MAŁGORZATA WALKIEWICZ-KRUTAK
https://orcid.org/0000-0002-3628-8953
walkiewicz.krutak@gmail.com
MAŁGORZATA PAPLIŃSKA
https://orcid.org/0000-0002-2753-6636
mpaplinska@aps.edu.pl
The Maria Grzegorzewska University in Warsaw

ISSN 0137-818X
DOI: 10.5604/01.3001.0013.4623
Data wpływu: 02.10.2018
Data przyjęcia: 14.08.2019

THE SPECIFIC NATURE OF DIFFICULTIES IN VISUAL PERCEPTION RESULTING FROM CHILDHOOD BRAIN TUMORS

The analyses presented in the article aim to investigate the specific nature of visual problems in a young child whose visual disability results from a brain tumor. The article presents a case study on difficulties in using vision and visual perception development in an almost 4-year-old boy with a brain tumor. It refers to knowledge concerning visual problems in children with brain tumors that is available in source materials and presents a detailed description of difficulties in visual reception and perception in a boy whose visual problems result from cancer. This description was made based on the results of a functional vision assessment. Decreased visual acuity, reduced visual fields, abnormalities in the development of oculomotor functions, lack of spatial vision, and difficulties in visual perception were found in the boy. Both the analysis of medical literature presented in the paper and the results of the boy's functional vision assessment suggest possible development of visual functioning disorders secondary to a brain tumor, such as decreased visual acuity and reduced visual fields, which determine visual abilities and have an adverse impact on the development of visual perception in early life. Based on the analysis of an individual situation, the description of difficulties in visual functioning suggests there is a risk of similar impairments in children with brain tumors.

***Keywords*:** visual disability, brain tumors, visual perception

Introduction

Central nervous system tumors are the second most common childhood cancers. Every year 200–250 new cases are diagnosed in Poland, which constitutes about 20% of all cancers in children. The average age at brain tumor diagnosis is 7 years 10 months; children who are younger than 3 constitute 24%, children older than 10 – 33%, and children between 3 and 10 – 43% (Perek & Perek-Polnik, 2013). The literature on the subject stresses that early brain tumor symptoms are nonspecific and may resemble the symptoms of other childhood conditions. This delays diagnosis of the actual condition, which sometimes results in its more advanced stage and the need to perform an extensive surgery and use adjunctive therapy (Muszyńska-Rosłan, 2009). Despite advances in diagnostics and treatment, which have taken place thanks to the development of neuroimaging techniques and the introduction of intensive chemotherapy and new radiotherapy techniques among others, central nervous system tumors have a very serious

prognosis and treatment outcomes in this group of tumors are far from expectations (Perek & Perek-Polnik, 2013).

The clinical symptoms of central nervous system tumors in children are varied and depend largely on the child's age, the tumor's location, its growth rate, and histological structure. The knowledge of signs and symptoms associated with the development of a brain tumor is the key to correct diagnosis and so are the changes in the child's behavior, such as drowsiness, reluctance to play, attention and memory deficits, and other disturbing behaviors (Szołkiewicz, Adamkiewicz-Drożyńska, & Balcerska, 2009). Children with brain tumors are also the group with the highest risk of serious early and late effects of cancer and its treatment (Muszyńska-Rosłan, 2009).

The factors determining the cognitive functioning of children with brain tumors and its distinctive features are rarely discussed in Polish psychological and educational literature. One of the few studies in this area was conducted by Agnieszka Maryniak (2000), who examined a group of 50 school-age children in the period after diagnosis of a brain tumor and before treatment initiation. The following disorders were found in the sample:

- praxis disorders (30% of participants);
- speech disorders (24% of participants);
- memory disorders (24% of participants);
- visuospatial agnosia (4% of participants) co-occurring with increased spatial- and constructional-apraxia-type difficulties.

The group included both children in whom no abnormalities in cognitive, emotional, and social functioning were found despite proliferative lesions (36% of participants) and children in whom disorders occurred. No lasting relationships were found between tumor location and symptoms/signs – in some cases, no disorders were found despite considerable damage to cerebral tissue, while in others – relatively small lesions were accompanied by significant functional difficulties. The author concludes that a brain tumor is not a factor that directly determines the child's development.

Visual problems as a result of childhood brain tumors

Visual problems are among the symptoms and signs that suggest childhood brain tumors. Visual symptoms and signs listed in medical literature include: decreased visual acuity; signs suggesting cranial nerve palsies, such as: strabismus, nystagmus, and double vision; papilledema, which is one of the signs of increased intracranial pressure (Muszyńska-Rosłan, 2009).

