

Impaired Binocular Vision and Learning Difficulties ¹⁾

Time and time again, we are confronted with the baffling problem as to why children, and those at the primary school level of their education in particular, perform badly in school despite a reasonable level of intelligence and adequate support from their parents. Children with poor concentration and conspicuous difficulties in reading and writing often prove to be particularly unresponsive to assistance and therapy. The expenditure required to assist these children bears no relation to the success of the measures implemented. This was one of the reasons why the euphoria that emerged in Berlin in the 1970s concerning envisaged possibilities of assisting children with dyslexia soon gave way to disillusionment. In Germany, the term “dyslexia” was subsequently deleted from the official vocabulary of reasons for providing children with special aid.

“Dyslexia” is understood to mean an impaired reading and writing ability with a competence below that expected on the basis of the individual’s level of intelligence as a result of an impairment of auditory or visual perception.

The causes of dyslexia have not yet been clarified, which explains why no therapy or cure yet exists. Depending on the conspicuous difficulties experienced by the child, a symptomatic therapy is recommended aimed at improving his or her learning abilities. For the past three decades, an indication of an existing dysfunction in visual perception has led to all visual defects present in binocular vision being measured exactly and corrected with special prismatic spectacles in individual children with conspicuous difficulties in reading and writing. This procedure was performed regardless of whether dyslexia had been diagnosed by a physician or not.

The positive experience gained here led slowly and unnoticed by the general public to a re-evaluation of the considerable impact of such defects in binocular vision on children’s general pre-school and school performance.

In 1991, when seeking assistance for two children whose reading and writing abilities were becoming steadily worse instead of better, teachers from a Berlin primary school came across an ophthalmologist who had been correcting malfunctions in

¹ Information received from paediatricians and ophthalmologists led to a revision of the original paper by Jens Haase which appeared in the magazine Akzente No. 1, 1st quarter of 1997, ISSN 0948-4507.

binocular vision with prismatic spectacles for more than two decades. Although the two children already wore glasses, they both still seemed to have considerable visual impairment. As it turned out, one child had a residual visual ability of 20% with its spectacles. A corneal astigmatism had not been corrected. The other child was wearing lenses to correct what was described as hyperopia. Hyperopia was not present, however, but the child was in fact suffering from previously unrecognised gonio-sightedness, which was considerably hindering perception. (An explanation of this condition is provided later in this article). Four weeks after prismatic spectacles had been prescribed to correct this visual defect, the child's father complained that a shopping spree with his son no longer took a half an hour, but three to four hours: it was practically impossible to drag his son away from the shelves as he wanted to read the texts on the packaging.

Since then, partly as a result of a letter sent by the German Association of Ophthalmologists to all schools in Germany, parents, teachers, occupational therapists and paediatricians have sometimes been surprised, but always encouraged by the favourable effects of full gonio-sightedness ²⁾ correction on the learning behaviour and performance of schoolchildren.

Conspicuous difficulties experienced by children

Fine co-ordination and writing

- Clumsiness and underdeveloped skills in drawing, painting and cutting out shapes (jerky, failure to keep within outlines, poor positioning of individual elements, etc.) compared to other children of the same age
- Avoidance or hostile attitude to drawing and writing to the point of aggression towards the work of other children.
- Scrawly, uneven handwriting, large letters, difficulty in keeping to lines.
- Unsystematic spelling errors, omission or doubling of letters, confusion of adjacent letters, confusion of similar letters (b and d), long periods of or frequent back-to-front handwriting. When copying texts, the child omits or repeats entire words or lines.
- Lack of stamina or concentration.

² Gonio-sightedness is the new definition derived from the german word "Winkelfehlsichtigkeit".

- Slowness of work (an hour is required for three words) or superficial, inexact work.

Gross co-ordination

- Often conspicuous difficulties in gross co-ordination right from infancy. Difficulty with ball games, problems with movement and co-ordination, impaired spatial orientation, slow movements. Sometimes there is such a high degree of hyperactivity that treatment by medication is recommended:

Reading

- Reading of words not contained in the text
- Omission of words or lines or reading them twice.
- Long period of transition to reading with understanding
- Becoming tired quickly without actually saying so.
- Stamina, motivation and concentration problems
- Problems understanding a text after first reading, but no difficulty understanding the same text when it is read aloud.
- The child does not like reading, does so unwillingly, or needs to take a rest after only a few pages. It cannot describe any visual problems when reading, but simply finds reading “silly” or “boring”.

