so the image is blurred during the test.

Retinoscopy
Is a technique to obtain an objective measurement of the refractive error of a retinoscopy to shine light into the patient's eyes. The examiner uses a patient's eye and observes the reflection (reflex) off the patient's retina While moving the streak or spot of light across the pupil the examiner observes the relative movement of the reflex or manually places lenses over the eye (using a trial frame and trial lenses) to "neutralize" the reflex.
It is communicate with you – such as also extremely useful for people who cannot young children or people with mental disabilities – because you can estimate their refractive error without needing to do a subjective refraction. The retinoscope consists of a light, an intense lens that focuses the light, an a mirror. During the procedure, our doctors use a retinoscope to shine light through the pupil, then move the light vertically and horizontally through each eye and observe how the light reflects off the retina.
If the movement of reflection appears with the movement of the device, we add positive lenses, and if the reflection appears against the movement of the device, we add negative lenses. Figure (11) Retinoscopy test.

Fig 11: Retinoscopy test

Cup Finger test
And For young children who can't read letters use the finger test. Figure (12)

Fig 12: Finger test

Snellen chart
A Snellen chart is an eye chart that can be used to measure visual acuity. Snellen charts are named after the Dutch ophthalmologist Herman Snellen, Visual acuity test (Snellen chart) is used for children who have the ability to distinguish letters and directions.

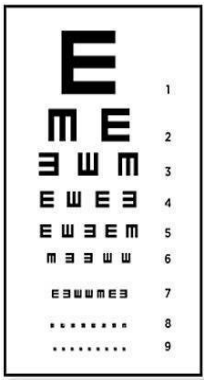


Fig 13: Snellen chart

Table 1: Tropic and associated refractive error 2-11 year.

No.	Sex	age	V.A (visual Acuity)		Refractive error		type
			Without eye glasses	With eye glasses	R.E (R.E)	LEFT EYE (Left Eye)	
1	Male	2	R.E 6/60 L.E6/60	R.E 6/9 L.E6/9	-7.00	-7.00	Exo
2	Female	2	R.E 6/18 LEFT EYE.C.F.lm	R.E 6/6 L.E6/60	R.E+50/+1.50 × 90	+6.01+1.50 × 90	Eso
3	Male	6	R.E 6/24p L.E6/36	R.E 6/6p L.E6/6p	-1.25/-1.25 × 180	-1.50/-2.00 ×10	Exo
4	Female	7	R.E 6/60 L.E6/60	R.E 6/36 L.E6/36p	0.00/-2.00 × 15	0.00/+2.00 ×100	Exo
5	Male	7	R.E 6/6p L.E6/6p	R.E 6/6 L.E6/6	0.00 /+0.50 × 90	0.00/+0.50 ×90	Eso
6	Male	7	R.E c.f 3m L.E6/9	R.E c.f 5m L.E6/6	+4.00	+1.00	Eso
7	Male	7	R.E 6/9p L.E6/36p	R.E 6/6 L.E6/24	+0.50/+0.50 × 95	+5.00	Eso
8	Male	8	R.E 6/18p L.E6/24p	R.E 6/6 L.E6/18p	+3.00/+0.50 × 95	+3.00/+0.50 ×97	Eso
9	Female	8	R.E 6/9p L.E6/12	R.E 6/6 L.E6/6	+1.00/+0.50 × 90	+1.50/+0.50 × 90	Eso
10	Female	8	R.E 6/9p L.E6/12	R.E 6/6 L.E6/6	0.00/+0.75 × 85	+0.00/+1.00 × 85	Eso
11	Male	8	R.E 6/12 L.E6/24p	R.E 6/6 L.E6/24	+0.50/+0.75 × 135	+0.50/+1.00 × 55	Eso
12	Female	9	R.E 6/12 L.E6/12	R.E 6/6 L.E6/6	0.00/-1.00 × 180	0.00/-0.50 × 180	Exo
13	Male	9	R.E/6/36 LEFT EYE/6/24	R.E 6/9 L.E6/6	+5.50	+3.50	Eso
14	Female	9	R.E 6/24 LEFT EYE.6/24	R.E 6/12 L.E6/6p	0.00/+3.50 × 90	-0.00/+3.50 × 90	Eso

