Brain Neurorehabil. 2023 Nov;16(3):e23
https://doi.org/10.12786/bn.2023.16.e23
pISSN 1976-8753·eISSN 2383-9910

Brain & NeuroRehabilitation

Case Report

Patient With Crossed Aphasia Undergoing Long-Term Speech Therapy: A Case Report

Tae-Hwan Kim, Myeong-Kwon Yoon, Seung-Gue Choi, Jeong-Seob Kim, Jyul-Lee Choi

Received: Jul 5, 2023
Revised: Aug 21, 2023
Accepted: Aug 31, 2023
Published online: Sep 20, 2023

Correspondence to
Jyul-Lee Choi
Department of Physical Medicine and Rehabilitation and Medical Device Clinical Trial Center, Presbyterian Medical Center, 365 Seowon-ro, Wansan-gu, Jeonju 54987, Korea.
Email: cjl1012@jesushospital.com

HIGHLIGHTS

- The patient showed crossed aphasia (CA) after right middle cerebral artery infarction.
- This report is the first in Korea to report the long-term speech therapy in CA.
- Language function was restored in the first six months, and then the pletaeu formed.

Brain Neurorehabil. 2023 Nov;16(3):e23
https://doi.org/10.12786/bn.2023.16.e23
pISSN 1976-8753·eISSN 2383-9910

bnr
Brain & NeuroRehabilitation

Case Report

Check for updates

Patient With Crossed Aphasia Undergoing Long-Term Speech Therapy: A Case Report

Tae-Hwan Kim, Myeong-Kwon Yoon, Seung-Gue Choi, Jeong-Seob Kim, Jyul-Lee Choi

Department of Physical Medicine and Rehabilitation and Medical Device Clinical Trial Center, Presbyterian Medical Center, Jeonju, Korea

OPEN ACCESS

Received: Jul 5, 2023
Revised: Aug 21, 2023
Accepted: Aug 31, 2023
Published online: Sep 20, 2023

Correspondence to
Jyul-Lee Choi
Department of Physical Medicine and Rehabilitation and Medical Device Clinical Trial Center, Presbyterian Medical Center, 365 Seowon-ro, Wansan-gu, Jeonju 54987, Korea.
Email: cjl1012@jesushospital.com

ORCID iDs
Tae-Hwan Kim
https://orcid.org/0009-0001-1199-8369
Myeong-Kwon Yoon
https://orcid.org/0009-0007-7654-7626
Seung-Gue Choi
https://orcid.org/0009-0003-0064-034X
Jeong-Seob Kim
https://orcid.org/0009-0002-4649-079X
Jyul-Lee Choi
https://orcid.org/0009-0008-4641-1899

Funding
None.

Conflict of Interest
The authors have no potential conflicts of interest to disclose.

ABSTRACT

Crossed aphasia (CA) is a type of aphasia caused by cerebral hemispheric lesions on the same side of the dominant hand. The prevalence of CA is extremely rare. To the best of our knowledge, this is the first case report in Korea to conduct 6 years of long-term speech therapy in a case of a patient with CA. The patient was a 57-year-old right-handed man with aphasia caused by extensive acute infarction in the right middle cerebral artery territory. He presented with global aphasia, right–left disorientation, and agraphia. Language function recovered in the first 6 months and then plateaued.

Keywords: Crossed aphasia; Stroke; Long-term speech therapy

INTRODUCTION

Crossed aphasia (CA) is a type of aphasia caused by cerebral hemispheric lesions on the same side of the dominant hand [1]. The prevalence of CA in right-handed individuals ranges between 0.38% and 3% of all aphasic syndromes [2]. To date, only 20 cases have been reported in Korea [3]. The diagnostic criteria for vascular CA encompass various factors, including lesion location, handedness, family history, and the absence of childhood brain damage [4]. While cases of CA have been documented in the literature, there is limited research on the long-term speech therapy outcomes and treatment progress for patients with CA. Herein, we report a case of a 57-year-old male patient with CA after right middle cerebral artery (MCA) infarction who received 6 years of speech therapy. In addition, we report a serial progress, including the language evaluation results. Written informed consent was obtained from the patient.

CASE DESCRIPTION

A 57-year-old male patient visited the emergency department with sudden weakness of the left extremities. After brain magnetic resonance imaging (MRI), an acute right MCA infarction was diagnosed (**Fig. 1**), and he was admitted for neurosurgery and treated for cerebral infarction. Seven weeks after the onset of symptoms, he was transferred to the

Author Contributions

Conceptualization: Kim TH, Choi JL, Yoon MK, Choi SG, Kim JS; Data curation: Kim TH, Choi JL; Supervision: Choi JL; Validation: name; Visualization: name; Writing - original draft: Kim TH; Writing - review & editing: Choi JL.

