Case Report

Relato de Caso

Fragile X syndrome with Dandy-Walker variant: a clinical study of oral and written communicative manifestations

Síndrome do X Frágil com variante de Dandy-Walker: estudo clínico das manifestações comunicativas orais e escritas

Dionísia Aparecida Cusin Lamônica[1]
Plínio Marcos Duarte Pinto Ferraz[2]
Amanda Tragueta Ferreira[3]
Lívia Maria do Prado[3]
Dagma Venturini Marquez Abramides[1]
Mariana Germano Gejão[4]

Keywords

Fragile X syndrome/diagnosis
Fragile X syndrome/complications
Dandy-Walker syndrome
Learning disorders/etiology
Language disorders/etiology
Genetics

ABSTRACT

The Fragile X syndrome is the most frequent cause of inherited intellectual disability. The Dandy-Walker variant is a specific constellation of neuroradiological findings. The present study reports oral and written communication findings in a 15-year-old boy with clinical and molecular diagnosis of Fragile X syndrome and neuroimaging findings consistent with Dandy-Walker variant. The speech-language pathology and audiology evaluation was carried out using the Communicative Behavior Observation, the Phonology assessment of the ABFW – Child Language Test, the Phonological Abilities Profile, the Test of School Performance, and the Illinois Test of Psycholinguistic Abilities. Stomatognathic system and hearing assessments were also performed. It was observed: phonological, semantic, pragmatic and morphosyntactic deficits in oral language; deficits in psycholinguistic abilities (auditory reception, verbal expression, combination of sounds, auditory and visual sequential memory, auditory closure, auditory and visual association); and morphological and functional alterations in the stomatognathic system. Difficulties in decoding the graphical symbols were observed in reading. In writing, the subject presented omissions, agglutinations and multiple representations with the predominant use of vowels, besides difficulties in visuo-spatial organization. In mathematics, in spite of the numeric recognition, the participant didn't accomplish arithmetic operations. No alterations were observed in the peripheral hearing evaluation. The constellation of behavioral, cognitive, linguistic and perceptual symptoms described for Fragile X syndrome, in addition to the structural central nervous alterations observed in the Dandy-Walker variant, caused outstanding interferences in the development of communicative abilities, in reading and writing learning, and in the individual's social integration.

Descritores

Síndrome do cromossomo X frágil/diagnóstico
Síndrome do cromossomo X frágil/complicações
Síndrome de Dandy-Walker
Transtornos de aprendizagem/etiologia
Transtornos da linguagem/etiologia
Genética

RESUMO

A síndrome do X Frágil é a causa mais frequente de deficiência intelectual hereditária. A variante de Dandy-Walker trata-se de uma constelação específica de achados neurorradiológicos. Este estudo relata achados da comunicação oral e escrita de um menino de 15 anos com diagnóstico clínico e molecular da síndrome do X-Frágil e achados de neuroimagem do encéfalo compatíveis com variante de Dandy-Walker. A avaliação fonoaudiológica foi realizada por meio da Observação do Comportamento Comunicativo, aplicação do ABFW – Teste de Linguagem Infantil - Fonologia, Perfil de Habilidades Fonológicas, Teste de Desempenho Escolar, Teste Illinois de Habilidades Psicolinguísticas, avaliação do sistema estomatognático e avaliação audiológica. Observou-se: alteração de linguagem oral quanto às habilidades fonológicas, semânticas, pragmáticas e morfossintáticas; déficits nas habilidades psicolinguísticas (recepção auditiva, expressão verbal, combinação de sons, memória sequencial auditiva e visual, closura auditiva, associação auditiva e visual); e alterações morfológicas e funcionais do sistema estomatognático. Na leitura verificou-se dificuldades na decodificação dos

Correspondence address:
Dionísia Aparecida Cusin Lamônica
Via Puccini, 1-16, Residencial Tívoli I, Bairro Tívoli, Bauru (SP), Brasil, CEP: 17053-095.
E-mail: dionelam@uol.com.br