Sophie Wilne and colleagues (2006) conducted a study that aimed to determine the most common initial symptoms of brain tumors in children. The study covered 200 children. Its findings show that among many different signs and symptoms (such as headaches, vomiting or seizures), visual abnormalities developed in 10% of participants. As far as symptoms and signs appearing at later stages of tumor progression are concerned, visual problems occurred in 38% of children in the study. The authors emphasize that the diagnosis of central nervous system tumors should consider not only the occurrence of such symptoms as headaches or vom-

iting, but also visual symptoms as well as behavioral and educational difficulties. Another study conducted by Wilne and colleagues (2012) had a similar objective (finding the first symptoms/signs of the condition and their progression till the diagnosis of brain tumor is confirmed). The study covered 139 children with brain tumors diagnosed in four pediatric neuro-oncology centers in Great Britain. Medical data about individual patients were gathered and the symptoms/signs were grouped into the following categories: headache, nausea and vomiting, seizures, alteration in or loss of consciousness, motor system abnormalities (e.g.: abnormal gait, abnormal coordination, focal motor weakness, involuntary movements, etc.), visual system abnormalities (reduced visual acuity, reduced visual fields, nystagmus, squint, exophthalmia, diplopia, papilloedema, optic atrophy, unequal pupils, and sunsetting), cranial nerve palsies, abdominal or back pain, spinal deformity, behavioral change (including lethargy and school difficulties), growth abnormalities, and other findings. Statistical analyses were performed with the use of the Mann–Whitney and Kruskal–Wallis tests and a Cox regression analysis to investigate the relationship between symptom onset and time to diagnosis. The average age of the participants was 8.1 (ranging from 29 days to 16.7 years of age). The results of the analyses indicated a significant occurrence of visual problems secondary to brain tumors. In the group of 139 children, 23 presented with visual problems as onset symptoms, and as many as 96 experienced the symptoms when the brain tumor diagnosis was confirmed. Changes in the visual system turned out to be most frequent in the participants; they were not among onset symptoms and were experienced at diagnosis in 73 children. The authors conclude that more than half of the participants developed visual system abnormalities, while one third up to half of the participants developed motor system abnormalities, cranial nerve palsies, behavioral change, and nausea and vomiting (motor system abnormalities – 62 children, cranial nerve palsies – 51 children, behavioral change – 51 children, and nausea and vomiting – 49 children). The analyses also showed more frequent visual system abnormalities in the participants younger than 4. The most frequent signs and symptoms of visual system abnormalities in the participants at brain tumor diagnosis included: papilloedema (50), nystagmus (25), reduced visual acuity (20), squint (18), and diplopia (18). The authors conclude that children with suspected brain tumors should also be assessed for symptoms and signs of visual system abnormalities. Based on meta-analysis of data from medical articles published from 1991 through 2005 on signs and symptoms of central nervous system tumors in children, Wilne and colleagues (2007) also confirmed the frequent occurrence of decreased visual acuity (41% of participants) and optic atrophy (15% of participants) in children with intracranial tumors and neurofibromatosis.

Mary Jo Harbert and colleagues (2012) presented the findings of a study on reduced visual fields resulting from a brain tumor (its location or treatment). The study was prompted by the authors' hypothesis that children with brain tumors are not always thoroughly evaluated for visual field deficits. Children diagnosed with primary brain tumors were given visual field assessments. Analysis of the results included children with reduced visual fields confirmed in two assessments. As many as 14 (15.2%) out of 92 children in the study (average age 8.9) had undiagnosed visual field deficits. The average interval between tumor diagnosis and diagnosis of

reduced visual fields was 3.7 years. Reduced visual fields were attributed to direct tumor infiltration (8 children), postoperative complications (5 children), and post-radiation edema (1 child). Visual field loss included bitemporal hemianopsia, which developed in two children, homonymous hemianopsia – nine children, quadrantanopsia – two children, and concentric visual field loss – one child. Interestingly, visual field deficits in all 14 children were diagnosed based on examination only and were not reported by the children or their caregivers. The authors conclude that the prevalence of unrecognized visual field deficits can be high in children with brain tumors; that is why those children should be evaluated for reduced visual fields too.