No.	Sex	age	V.A (visual Acuity)		Refractive error		type
			Without eye glasses	With eye glasses	R.E (R.E)	LEFT EYE (Left Eye)	
15	Male	9	R.E 6/24 L.E6/24p	R.E 6/9p L.E6/18	+2.00	+3.50	Eso
16	Male	9	R.E 6/18 L.E6/12	R.E 6/6 L.E6/6	+3.50	+2.00	Eso
17	Male	9	R.E 6/9 L.E6/12	R.E 6/6 L.E6/6p	-1.50/-0.50 × 180	0.50-/1.50 × 180	Exo
18	Female	10	R.E 6/6 L.E6/12	R.E 6/6 L.E6/6	+4.0/+1.0 × 90	+4.0/+1.0 × 90	Eso
19	Male	10	R.E 6/36p L.E6/60	R.E 6/12 L.E6/12p	+6.00/+1.00 × 30	+6.00/+1.50 × 160	Eso
20	Female	11	R.E 6/12 L.E6/12	R.E 6/6 L.E6/6	+1.50/+0.50 × 80	+1.50/+0.50 × 105	Eso
21	Male	11	R.E 6/9p L.E6/9p	R.E 6/6 L.E6/6p	0.00 /+0.50 × 90	+0.25/+0.50 × 90	Eso
22	Female	7	R.E 6/18p L.E6/18p	R.E 6/6p L.E6/6p	0.00/-2.00 × 5	0.00/-2.00 × 165	Exo
23	Male	7	R.E 6/9 L.E6/9	R.E 6/6 L.E6/6	0.00/+0.75 × 90	0.00/+0.50 × 165	Eso
24	Female	9	R.E 6/12p L.E6/18p	R.E 6/6 L.E6/9	0.00/-1.00 × 180	0.00/-1.50 × 180	Exo
25	Female	6	R.E 6/18p L.E6/9p	R.E 6/9p L.E6/6	+3.00	+3.00	Eso
26	Male	8	R.E c.f 3m L.Ec.f 3m	R.E 6/36p L.E6/6p	+4.00/+2.00 × 95	+4.00/2.00 × 100	Eso
27	Male	11	R.E 6/6p L.E6/6	R.E 6/6p L.E6/6	0.00/-0.25 × 180	0.00/-0.25 × 180	Eso
28	Male	10	R.E 6/36p L.E6/24	R.E 6/60 L.E6/36	+1.50/+3.50 × 100	+2.50/+3.50 × 90	Eso
29	Male	10	R.E/6/18 LEFT EYE/6/6	R.E 6/18 L.E6/6	+3.00/+1.00 × 90	+2.50/+1.50 × 110	Eso