Received: 11/4/2010

Accepted: 4/6/2011

Study carried out at the Department of Speech-Language Pathology and Audiology of the Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.
(1) Department of Speech-Language Pathology and Audiology, Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.
(2) Neonatal Screening Laboratory of Association of Parents and Friends of Exceptional – APAE – Bauru (SP), Brazil; UNIMED – Bauru (SP), Brazil.
(3) Post-graduation Program (Masters degree) in Speech-Language Pathology and Audiology of the Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.
(4) Post-graduation Program (Doctorate degree) in Applied Oral Sciences of the Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil; Department of Speech-Language Pathology and Audiology of the Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.

símbolos gráficos, e na escrita havia omissões, aglutinações e representações múltiplas com o uso predominante de vogais e dificuldades na organização viso-espacial. Em matemática, apesar do reconhecimento numérico, não realizou operações aritméticas. Não foram observadas alterações na avaliação audiológica periférica. A constelação de sintomas comportamentais, cognitivos, linguísticos e perceptivos, previstos na síndrome do X-Frágil, somada às alterações estruturais do sistema nervoso central, pertencentes à variante de Dandy-Walker, trouxeram interferências marcantes no desenvolvimento das habilidades comunicativas, no aprendizado da leitura e escrita e na integração social do indivíduo.

INTRODUCTION

The Fragile X syndrome is the most frequent cause of hereditary intellectual deficiency[1,2]. It is related to the presence of a fragile region that is more prone to breaks or failures, or of a fragile site in the distal portion of the long arm of chromosome X, more specifically at Xq27.3. This chromosomal fragility it not the cause, but the cytogenetic expression of the mutation of a gene located in this region, designated FMR-1[3]. As general characteristics are various degrees of intellectual disability, behaviors in the autistic spectrum, language alterations, convulsions, strabismus, hypotonia, flaccid joints, increased cephalic perimeter, flat feet, narrow face, high forehead, thin lips, macrodontia, macro-orchidia, long and large nose, arched and narrow palate, prognathism, anomalies of the auricular pavillion and cardiac malformations , particularly prolapse of the mitral valve[4,5].

The literature also describes other characteristics. It mentions the occurrence of hyperactivity, attention deficit, hypersensitivity to stimuli, behavioral disorders, anguish in unknown situations, shyness, repetitive discourse, avoidance of eye contact and stereotyping, difficulty with socialization and difficulty in acquiring independence in daily life activities, particularly in the male gender[3,5-8].

The term "Dandy-Walker Complex" has been described as a continuum of anomalies of the posterior fossa associated with multiple congenital anomalies, classified according to certain criteria, depending on the type of alteration found. Thus, the Dandy-Walker malformation is characterized by cystic dilation of the fourth ventricle and widening of the posterior fossa, complete or partial agenesia of the cerebellar vermis, tentorial alteration and hydrocephalia. Whereas the Dandy-Walker variant is characterized by variable hypoplasia of the cerebellar vermis with or without widening of the cisterna magna, presence of communication between the fourth ventricle and the arachnoideal space, and absence of hydrocephalia[9]. Thus, the Dandy-Walker variant is considered the mildest form of the Dandy-Walker complex[9-11].

Association between the Fragile X syndrome and Dandy-Walker variant has rarely been described in the literature. In view of the above discourse, the aim of this study was to relate the oral and written communication manifestations of an individual with the diagnosis of Fragile X syndrome and radiological findings in the central nervous system of the Dandy-Walker variant.

CLINICAL CASE

The study was approved by the Committee of Ethics in Research of the Bauru School of Dentistry of the University of São Paulo, Protocol No. 004/2009. The subject's participation was allowed by signature of the Free and Illustrious Consent by their legal representative, in accordance with Resolution 196/96 of the Brazilian National Research Ethics Committee (CONEP).

Clinical contextualization

A 15-year-old boy participated in this study. He was genetically and clinically diagnosed as having the Fragile X syndrome and neuroradiological findings of the Dandy-Walker variant. The family's complaint was related to difficulties with oral and written communication, as well as school learning.