Different symptoms and signs are related to tumors in the optic tract. Depending on tumor location, visual acuity problems and reduced visual fields occur, or less frequently: papilledema, increased intraocular pressure or secondary optic atrophy (Muszyńska-Rosłan, 2009). And occipital lobe tumors cause reduced visual fields, visual agnosia, and visual hallucinations, which may be a prodrome of seizures (Perek & Perek-Polnik, 2013).

The information provided above proves that both clinical and functional vision assessments should be an important element in diagnosing the effects of central nervous system tumors, especially when a child with a brain tumor becomes a low vision child who needs development support that will take into account visual disability consequences. Low vision entails numerous difficulties in visual functioning. The most common visual problems in young low vision children include: decreased visual acuity, low contrast sensitivity, visual field deficits, light sensitivity issues, and binocular and spatial vision disorders (Walkiewicz-Krutak, 2014).

Skills and limitations in the area of visual reception and perception in a child with low vision resulting from a brain tumor

Research objective and research questions

The authors formulated the following objective of research analyses performed based on educational and psychological records and the observation of a boy suffering from visual disability as a sequela of cancer: *to investigate the specific nature of visual problems in a child after treatment for a brain tumor located in the lateral ventricles.* A case study was used to meet the research objective. Case studies are used in medicine as well as in pedagogy and psychology as a thorough analysis of problems an individual contends with. The choice of a case study as a qualitative research method follows the assumption that even a study of an individual case is valuable for gaining specific knowledge (Guziuk-Tkacz, 2011). The choice of this method is also justified by the topic discussed – the consequences of childhood brain tumors are not frequently observed in educational practice; that is why, it is difficult to get a significantly large research sample here. The studies on samples that are statistically significant mentioned in the article constitute medical analyses performed based on the medical records of patients treated in specific medical centers.

In the analysis of psychological and educational records gathered for the purpose of assessing and supporting the boy's development, answers to the following research questions were sought:

- What are the boy's skills in terms of visual-receptive[1] and oculomotor[2] functions?
- What are the boy's problems in terms of visual-receptive and oculomotor functions?
- What are the boy's skills in visual perception[3]?
- What are the boy's problems in visual perception?

Initial information

The boy was provided with early childhood development support due to developmental difficulties resulting from an extensive malignant bilateral choroid plexus carcinoma of the lateral ventricles. Choroid plexus carcinomas account for 2.3 to 3% of cancers that occur during childhood – mainly in the first decade of life. They develop within the ventricular system of the brain, sometimes growing to a large size. A choroid plexus carcinoma is a very malignant tumor, which may spread through the cerebrospinal fluid. It usually grows to a large size and is a malignant lesion – with necrotic foci and posthemorrhagic cavities (Walecki & Chojnacka, 2007).

A functional assessment was made when the boy was 3 years 10 months old – a year and a half after cancer treatment was completed (surgical treatment and chemotherapy with numerous systemic complications). The boy's cognitive and social development at the age of 3 years 10 months was marked by significant delays and dissonance between individual functions. The boy demonstrated a low level of task maturity, very short attention span, and high susceptibility to environmental distractors. He also had considerable difficulties with emotion regulation.

The analysis focused on the boy's visual functioning, i.e. his abilities in perceiving visual stimuli, the level of oculomotor development, and the perceptual ability level, at the moment when the boy's parents declared their readiness to use early childhood development support services in a specialist counseling center offering services to blind and low vision children and the child was provided with psychological and educational assistance.

Information on the boy's visual functioning (his strengths and weaknesses)

As far as his visual-receptive abilities (ability to perceive) are concerned, the boy was able to visually perceive various objects around him that were of dif-

[1] In this paper, reception, as defined in cognitive psychology, is understood as a process during which stimuli are registered in the receptor cells of the sense organs (the sense of sight in this case), which produces a sensation. Reception is a precondition of active perception (Nęcka, Orzechowski, & Szymura, 2006). Visual-receptive functions refer to perceiving objects with specific visual features and are determined by such variables as, among others: visual acuity, contrast sensitivity, and range of vision (Walkiewicz-Krutak, 2018).

[2] Oculomotor functions develop based on the ability to receive visual stimuli and include such skills as: fixing gaze on an object, visually tracking a moving object, shifting gaze from one stimulus to another, and making convergent eye movements (Walkiewicz-Krutak, 2018).

[3] Visual perception skills that were assessed included, among others: identifying objects and their features, discriminating and recognizing shapes and colors, figure-ground discrimination, and binocular vision.

ferent sizes (both small and large) and in colors with different degrees of saturation. He did not need high contrast between the target and the background or extra lighting to see the target. He established and maintained eye contact with another person. He responded fastest to visual stimuli presented in the central field of vision.