No.	Sex	age	V.A		Refractive error		type
			Without eye glasses	With eye glasses	R.E	LEFT EYE	
30	Male	8	R.E 6/12p L.E6/12	R.E 6/6 L.E6/6	+1.75/+0.75 × 70	+1.75/+0.75 × 92	Eso
31	Male	10	R.E 6/36p LEFT EYE.6/12	R.E 6/60 L.E6/18p	-2.00/-2.50 × 15	-2.00/-3.00 × 180	Exo
32	Female	11	R.E 6/9p L.E6/6	R.E 6/36p L.E6/24	+0.50/+0.50 × 95	+5.00	Eso
33	Male	10	R.E 6/12 L.E6/36	No correct L.E6/18	+1.50/+1.50 × 100	+3.00/+1.50 × 100	Eso
34	Male	11	R.E 6/6 L.E6/60	R.E 6/6 L.E6/60	Pl.	0.00/+1.00 × 170	Exo
35	Male	8	R.E 6/18 L.E6/60	R.E 6/6 L.E6/24	+3.50	+3.50	Eso
36	Female	4	R.E 6/9p L.E6/6	R.E 6/6 L.E6/6	+7.00/1.00 × 90	0.00	R.E Eso
37	Male	7	R.E 6/18 L.E6/9	R.E 6/12 L.E6/6	+0.50/+0.50 × 105	0.00/0.50 × 95	R.E Eso
38	Male	11	R.E c.f 3m L.E6/24	R.E c.f 5m L.E6/6	+6.00/+1.5 × 100	+3.50/+1.50 × 65	R.E Eso
39	Female	4	R.E 6/24p L.E6/60	R.E 6/9 L.E6/24	+4.00	+6.00	Eso
40	Female	4	R.E 6/18p L.E6/24	R.E 6/6p L.E6/18p	+2.00 / +1.00 × 90	+1.00 / +1.50 × 95	L.EEso
41	Female	4	R.E 6/12 L.E6/12P	R.E 6/6 L.E6/6p	+1.00/+0.50 × 100	0.00/+2.50 × 80	Eso
42	Female	4	R.E 6/9P L.E6/12	R.E 6/6 L.E6/6P	+0.50/+0.50 × 90	0.00/+1.25 × 80	L.EEso
43	Male	4	R.E 6/24P L.E6/18	R.E 6/24 L.E6/9	+3.50	+2.50	R.E Eso
44	Male	7	R.E 6/18 L.E6/36	R.E 6/6 L.E6/24	+3.00/+1.00 × 90	+2.00/1.50 × 90	L.EEso

No.	Sex	age	V.A		Refractive error		Type
			Without eye glasses	With eye glasses	R.E	LEFT EYE	
45	Female	7	R.E c.f 5m L.E6/60	R.E 6/36p L.E6/18	0.00/-2.00 × 180	0.00/-1.50 × 180	R.E Exo
46	Male	7	R.E 6/18 L.E6/12	R.E 6/6 L.E6/6	+ 3.00	+2.50	R.E Eso
47	Male	7	R.E 6/18p L.E6/12p	R.E 6/6 L.E6/6	+3.50	3.00	R.E Eso
48	Male	7	R.E 6/36p L.E6/36	R.E 6/18 L.E6/18	-1.50/-1.00 × 180	-1.00/-1.00 × 175	Exo
49	Male	7	R.E 6/24p L.E6/24p	R.E 6/9 L.E6/9p	-2.50/-1.50 × 180	-1.50/-1.50 × 180	Exo
50	Female	7	R.E c.f 3m L.E6/36p	R.E c.f 3m L.E6/6p	+4.00/+2.00 × 95	+4.00/+2.00 × 100	R.E Eso

Fig 14:

Fig 15:

A child suffers from esotropia strabismus where it was corrected by a prismatic lens. (6 prism) and as shown in the pictures).

Fig 16:

Fig 17:

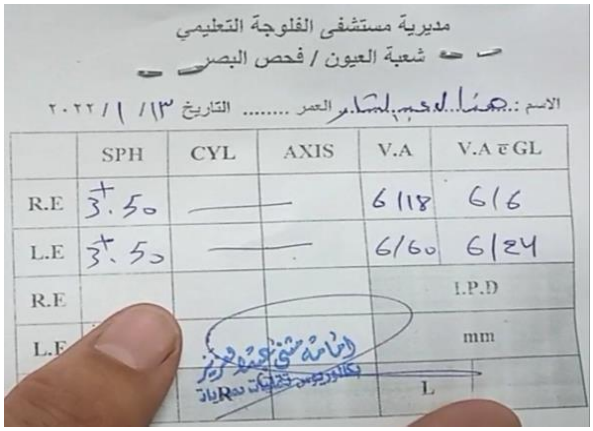
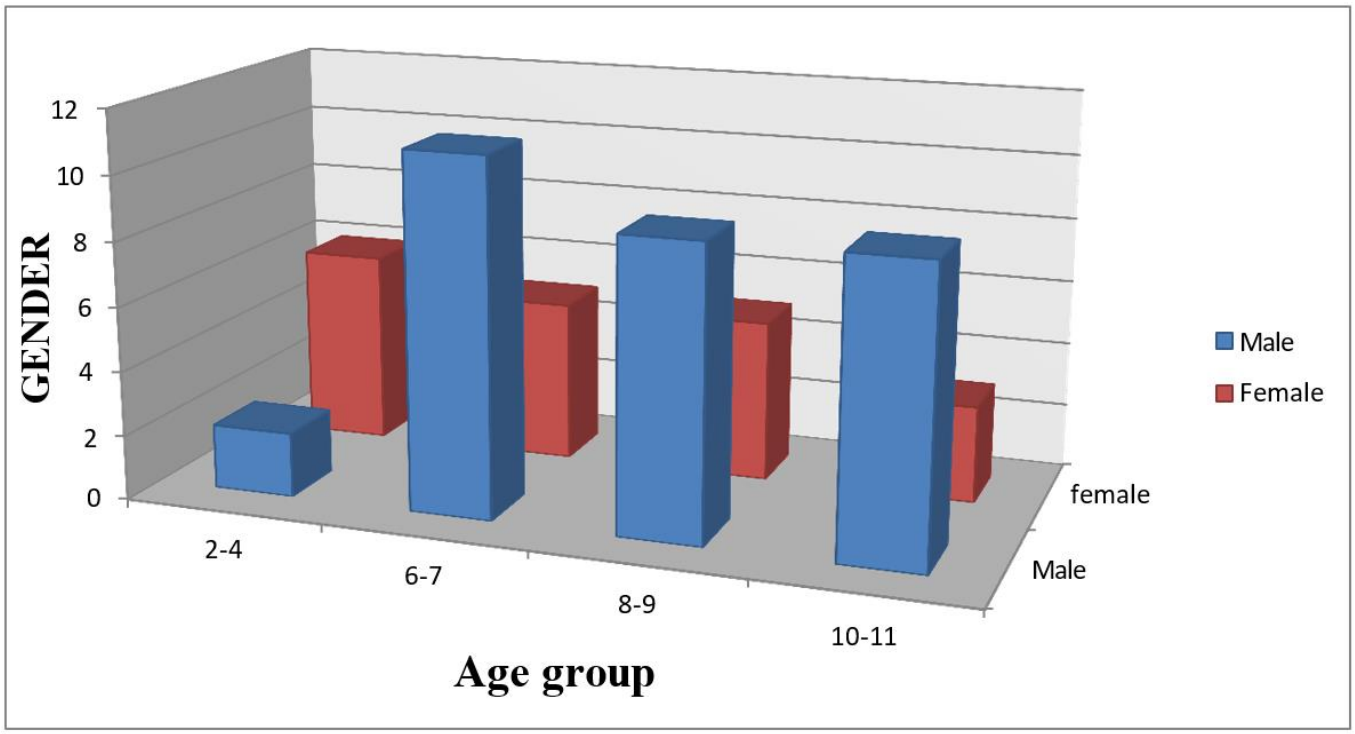


Fig 18:

A 4-year-old boy suffers from esotropia strabismus.
He was treated with prismatic lenses (+3.50 Diopter) and at the age of 8 years, part of the strabismus was corrected and not permanently.

Table 2: Distribution of cases according to age and gender.

Age group (years)	Gender		Total
	Male	Female	
2-4	2	6	8
6-7	11	5	16
8-9	9	5	14
10-11	9	3	12
Total	31	19	50