The oral communication and written evaluation consisted of the application of the following procedures: Communicative Behavior Observation; ABFW Child Language Test – Phonology (Part A)[12]; Phonological Awareness Profile – PAP[13]; Academic Performance Test – APT[14], written text on the subject of his choice; Illinois Test of Psycholinguistic Abilities (Brazilian adaptation) – ITPA[15]. The results of these evaluations were analyzed in accordance with the manual of each procedure. The stomatognathic system was evaluated regarding the morphological and functional aspects and the hearing evaluation was made by tone threshold audiometry, logoaudiometry, imitanciometry – Midmatte 622 and Zodiac automatic screening.

During the structured interview, the mother reported the absence of intercurrences during gestation and delivery; delay in neuropsychomotor development and hypotonia in childhood. In addition, after the age of 2 years there was diminished visual contact, appearance of flapping *(*observed up to approximately 5 years of age), uncoordinated motor development and slow linguistic development. At the time of the interview, the participant still presented repetitive behaviors of biting the backs of hands, poor motor coordination (difficulty with running, walking up and down stairs, tying shoe laces, using a pair of scissors), food compulsion, and intolerance of frustration or changes in routine. As regards academic skills, at the time he went to regular school (third grade in primary education at a public school) with little benefit from this. At school he had only one friend (who came from a special classroom), and spent most of his time alone.

The participant underwent speech and language therapy from the age of 4 to 11years and occupational and psychological therapy from the age of 7 to 14 years. Despite the search from early childhood, the diagnosis was only obtained at age14. The participant has two second cousins with the Fragile X syndrome.

The participant underwent medical and psychological evaluations (Chart 1).

The participant underwent an evaluation of the stomatognathic system (Chart 2).

With regard to communicative behavior, inadequate con-

Chart 1. Clinical history data with regard to medical and psychological evaluations

Procedures	Results
Magnetic resonance	Slightly widened frontal region Increased cisterna magna communicating with the IVth ventricle characterizing the Dandy-Walker variant
Medical clinical exam	Joint flaccidness and slackness Increase in cephalic perimeter Flat feet Narrow face, high forehead, thin lips, long nose, macroorchidism, macrodontia, arched and narrow palate and prognathism
Ophthalmology	Hyperopia
Spinal radiograph	"S" Curve Scoliosis of the thoracic-lumbar spine
Echocardiography	Normal
Genetic exam	Complete mutation of FMR1 gene – Fragile X Syndrome (Investigation of mutation of FMR1 gene by PCR technique)
Psychological assessment	Nonverbal IQ indicating moderate intellectual disability Verbal IQ indicating moderate level of disability Graphic-perceptive performance severely compromised Mal adaptive behaviors and attention deficit (Gestaltic Visomotor Test and WISC-III)

Chart 2. Results of stomatognathic system evaluation

Stomatognathic system	Results
Morphological aspects	Half-open lips Anterior and limiting insertion of the lingual frenulum Ogival palate; absence of tooth 45 Overbite of four millimeters Crowding of central and lateral incisors Orthodontic appliance in mandibular arch Dolicocephalic face Prominent front and reduced naso-genial angle Scapular belt and head slightly anteriorized
Functional aspects	Slight hypotonia in cheeks, masseters, mentum and upper lip Altered facial mobility/motricity Velopharyngeal function altered Oronasal respiration of the medium type Pneumophonoarticulatory incoordination Parted lips Absence of food bolus formation during mastication Deglutition of liquid with mentual contraction, lingual pressure, and associated movements of the head