As far as oculomotor functions are concerned, the boy maintained the gaze (visually fixated) long enough on the objects presented (mainly in the central visual field), smoothly tracked a moving target from the midline to the right and also vertically (upwards and downwards). No tracking eye movements to the left were observed (despite numerous attempts to prompt them). Oculomotor function limitations were found (in shifting the gaze horizontally, scanning the visual environment, and locating targets in the far peripheral visual fields).

The Lea Symbols Test (Hyvärinen & Jacob, 2011) was used to test for near visual acuity and the near visual acuity score obtained was 0.25 (normal near visual acuity in this test is 1.0). The Lea Symbols Test (ibid.) was used to test for distance visual acuity and the distance visual acuity score obtained was 0.2 (normal distance visual acuity in this test is 1.0). The scores in both tests show decreased visual acuity, which, at that stage of the child's development, is classified as moderate low vision according to the International Classification of Visual Acuity Loss. Contrast sensitivity assessment with the Hiding Heidi test (ibid.) showed the boy's response to the 25% contrast chart, which indicates reduced contrast sensitivity, albeit to a small extent. Confrontation visual field testing adapted for young children (Walkiewicz-Krutak, 2009) showed loss in the left side of the visual field.

As far as visual perception development is concerned, the boy discriminated and recognized basic shapes; he also discriminated and correctly described their size, which should be considered a strength of his visual perception. With little assistance, he correctly matched the Lea Rectangles (Hyvärinen & Jacob, 2011) according to their discriminative characteristics (the length of lines and size of objects). Apart from the assessment results, also conclusions drawn from observations in various task situations confirmed that the boy did not have difficulties with discriminating simple shapes and also in fitting them into the matching holes. Another strength of the boy's visual perception was the ability to recognize everyday items (based on visual information) – he recognized objects that were related to his daily functioning (different categories of items) and had no trouble identifying them and understanding their function. The assessment as well as everyday situations and tasks showed that the boy could not recognize faces. However, the inability to recognize faces (prosopagnosia) did not prevent him from making eye contact with interaction partners. He would gaze at a given face for a long time, especially when starting an interaction with a familiar person again, as if he was looking for its unique features. The boy did not respond correctly to a binocular vision test (Stereo Butterfly Test) (Kanski & Bowling, 2011), which was interpreted as a lack of stereopsis and considered to substantially limit his visual-perceptual abilities.

As far as two-dimensional representations are concerned, the boy was able to recognize some everyday items in simple pictures, i.e. pictures showing one object with few elements against a contrasting background. He was able to recog-

nize objects whose shapes were easy to identify if they were reproduced in a way that was adapted to his abilities resulting from his decreased visual acuity and contrast sensitivity. The boy was observed to have considerable difficulty in interpreting the content of pictures with several elements – he did not demonstrate the ability to recognize objects in most attempts if there were two or more objects in the picture. The boy was not able to interpret simple scenes shown in the pictures (where it was necessary to recognize not only objects but also activities). He had difficulty in identifying colors as well – he did not give correct answers in a color vision test (Ishihara test adapted for children) and he also used incorrect color names in different everyday situations and tasks.

At the time of the assessment, graphomotor skills, which are dependent on perceptual abilities and the level of motor function development, were the boy's weakness: he drew mainly small objects whose shapes were difficult to discern; he also made his first attempts at coloring. Hand dominance was not developed – he used his right hand and his left hand alternately. Drawing and coloring, he would alternate his hands very frequently.

The boy's abilities and skills relating to the perception of the environment were his strength – he did not have major difficulties in understanding visual information while moving about: he was able to see different objects around him, did not stumble and avoided obstacles. However, in some situations relating to independent mobility, he was observed to have functional problems with depth perception (he sometimes did not react to changes in elevation, such as curbs or stairs, which was a potential threat to him moving around safely).