Arithmetic

- Here, there are usually surprisingly few problems compared to reading and writing. Often very good at mental arithmetic, but chaotic exercise books. However, sometimes enormous problems in understanding figures and imagining quantities, which can be explained by the “muddling” of the single images of the two eyes during the phase of development when the child starts to be aware of quantities (2 – 4 years old).
- Teachers and parents fail to understand why children who were initially very good at arithmetic are inept at text-related exercises, also at those, which are undemanding from the viewpoint of their mathematical content. Difficulties in reading do not have any obvious effect here until this stage.

Behaviour

- A very wide variety of behavioural problems. Parents express these in different ways:
 - “He can do more if he wants (but he doesn’t often want to...)”
 - “He’ll have to learn to concentrate”
 - “He’s a real fidget or the clown of the class”
 - “If you sit down beside him and keep encouraging him, he can do it”
 - “He’s a real daydreamer”
 - “When it’s time to work he always thinks up some reason not to”
- Due to their poor performance but normal intelligence, these children are sometimes categorised as suffering from MCD (Minimal Cerebral Dysfunction). Organic defects in the brain have not yet been proven (at the very most, there are sometimes indications of an increased blood supply in the area of the brain’s visual and hearing centres, especially in children with accompanying headaches). A relatively typical phenomenon is the large discrepancy between good general knowledge, communicativeness and a good memory on the one hand, and major problems sitting still or doing housework or written homework on the other. Several of the above symptoms are usually found at the same time. Rare cases include “bookworms” with spelling problems, or children who perform well in all subjects at school, but whose parents report that they are totally “wound up” or exhausted after school.
- Before children experiencing major problems in school due to gonio-sightedness are corrected with spectacles, it can be generally said, that “the more they practice (reading, writing), the worse their performance becomes.”
- Some children do not experience problems until during their primary school education. Gonio-sightedness can develop in conjunction with the child’s growth, or the compensatory abilities of the central nervous system may decline as increasing demands are made on the child in school. In other words, these children have successfully learnt to read and write, but at the age of 10 or 11 there is a sudden and drastic deterioration in spelling ability and concentration. After the gonio-sightedness has been corrected, their school performance returns to its former status. In some children, an increasing number of mistakes in

dictations, for example, may indicate the need for subsequent correction of the prismatic lenses.

Strain-related symptoms

- Relatively often, eye-related headaches are experienced which frequently also run in the family. They are often combined with a sensitivity to light during the headache phases. Unfortunately, headaches experienced up to once a week are seen as “normal” or not worth mentioning. **However, children who have headaches for no apparent reason, e.g. feverish colds, have them too often.**
- Tendency to nausea and dizziness.
- Tendency to bloodshot eyes, particularly after school and in the evening
- Tendency to blink too frequently and screw up and rub eyes. Tendency to dry or watering eyes. Feeling of pressure in the vicinity of the eye.
- Children with gonio-sightedness in the vertical direction often have a tendency to tilt their heads slightly or markedly to the side, sometimes resulting in problems in the area of the vertebral column. These are evident in an orthopaedic examination and are then incorrectly seen as an obvious explanation for the child’s headaches.

General

- Strangely enough, different children react to the same gonio-sightedness with totally different, indeed sometimes opposite symptoms. For example, one child may display hyperactivity, another’s movements may be slow or even apathetic. As yet, there is no easy test available to ascertain gonio-sightedness, especially as every child has a different combination of symptoms. The last page of this article provides two short tests, which can give at least some indication of gonio-sightedness that needs correction. A fairly reliable indicator is simultaneous headaches and impaired fine co-ordination (handwriting, spelling).
- The range of signs indicating the presence of gonio-sightedness corresponds exactly to that long associated with dyslexia. Furthermore, the fact that children with one eye are practically never affected by dyslexia, would suggest that the symptoms described above are primarily triggered by defects in binocular vision or by impaired co-operation between the two eyes. Our experience has shown that prismatic spectacles should be tried on an experimental basis with children

suffering from gonio-sightedness. Dyslexia cannot be cured. However, it has been seen that this type of correction can markedly reduce the symptoms involved. In some cases, the diagnosis “dyslexia” can often be withdrawn.

Among the children with poor learning abilities despite adequate intelligence who have been referred to ophthalmologists by teachers, school psychologists, occupational therapists and paediatricians, only 5% have not had a visual defect of some sort or their visual defect has not been adequately corrected. The success rate achieved in the correction of gonio-sightedness by prismatic spectacles lies at 65%, i.e. in these cases, obvious improvements are achieved. Headache as a result of eyestrain is removed in about 90% of cases.