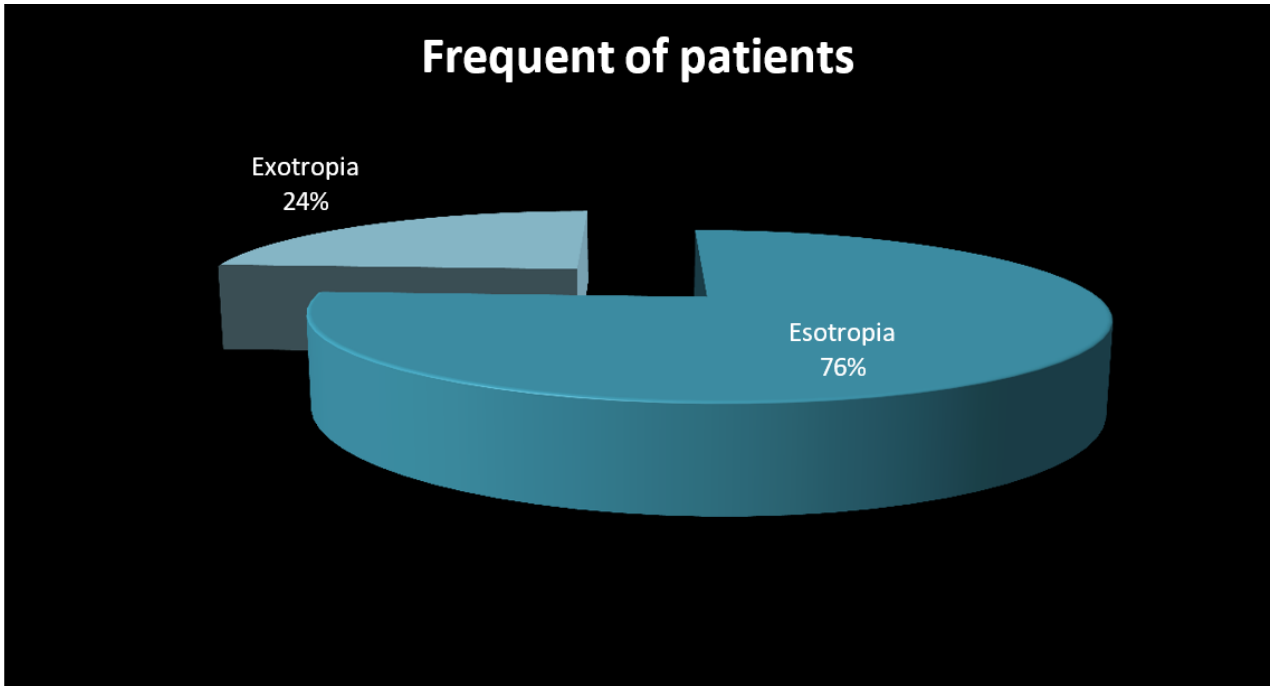


Distribution of cases according to age and gender

Table (2) showed the distribution of cases according to age and gender. It showed that (31) children were male (19) and were females.
(8) Children presented at group of (2-4) years, (16) children at the age below 6-7 years, (14) children are below 8-9 years, (12) Children are below 10-11 years.

Table 3: Distribution of cases according to the type of heterotropia

Type of heterotropia	Frequent of patients
Esotropia	38
Exotropia	12
Total	50



Distribution of cases according to the type of heterotropia.

Table (3) showed the distribution of our cases according to the type of heterotropia. It revealed that (38) children had esotropia and children had (12) exotropia

Then, from previous results we note

In order to establish the relationship between these types of heterotropia and any refractive error, if present, we started this study in Fallujah Teaching hospital, department of ophthalmology and AL_Hayat optics clinc.

We succeeded to collect 50 children with different types of strabismus for this purpose. Children had esotropia while of less, had exotropia. Most of children with esotropia had hypermetropic relationship, while those children with exotropia had mostly a myopic refraction.

This agrees with most studies which correlates the type of strabismus in children with the type of refraction error. Since hypermetopic children tend to converge more for near and this will lead to the establishment of esotropia with increased accommodative effort.

Similarly, children with myopic refraction who tend to accommodate less and subsequently they tend to have a divergent strabismus because their accommodation will be relaxed.

All children examined with Cyclo eye drops, and some of the children were examined after using atropine drops, where the examination is done 3-4 days after taking the drops.

Through the aforementioned cases, we found that some children were treated through the use of eyeglasses, and others were treated through surgical operations.

Others have had positive results by using exercises to activate the muscles with the placement of the plug, Where the healthy eye is closed and the brain is forced to use the lazy eye.

The rate of closure depends on the patient's age, refractive error, and visual acuity.

The lazy eye is closed for a specific period determined by the doctor, after the closing period, it is examined again to make sure that there is development in the eye.

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