Summary concerning the boy's visual functioning

The most important issue in the boy's visual functioning and visual perception was the short attention span – he engaged in the activities offered but focused on a given task for a very short time. He needed a lot of prompting, and instructions/tasks had to be repeated several times for him to do most of the tasks. He avoided looking relatively frequently – the behavior intensified when he was tired. Cognitive and motor activities requiring the use of vision clearly made the boy tired. The issues mentioned could result from the boy's limited visual abilities, especially his decreased visual acuity, but they could also stem from difficulties experienced in the area of cognitive development. Based on the boy's strengths in visual reception and perception and with his difficulties experienced in this area in mind, the following interventions were suggested (based on the results of the functional vision assessment) to support the development of cognitive functions with special emphasis on visual perception development:

- imitate activities with the use of objects;
- discriminate, identify, and name the graphical representations of objects and activities shown in pictures;
- scan visually, locate, and point to details with the use of specific objects;
- match concrete objects to their representations by color, shape, size, and function;
- discriminate and identify small objects in pictures;
- reproduce the direction of lines and shapes;
- discriminate, recognize, and identify colors;

- assemble objects;
- identify events in pictures, tell stories based on them.

Due to the specific nature of the boy's perceptual difficulties, it was particularly important for his effective functioning – especially in terms of concentration – that he be in a visually organized environment (visual overload resulted in easy distraction, loss of attention but also in fatigue that led to him refusing to cooperate during some tasks). The detailed plan designed to support the boy's development (that involves developing his visual perception) is being implemented in close cooperation with the child's family – according to the paradigm of early childhood development support (Twardowski, 2012). The main goal of interventions for the child and his family is to provide optimal development support. Other objectives, which result from the main goal, include: attempt to improve the child's and the family's quality of life, help the parents to accept their son's disability and to realistically evaluate his potential, and support the parents in overcoming emotional crisis and in developing a greater sense of parenting competence.

Conclusions

Even though the above description of the visual functioning of a boy exemplifies difficulties experienced by one child, it suggests potential difficulties in visual functioning that may occur in a similar or different configuration in children with brain tumors. It is crucial that children at risk of developing visual functioning problems be assessed for those problems. To respond to the developmental needs of children who are experiencing visual problems, it is important to conduct a functional vision assessment and provide interventions that will support the development of vision and visual perception through intense stimulation of the visual system – based on knowledge concerning brain plasticity. According to Krystyna Szymańska (2007), if a focal brain injury occurs in early years, the damaging process, the developmental plasticity process, and the compensatory plasticity process may overlap. It is also assumed that the young brain is plastic thanks to compensatory reorganization mechanisms and transfer of function to other parts of the nervous system (Borkowska, 2012). It should be remembered that the conditions in which development occurs as well as the nature of stimuli may impact structural changes taking place in the brain. Compensatory and developmental plasticity that occurs in children brings hope that is fundamental to child development support interventions, including those in the area of visual functions.

References

Borkowska, A.R. (2012). Neuropsychologiczne mechanizmy powstawania zaburzeń rozwojowych. In A.R. Borkowska & Ł. Domańska (Eds.), *Neuropsychologia kliniczna dziecka* (pp. 13–30). Warszawa: Wydawnictwo Naukowe PWN.

Guziuk-Tkacz, M. (2011). *Badania diagnostyczne w pedagogice i psychopedagogice*. Warszawa: Wydawnictwo Akademickie „Żak".

Harbert, M.J., Yeh-Nayre, L.A., O'Halloran, H. S., Levy M. L., & Crawford, J. R. (2012). Unrecognized visual field deficits in children with primary central nervous system brain tumors. *Journal of Neuro-Oncology*, *107*(3), 545–549.