Gonio-sightedness and differences from obvious squinting

Binocular vision is the ability of mankind to look at an object at the same and to fuse the two images obtained by the two eyes to form one three-dimensional image. For this to be possible, the image of a viewed point must be imaged exactly on the centre of the retina.

Gonio-sightedness is understood to mean an imbalance in the motor muscles of the two eyes. For the sake of simplicity, this can be compared to a pair of horses with reins of unequal lengths. If the coachman does not take the appropriate corrective action, the horses will not run in the same direction.

The coachman in the case of people is the brain, which compensates for the length differences by taking the appropriate corrective action. The muscle imbalance in the eyes is therefore not evident. Strictly speaking, the person suffering from gonio-sightedness should actually have a squint, but he does not. The brain ensures that the eyes remain parallel and that binocular vision is hence maintained. If this compensatory measure is no longer present (e.g. due to too over-exertion), gonio-sightedness can lead to temporary or permanent squinting. The compensation itself places considerable and constant strain on the body and often leads to such problems as headaches, sore eyes and concentration difficulties.

Measurement of gonio-sightedness is not performed in degrees of angle, but in prisms. Gonio-sightedness of 10 prisms means: if one eye fixates a point at a distance of one metre, the other eye “wants” to look 10 cm to the side. And the brain has to use a corresponding amount of energy to remedy this error.

Gonio-sightedness for which compensation is sometimes not made leads to visible squinting. When their infants are being medically examined, parents who express the opinion that their child has a slight inward squint are usually told that the impression is deceptive as the bridge of infants' noses is so wide. And when the parents say that one eye sometimes seems to "slide" away to one side (especially when the child is tired), they are informed that this is a totally normal condition in infants and that it usually disappears of its own accord.

All too often the first answer is incorrect. If the parents have the impression that the child has a squint, they are often right. The second answer can be right and wrong. During the first months of life, an occasionally squinting infant can learn to compensate for an existing imbalance in the ocularotary muscles by appropriately exerting one or more muscles and hence achieve matching visual impressions in the two eyes (i.e. double images are prevented). If the infant does indeed succeed in accomplishing this, the incorrect position of his eyes is no longer visible, but the imbalance in the ocularotary muscles is still present and demands a lot of energy from the brain and therefore from the entire body.

Unlike children with gonio-sightedness, those with a visible and stable squint have only minor problems in school. This can be explained by the fact either that these children's brains have already largely "deactivated" one eye (the visual ability of the squinting eye is then often only 10 to 40%), or that so-called incorrect co-operation of the two eyes has emerged. Here, a shift in directional perception occurs in the squinting eye. The oculocentric direction for "straight-ahead" is no longer what is imaged on the centre of the retina of this eye, but what is imaged a little to its side. The consequence is obvious squinting with few complaints, but with considerably reduced visual performance of the squinting eye, as the image of the viewed point in this eye lies on a area with decreased visual performance. Children with squints will never have proper three-dimensional vision.

If, however, these children's angle of squint alternates (e.g. it increases with fatigue), they can have considerable problems with their gross and fine co-ordination.

Children with gonio-sightedness are inconspicuous from the viewpoint of the position of their eyes, as they actively compensate for their muscle imbalance. The vast majority of them pass screening tests, including those for binocular and three-dimensional vision. This does not mean that these screening tests are not important. However, only if the limits of such tests are clearly recognised is it possible to prevent

gonio-sightedness from not being discovered and corrected until it is too late and everything has already gone wrong for the child in school.

In actual fact, children with gonio-sightedness are often conspicuous before they start school. **One of the earliest and most obvious symptoms is the disinclination or indeed inability to draw, paint or cut out shapes.** During their school education, they can be recognised with a high degree of certainty by the type of symptoms they display. As gonio-sightedness is often hereditary, additional information can be obtained by asking the parents about any conspicuous indicators they have noticed in themselves.

There does not seem to be any connection between the extent of gonio-sightedness and the severity of the problems to which it gives rise. There are children who have very great difficulties with small gonio-sightedness, and there are others who are not at all conspicuous despite large gonio-sightedness.

Possibilities of correcting gonio-sightedness

The most successful and fastest improvements are obtained in children in whom even the smallest gonio-sightedness has been corrected between the ages of 5 and 7 using prismatic spectacles.