versational ability for his chronological age was observed, with significant alterations in the pragmatic, semantic and morphosyntactic levels. The participant initiated and maintained verbal exchanges with his own productions, making use of personal pronouns, names of everyday objects and places, and attributes with lexical sense (possessive pronouns, time and space adverbs with grammatical meaning). His sentences were coordinated, however, frequently his exchanges were incoherent and noncontextualized, with perseverance of themes and morphosyntactically disorganized, due to errors of verbal and nominal flexion. Thus, his narrative discourse was elaborated with linked phrases, but showed compromised coherence and cohesion, and used preferential themes for activities involving dialogue. Speech intelligibility was compromised due to imprecise articulation, hesitations and repetitions of words and phrases during the discourse. With regard to receptive and expressive aspects, the semantic level was shown to be less harmed, since the discourse of the participant almost always discussed a repertoire compatible with his daily life activities and interests. It was noted that he understood simple orders and comments in concrete contexts, immediate or otherwise, related to activities of daily living experiences. His attention span was reduced, and there was little maintenance of eye contact. Maladaptative behaviors, such as biting the backs of his hands and making repetitive movements were also observed.

The results of the hearing, ABFW[12], PAP[13] and APT[14] evaluations were obtained (Chart 3).

In the subtest of written through dictation of the APT, there were observed inadequate use of the space on the paper, body posture and holding the pencil; orthographic deviations and exclusive use of block capital letters. The orthographic deviations in dictation subtest were characterized by errors of multiple representation, confusion between words ending in "ão" x "am", exchange of letters similar in appearance, omissions of letters, addition of extra letters and support in oral language. This subtest score was 13 points, being lower than expected for his grade level. In the reading subtest, the participant read in a syllabled manner, with failure in graphemic-phonemic decoding. This compromised understanding of the material read, characterizing unsatisfactory use of the phonological route. Only regular and highly frequent words of two and three syllables were read correctly, however, the participant did not always understand what he read. The score obtained in this

Chart 3. Results of ABFW – Child Language Test, APT and PAP

Procedures	Results
Tone threshold audiometry, imitanciometry and logoaudiometry	Normal peripheral hearing
ABFW – phonology	Phonological system completely acquired
Phonological awareness profile	Analysis: 6 points Addition: 5 points Segmentation: 5 points Subtraction: 2 points Substitution: 0 point Reception of rhymes: 4 points Sequential rhyme: 2 points Syllabic reversal: 0 point Articulatory image: 6 points Total score: 30 points (phonological abilities below those at 5 years)
Academic performance test	Reading: 32 points – Low for his school level Writing: 13 points – Low for his school level Arithmetic: 3 points – Low for his school level Gross total score: 48 points – Low for his school level

subtest, 32 points, was lower than expected for his grade level. In the arithmetic subtest, number recognition was observed. However, there was better performance in sums of numbers containing only one digit, characterizing the difficulty in performing mathematical operations. The score obtained in this subtest, 3 points, was lower than expected for his grade level.

During spontaneous writing, there was also difficulty in using the space on the paper, body posture and holding the pencil. The participant wrote about "the mother-in-law", one of the subjects that form part of his repetitive discourse. The following orthographic deviations were observed: errors of multiple representation, omission of letters, syllables and words carrying a low semantic load (articles, pronouns and prepositions), junction of words, predominant use of vowels and restriction of consonants. In addition, and absence of punctuation and accentuation was noted. When asked to read the text, the participant did not decodify the graphic symbols, and narrated what he had written with the support of his test. During the attempt to read, he was able to identify regular and highly frequent words, which was also verified when reading isolated words (APT). In view of the difficulties with writing (isolated words of the APT and spontaneous narrative) and reading (reading isolated words of the APT and spontaneous narrative), it was concluded that the participant was not literate and his writing skill was at a syllabic-alphabetic level.

Evaluation of his psycholinguistic abilities was performed by means of the (Chart 4).

Chart 4. Results of ITPA

Sub-tests	Psycholinguistic age	Score scale*
Auditory reception	7 years and 9 months	25
Visual reception	9 years	36
Auditory sequential memory	4 years and 8 months	26
Visual sequential memory	4 years and 3 months	36
Auditory association	8 years and 6 months	28
Visual association	8 years and 6 months	34
Visual closure	8 years and 6 months	36
Grammatical closure	8 years and 9 months	24
Auditory closure	8 years and 3 months	34
Manual expression	10 years and 11 months	38
Verbal expression	3 years and 3 months	26
Sounds combination	Unable to perform	-

*The score scale expected for 10 years and 11 months. Maximum age for the procedure.