Hyvärinen, L. & Jacob, N. (2011). *What and how does this child see? Assessment of visual functioning for development and learning.* Helsinki: Vistest.
Kanski, J. & Bowling, B. (2013). *Okulistyka kliniczna.* Wrocław: Elsevier Urban & Partner.
Maryniak, A. (2000). *Rozwój dzieci z guzami mózgu*. Warszawa: Wydawnictwo Akademickie „Żak".
Muszyńska-Rosłan, K. (2009). Jedne z najczęstszych nowotworów wieku dziecięcego – guzy mózgu i mięsaki tkanek miękkich. *Opieka Paliatywna nad Dziećmi*, *17*, 149–153.
Nęcka, E., Orzechowski, J., & Szymura, B. (2006). *Psychologia poznawcza*. Warszawa: Wydawnictwo Naukowe PWN.
Perek, D. & Perek-Polnik, M. (2013). Nowotwory ośrodkowego układu nerwowego: rozpoznawanie i leczenie. *Pediatria po Dyplomie*, *17*(3), 23–32.
Szołkiewicz, A., Adamkiewicz-Drożyńska, E., & Balcerska, A. (2009). Guzy ośrodkowego układu nerwowego u dzieci – analiza objawów i propozycje diagnostyczne. *Forum Medycyny Rodzinnej, 3*(3), 181–185.
Szymańska, K. (2007). Refleksje nad rozwojem układu nerwowego u człowieka. In G. Kmita (Ed.), *Małe dziecko i jego rodzina. Z teorii i praktyki wczesnej interwencji psychologicznej. Zeszyty Sekcji Psychologii Klinicznej Dziecka, PTP, 5,* 49–56.
Twardowski, A. (2012). *Wczesne wspomaganie rozwoju dzieci z niepełnosprawnościami w środowisku rodzinnym*. Poznań: Wydawnictwo Naukowe UAM.
Walecki, J. & Chojnacka, E. (2007). Diagnostyka obrazowa guzów wewnątrzczaszkowych. Część I – guzy neuroepitelialne. *Onkologia w Praktyce Klinicznej*, *3*(4), 177–197.
Walkiewicz-Krutak, M. (2009). *Funkcjonowanie wzrokowe małych dzieci słabowidzących*. Warszawa: Wydawnictwo APS.
Walkiewicz-Krutak, M. (2014). Uwarunkowania zaburzeń widzenia u małych dzieci. In R. Piotrowicz (Ed.), *Interdyscyplinarne uwarunkowania rozwoju małego dziecka*. *Wybrane zagadnienia* (pp. 195–213). Warszawa: Wydawnictwo APS.
Walkiewicz-Krutak, M. (2018). *Mózgowe uszkodzenie widzenia u małych dzieci*. *Studium teoretyczno-empiryczne*. Warszawa: Wydawnictwo APS.
Wilne, S. H., Ferris, R. C., Nathwani, A., & Kennedy, C. R. (2006). The presenting features of brain tumours: A review of 200 cases. *Archives of Disease in Childhood*, *91*(6), 502–506.
Wilne, S., Collier, J., Kennedy, C., Koller K., Grundy, R., & Walker, D. (2007). Presentation of childhood CNS tumours: A systematic review and meta-analysis. *The Lancet Oncology*, *8*, 685–695.
Wilne, S., Collier, J., Kennedy, C., Jenkins, A., Grout, J., Mackie, S., Koller, K., Grundy, R., & Walker, D. (2012). Progression from first symptom to diagnosis in childhood brain tumours. *European Journal of Pediatrics*, *171*, 87–93.

SPECYFIKA TRUDNOŚCI W ZAKRESIE PERCEPCJI WZROKOWEJ BĘDĄCYCH KONSEKWENCJĄ NOWOTWORU MÓZGU U DZIECKA

Abstrakt

Celem analiz podjętych w artykule jest poznanie specyfiki zaburzeń widzenia u małego dziecka, u którego niepełnosprawność wzroku jest konsekwencją nowotworu mózgu. W artykule zaprezentowano studium przypadku dotyczące trudności w zakresie posługiwania się wzrokiem i rozwoju percepcji wzrokowej u niespełna czteroletniego chłopca z nowotworem mózgu. W opracowaniu odwołano się do wiedzy na temat zaburzeń widzenia u dzieci z nowotworami mózgu dostępnej w materiałach źródłowych oraz przedstawiono szczegółowy opis trudności w zakresie recepcji i percepcji wzrokowej u chłopca, którego problemy w zakresie funkcjonowania wzrokowego wynikają z choroby nowotworowej. Opis ten został sporządzony na podstawie wyników funkcjonal-

nej oceny widzenia. U badanego dziecka stwierdzono obniżoną ostrość wzroku, ubytki w polu widzenia, nieprawidłowości w zakresie rozwoju funkcji motorycznych oczu, brak widzenia przestrzennego oraz trudności w zakresie percepcji wzrokowej. Zarówno zaprezentowana analiza literatury medycznej, jak i opisane wyniki funkcjonalnej oceny widzenia chłopca, wskazują na potencjalną możliwość wystąpienia w przebiegu choroby nowotworowej mózgu takich nieprawidłowości z zakresu funkcjonowania wzrokowego, jak obniżenie ostrości wzroku i pojawianie się ubytków w polu widzenia, które determinują możliwości wzrokowe i niekorzystnie wpływają na rozwój percepcji wzrokowej we wczesnym okresie życia. Oparty na analizie jednostkowej sytuacji opis trudności w zakresie funkcjonowania wzrokowego wskazuje na ryzyko wystąpienia podobnych dysfunkcji w przebiegu choroby i jej leczenia u dzieci z nowotworem mózgu.

***Słowa kluczowe*:** niepełnosprawność wzroku, nowotwory mózgu, percepcja wzrokowa