The measuring technique used for this procedure was initially called the Polatest method. The method to be used for performing the test has been stipulated in binding directives for some years now. Responsibility for this is borne by the International Association of Binocular Fullcorrection. The technique is now officially called the Measuring and Correcting Methodology according to H.-J. Haase, the MKH method in short.

Often to the parents' great surprise, the children who receive prismatic spectacles on the basis of this method are very willing to wear their glasses. One can conclude from this that spectacles which are worn unwillingly in the long term are in all likelihood no longer correct, are unnecessary or incorrect for the wearer.

Prospects for children wearing prismatic spectacles

- Rapid results within 3 to 6 months are usually only obtained if the first pair of prismatic spectacles are already worn in the pre-school phase or at least in the first two years of school:
 - better drawing, painting, cutting out shapes

- developing a liking for reading and writing
- improvement in concentration and stamina
- increased ability to tolerate stress
- reduction in fidgetiness and in attitude of avoidance
- improved motor co-ordination
- stabilisation of self-confidence
- additional exercises are enjoyable and are worthwhile, as they now lead to success.
- Medium- to long-term success is to be expected within one to two years if the first pair of prismatic spectacles is not worn until after the second year at school.
 - improvement in handwriting (keeping to lines, uniform size of letters)
 - reduction in inexplicable spelling mistakes
 - positive changes to social behaviour.
 - but even, balanced handwriting is often no longer possible.

It is therefore important to note: The earlier children start to wear their first prismatic spectacles, the faster the first positive effects will be obtained.

Hence, the optimum solution would be to carefully observe the child in kindergarten, nursery school and in the first year of school. Parents of a child with a slight squint can be immediately approached concerning the behaviour of their other children. The handwriting and spelling of older brothers and sisters can be checked accordingly. In some children who did not receive correct spectacles until approximately the end of their third year at school, it was observed that the tendency to misspell remained in the children's native language (German), while the foreign language learnt from the fifth year at school onwards was written practically without spelling mistakes. It would therefore seem that handwriting and the incorrectly learnt and unstable appearance of the words are filed as a fixed pattern in the brain.

As these children were given an opportunity to learn by practice when they received their spectacles, there is a marked increase in the scope available for pedagogic measures. Recommended measures include the ignoring and non-assessment of typical errors for a set time period, additional tuition, and aiding the reading process by starting with books which contain a smaller proportion of text (comics or the like). Ergotherapeutic measures to remove motor malfunctions or behavioral therapy may now prove to be particularly successful.

Children, showing no positive effects, whatsoever after receiving prismatic spectacles, are the exception to the rule. Immediate, dramatic improvements are just as rare. This should only be expected. To learn binocular vision at least to some extent, the eyes of the children suffering from gonio-sightedness have increasingly developed firmly anchored compensation mechanisms over the years. After correction of gonio-sightedness, their eyes have first to learn to cope with the sudden better match of the visual impressions they receive. Nor is it possible to change overnight the attitude of resignation or rebellion resulting from the many disappointments (particularly in school) and frequent criticism they have suffered due to a lack of concentration and diligence.

Comments on orthoptic training

In Germany, the term “vision schools”, i.e. orthoptic training centres, was invented at a time when there was still hope that squints could be removed by appropriate training of the eyes. The term is still used, although experience has shown that the only way of remedying squints is by surgery.

Nowadays, such training methods are attempted in very few cases only. Although this does not change the imbalance in the eye muscles, it can bring some relief to some individual children with gonio-sightedness in the same way that gymnastics and massage can help people with one leg shorter than the other. Whether it would not be better to prescribe prismatic spectacles from the outset or give the person with a short leg a shoe with a thicker sole is a matter of decisive importance. Hilke Oberländer, head of a “vision school”, describes the situation in a magazine dealing with writing and spelling problems as follows:

Uncorrected errors in monocular and binocular vision can make the visual situation and learning difficult for children. Even minor errors must therefore be corrected. This is the only way of creating optimum conditions for vision. This has a positive influence on the reading and writing process.

Comments on prismatic correction using the MKH method

The gonio-sightedness is corrected by exactly measured prismatic lenses. Due to the correction of the actual cause of a usually congenital visual defect, this technique (MKH method) offers major possibilities, but it also entails some problems.