DISCUSSION

In the case presented, the genetic-clinical characteristics with reference to the facial dysmorphisms (elongated face, arched palate and prognathism), anomalies of the auricular pavillion (large, protruding ears), macroorchidism and flaccid ligaments, in conjunction with complete mutation in gene FMR1, confirmed the diagnosis of Fragile X syndrome[1-8].

In the neurological evaluation, the magnetic resonance imaging findings of the cranium were compatible with the Dandy-Walker variant (slightly widened frontal region; increased cisterna magna in communication with the IVth ventricle). These anomalies pertain to a continuum of malformations (hypoplasia of the cerebellar vermis, slightly widened frontal region; increased cisterna magna in communication with the IVth ventricle)[8-10]. It should be pointed out that in the literature review performed, only one clinical description was found of the association of the Fragile X with neuro-radiological findings compatible with Dandy-Walker malformation [11]. However, in this description there was no report with regard to the communicative or academic performance.

The participant was diagnosed with intellectual disability compatible with that described in the literature for the Fragile X syndrome[2,4-6]. In his family there are other confirmed cases of the syndrome, which is responsible for approximately 14% of all the idiopathic intellectual disabilities in the male gender, and for one third of all the intellectual disabilities linked to X[1]. Men with the Fragile X syndrome tend to present more limitations as regards independence, with respect to residence, employment, ability to perform daily activities (social), friendship and leisure activities[5].

The presence of intellectual disability[2,4-6] interferes in the development of general learning and reflects on the development of oral and written language, which may be observed in the present clinical case. During the evaluation, several maladaptive behaviors were observed, such as biting his hands, persistent behaviors, poor eye contact, repetitive speech, and

fixation on a conversational topic. The literature has shown that in the Fragile X syndrome, behavior is extremely varied, and there may be characteristics of the autistic spectrum associated with this entity[3,5,6,8].

Studies have shown that behaviors of the autistic spectrum may also be found in conditions involving the Dandy-Walker complex[9]. In spite of the controversial findings in the literature, alterations in the cerebellum present in the Dandy-Walker variant have been described in cases that present manifestations of the autistic spectrum. However, it should be emphasized that hypoplasia of the cerebellar vermis is not considered a neuroanatomic marker of autism. Researches have also related alterations of the cisterna magna to psychotic conditions [11] and agenesia of the corpus callosum may be associated with greater intellectual compromise.

The results of the stomatognathic system evaluation indicated alterations in craniofacial structures, such as a long face, half-open lips, hypotonia, ogival palate, overbite and prognathism, corresponding to some of the alterations in facial dysmorphism presented in the Fragile X syndrome. These alterations are of clinical importance as they form part of the phenotypical characteristics of this syndrome[1,2,5]. The orofacial mobility and motricity aspects, and stomatognathic functions altered indicate imbalance between the functional and skeletal system[1] and bring about interference in the expressive aspects of language.

As regards communicative abilities, interference of the behavioral aspects in the interactive situations was observed, which make it difficult to develop interpersonal relationships in a more satisfactory manner. The literature states that the lack of social perception, the increase in social anxiety and the characteristics of the autistic spectrum commonly observed in the Fragile X syndrome, interfere in social relationships, and in the independence to perform the roles that define adult life[5]. The receptive abilities were shown to be more preserved, that is to say, the participant was capable of understanding situational contexts of daily life. Expressive abilities suffer interferences in morphosyntactic, pragmatic and semantic elaboration.

The semantic level was the most preserved feature, considering that in the ability to engage in dialogue, the topic almost always talked about was the repertoire related to his daily life activities. In his discourse, hesitations were identified, with broken phrases and unintelligible episodes, corroborating the literature[2,3,5,6]. Individuals with the Fragile X syndrome present not only deficiencies related to syntax, but also to semantics, such as the difficulty to evoke words and little ability to choose target words from the mental lexicon when trying to produce a well structured, significant thought. This causes interference in the fluency of the discourse and intelligibility of the content to be transmitted[3]It s inferred that the low occurrence of receptive alterations reported in this study is due to the fact that receptive language is considered as being related to intellectual level. These alterations were in agreement with those expected for the mental age as described in the literature[4,5,8].