- As this method demands an extremely long learning process and considerable practice from the tester and since it is not yet an integral component of ophthalmologists' training due to its lack of acceptance by traditional medicine, very few experts are currently available to perform this technique, which has been in use for about 40 years.
- In the initial measurement for gonio-sightedness, only the "tip of the iceberg" is almost always found due to the long-established compensation mechanisms and the changed muscle tone. Often, several follow-up examinations with changes to the prismatic lenses are required until the full extent of the gonio-sightedness is found.
- There are adaptation problems experienced when wearing the prismatic spectacles for the first time, as they constitute an intervention in everything the brain has previously learnt for eye control. Once these first few hours or days have been overcome, it can be immediately established whether the prescribed spectacles are correct if the child becomes "addicted" to them and positive changes are evident. If these successful results lessen after some time, a follow-up examination is required, in which the need for new prismatic lenses is generally established.
- If the compensated gonio-sightedness is very large, it may become visible behind the lenses. However, it is not correct to say that prismatic spectacles lead to squinting, even if this is indeed sometimes wrongly alleged. What is correct is that the previously invisible visual defect can only be seen behind the prismatic spectacles. After the spectacles have been removed, this effect disappears, as the brain then automatically starts again to compensate for the gonio-sightedness.
- Sometimes the gonio-sightedness is too large for permanent correction with thick prismatic lenses. In these cases, oculorotary muscle surgery can be performed without difficulty and the defect thus removed at its "source".

The opinion is often voiced that gonio-sightedness of up to 5 prisms does not cause any impairment and is therefore harmless and do not have to be corrected. The experience gained in the past four decades makes this untenable. Furthermore, it is often forgotten that the value found in the first examination is often not "the full truth". In an official communiqué of the Association of Ophthalmologists in Germany (*Der Augenarzt*, issue 4, 1997) it is stressed that *paediatricians and ophthalmologists have*

agreed that even the slightest refractive errors must be corrected in dyslexic children in order to also utilise the therapeutic effect of the spectacles.

Experts proficient in the correction of gonio-sightedness in conspicuous children recommend that an attempt be made with prismatic spectacles determined using the MKH method in order to establish whether the existing symptoms can be substantially reduced.

Time of correction

Vision is also something that has to be learned! This primarily occurs in the first two years of life. This learning process is complete by the age of six. Early diagnosis and therapy is important if visible squinting defects are present or if a child's conspicuous behaviour indicates gonio-sightedness. If a squinting defect exists, proper binocular vision cannot evolve. The result is usually the much-feared monocular vision due to "deactivation" of the visibly squinting eye by the brain, and this can unfortunately no longer be remedied after the age of two.

Children with gonio-sightedness (i.e. children without a visible squint) represent a less serious problem. In the first two years of life they have compensated for their defect and have usually learned binocular vision in the process. These children generally need prismatic lenses if the symptoms typical of gonio-sightedness occur and no other causes are evident.

Some experts correct the gonio-sightedness present in their own children even if no symptoms are (yet) discernible. Experience has shown them that preventive correction is the more sensible approach. There is no danger of correction taking place "too late" in these cases. However, this procedure is not recommended. Firstly, many children with gonio-sightedness would be prescribed prismatic spectacles without actually having any symptoms of the condition. Secondly, this approach is practically impossible in view of the extremely small number of experts who are able to perform the MKH method in line with binding stipulations.

Final comments

Our experience which we have substantiated in studies has shown that a very large percentage of the approximately 20 to 40% of children with an unexpected poor performance at school (i.e. despite normal or above-average intelligence) can be

helped more effectively than has been the case in the past. Even critics of these prismatic spectacles motivated by the politics of the profession admit that the success rate of the MKH method lies at around 65%. This means not only that the educational and vocational opportunities open to many children would be improved, but also that the considerable funds spent on support measures, therapies, special pedagogic care, etc. could be more efficiently utilised.

Short test for children at pre-school age

1. Do the father, mother or brothers and sisters have
 - squints?
 - conspicuous difficulties reading or writing?
 - headaches?
2. Does the child enjoy drawing, colouring in and cutting out figures?
3. Does the child suffer from headaches?
4. Does the child have problems with his or her gross motor co-ordination?

The answers to these questions could indicate that problems may be expected in learning to read and write. A “No” to the second question in particular should prompt the eyecare professional to rule out the possibility of gonio-sightedness.

Short test for children at school age

To what extent are problems or symptoms occurring?

Please tick the appropriate box.

Reading	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Handwriting	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Spelling errors	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Careless mistakes	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Concentration	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Headaches	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Smarting or watering eyes	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous
Balance, orientation	Not conspicuous	Slightly conspicuous	Conspicuous	Very conspicuous

The answers may point to the presence of existing visual defects. A check can then be made to establish whether gonio-sightedness is present and whether the existing symptoms can be alleviated by prismatic spectacles.