A literature review about the communication of individuals with the Fragile X syndrome[8] also described delays in the acquisition and development of language, with emphasis on pragmatic alteration, stabilization of the phonological system and in the deviations of syntactic organization. Studies about the Dandy-Walker complex, more specifically the Dandy-Walker syndrome, also predicted harm to the communicational abilities. However, no studies were found giving detailed descriptions of the communicative abilities in conditions in which the Dandy-Walker variant is present.

The results of the reading, writing and arithmetic evaluations are in agreement with the scores below the school grade of the participant. His performance in written activities was compatible with the initial processes of written language acquisition: he was only able to write in capital block letters; he found difficulty in decoding graphic symbols, with syllabled reading and in the decodification of regular words, with compromised understanding; he showed number recognition, but had difficulty in performing simple mathematical operations for his school level.

For the his grade at school, it was expected knowledge of orthographic rules and adjustment to the abilities of perceptive and psycholinguistic processing. This, for example, concerns fine motor coordination, visual-spatial and visual-perceptual abilities, sustained attention, auditory and visual discrimination and memory, and metalanguage. In the Fragile X syndrome[3,4] it is possible that these abilities may be compromised, whether by overall developmental delay, predicted cognitive alterations, or by the delay in the acquisition of oral language.

The ability to process visual symbols plays an important role in learning to read and write in systems with alphabetic orthography. Any disorder in this ability may result in a deficiency in the awareness of phonemes and in phonemic-graphemic correlation[4]. When verifying the scores obtained in the Phonological Awareness Profile, it can be observed that the participant showed difficulty in decoding and handling of graphic symbols.

With regard the psycholinguistic abilities, the most prejudiced were the sounds combination, verbal expression, followed by auditory and visual sequential memory. Nevertheless, considering the participant's chronological age and the maximum age standardized by the test, there was prejudice in the other subtests, since the other abilities are suited to subjects of a maximum of 10 years of age, with the exception of the manual expression subtest. It was observed the influence of control of attention in these activities.

Retain information or assimilate abstract notions, such as those required in reading, write and mathematics learning, involving abilities to perceive, relate and fix sequences in the structure of sounds and letters with significance, resolve more abstract and complex situations-problems, generalize and apply information to new situations are difficulties found in the academic learning of individuals with the Fragile X syndrome[6-8]. These characteristics interfere in the cognitive functions, intellectual level, psycholinguistic and communicative abilities. There is a need for great influence in the social environment with regard to the promotion of qualitative and quantitative stimulation to optimize the potential of this individual.

Great variability in alterations in language could be noted among individuals with the Fragile X syndrome, as well as in

the degree of severity of the oral and written disturbances[8]. Success in school activities is potentially dependent on the family environment, development of language, cognitive functions and the specific perceptual abilities that would favor the capture of strategies used in the learning process[4].

The literature points out various possibilities of alterations in development in individuals who present conditions of Dandy-Walker complex [9]. As the Dandy-Walker variant is the mildest form of the complex, the occurrence of asymptomatic conditions is possible, this being dependent on the etiologic factor of these malformations or of the presence of associations with other clinical conditions. Thus, when the Dandy-Walker variant is associated with other malformations, chromosomal abnormalities or syndromes, there will be a negative impact on the development of the patients.

With regard to the association of the Fragile X syndrome with the Dandy-Walker variant, it is understands that this is another risk factor for alterations in communication and learning. From this perspective, the importance of early diagnosis and attendance of a multidisciplinary team is emphasized, as indicated in a study on this subject[10].

The literature[11] points out that in the Dandy-Walker syndrome, cerebral malformation, although of unknown etiology, has been reported as having a causal relationship with various types of chromosomal abnormalities and syndromes with various malformations. In addition other conditions pertaining to the Dandy-Walker complex were discussed.

FINAL COMMENTS

In view of the data obtained in this study, it was verified that there were alterations in language as regards the acquisition of phonological, pragmatic, semantic and morphosyntactic abilities and alteration in psycholinguistic abilities. These alterations were shown to interfere in the processing of information, with relevant reflection on communicative and school learning abilities.

The presence of structural alterations in the central nervous system found in the Dandy-Walker variant added to the condition of the Fragile X syndrome, brings the additional risk of prejudice to the communicative process. Another important aspect refers to the presence of behaviors of the autistic spectrum, foreseen both in the Fragile X syndrome and in the Dandy-Walker complex.

Therefore, the importance of diagnosis as early as possible is emphasized, so that specific therapeutic opportunities may be offered. This would allow optimization of the potential and would contribute to the improvement in the quality of life of these individuals and their family members.

REFERENCES

1. Ridaura-Ruiz L, Quinteros-Borgarello M, Birini-Aytés L, Gay-Escoda C. Fragile X-Syndrome: Literature review and report of two cases. Med Oral Patol Cir Bucal. 2009;14(9):434-9.
2. D'Hulst C, Kooy RF. Fragile X syndrome: from molecular genetics to therapy. J Med Genet. 2009;6(2):577-84.
3. Yonamine SM, Silva AA. Características da comunicação em indivíduos com a síndrome do X Frágil. Arq Neuropsiquiatr. 2002;60(4):981-5.
4. Roberts JE, Schaaf JM, Skinner M, WeelerA, Hooper S, Hatton DD, et al. Academic skills of boys with fragile x syndrome: profiles and predictors. Am J Ment Retard. 2005;110(2):107-20.
5. Hartley SL, Seltzer MM. Exploring the adult life of men and women with fragile x syndrome: results from a national survey. Am Assoc Intellect Dev Disabil. 2011;116(1):16-35.
6. Price J, Roberts J, Vandergrift N, Martin G. Language comprehension in boys with fragile and boys with down syndrome. J Intellect Disabil Res. 2007;51(Pt 4):318-26.
7. Bayley DB, Raspa M, Holiday D, Bishop E, Olmsted N. Functional skills of individuals with fragile X syndrome: A lifespan cross-sectional analysis. Am J Intellect Dev Disabil. 2009;114(4):289-303.
8. Ferreira GC, Lamônica DA. Caracterização da linguagem na síndrome do X-frágil: estudo bibliográfico. Pró Fono. 2005;7(1):111-20.
9. Sasaki-Adans D, Elbabaa SK, Jewells V, Carter L, Campbell JW, Ritter AM. The Dandy-Walker Variant: A case series o f 24 pediatrics patients and evaluation of associated anomalies, incidence of hydrocephalus, and developmental outcomes. J Neurosurg Pediatrics. 2008;2(3)194-9.
10. Lavanya T, Cohen M, Gandhi SV, Farrel, T, Whiby EH. A case of Dandy-Walker Variant: The importance of a multidisciplinary team approach using complementary techniques to obtain accurate diagnostic information. Br J Radiol. 2008;81(970):242-5.
11. Imatala G, Yamanouchi H, Arisaka O. Dandy-Walker syndrome and chromosomal abnormalities: review. Congenit Anoma. 2007;47(1):113-8.
12. Wertzner HV. Fonologia (Parte A). In: Andrade RFA, Befi-Lopes DM, Fernandes FDM, Wertzner HF. ABFW – Teste de linguagem infantil nas áreas de fonologia, vocabulário, fluência e pragmática. São Paulo: Pró-Fono; 2000. p.5-40.
13. Alvarez AM, Carvalho IA, Caetano AL. Perfil de habilidades fonológicas. 2a ed. São Paulo: Via Lettera; 2004.
14. Stein LM. Teste de desempenho escolar: Manual para aplicação e interpretação. São Paulo: Casa do Psicólogo; 1994.
15. Bogossian MADS, Santos MJ. Manual do examinador: Teste Illinois de habilidades psicolinguísticas. Rio de Janeiro: EMPSI; 1977.