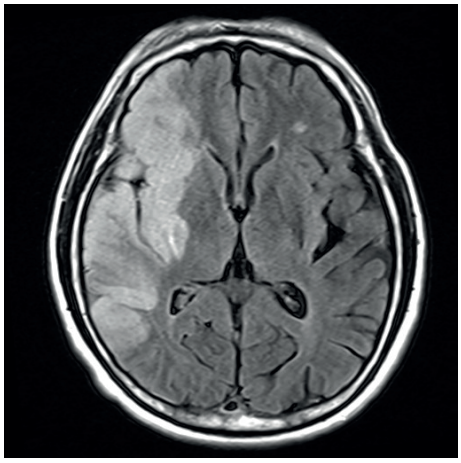

Fig. 1. Brain magnetic resonance imaging (T2 fluid-attenuated inversion recovery) reveals diffuse extensive acute infarction of the right middle cerebral artery territory (frontotemporoparietal and basal ganglia) with suspicious focal hemorrhagic transformation of the right basal ganglia.

Department of Rehabilitation Medicine for comprehensive rehabilitation, including treatment of language function impairment.

The patient was a high-school graduate who worked as a public official. He had no history of stroke or brain lesions. He was right-handed with no family history of left-handedness. There was no history of hypertension, diabetes mellitus, hyperlipidemia, or previous stroke; the patient only a history of iliac artery thrombectomy and vascular bypass 6 years prior. Brain MRI revealed a cerebral infarction in the right MCA territory and no brain lesions in the left hemisphere.

At the time of transfer, on neurological examination, the patient showed an alert mental status, a Mini-Mental State Examination score of 1/30, a yes or no question score of 5/10, right–left disorientation, and agraphia. Because of aphasia, an exact evaluation was impossible in the cerebral, cerebellar, and sensory function tests. In the manual muscle test, left hemiplegia with left-sided muscle strength of grades 0 to 1 was evaluated. The Hoffman sign was positive on the left side, and deep tendon reflexes were increased in the biceps and patellar tendons of the left side.

Brain single-photon emission computed tomography (SPECT) performed 3 weeks after the onset of infarction showed large perfusion defects in the right frontotemporoparietal lobes and focal perfusion defects in the right basal ganglia and right thalamus (**Fig. 2**).

The Line Bisection Test and the Letter Search Test were used to evaluate visuospatial neglect at the time of transfer. In the Line Bisection Test, patient was asked to place a mark through the center of 20 horizontal lines. After the test was complete, we analyzed the “mean value of deviation” using the formula: Deviation = (Measured Left Half − True Half)/True Half × 100. The test showed unilateral spatial neglect with a percent deviation of 6.6 [5]. And, in the Letter Search Test, the patient circled 9 out of 24 letters on the left side and 17 out of 22 letters on the right side, similarly showing unilateral visual neglect.

Because of the severity of his aphasia, further neurocognitive test was not performed at the time of transfer. The Korean Wechsler Adult Intelligence Scale-IV (K-WAIS-IV) conducted after six months of transfer showed 62 points of verbal intelligence quotient (VIQ), 80 points

https://doi.org/10.12786/bn.2023.16.e23

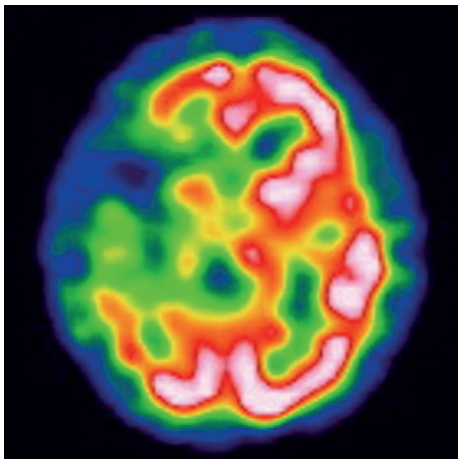

Fig. 2. Brain single-photon emission computed tomography reveals large perfusion defects in the right frontotemporoparietal lobes and focal perfusion defects in the right basal ganglia and right thalamus.

of performance intelligence quotient (PIQ), and 68 points for full scale intelligence quotient (FSIQ), showing a significant difference between VIQ and PIQ.

A Beery Visual-Motor Integration (VMI) Test conducted after six months of transfer to evaluate the visual-motor integration ability. In the VMI Test, the visual-motor integration ability was very low at the level of 6 years and 10 months, and it was difficult to accurately copy directional arrows and vertical Serial K-WAB tests show that language function recovery reaches a plateau within 6 months.diamond, and showed severe perseveration.

The Korean-Western Aphasia Battery (K-WAB) showed a 0/100 aphasia quotient (AQ) at the time of transfer. The results could not be obtained from all items because of the difficulty in understanding the sub-questions; therefore, it was considered global aphasia. It was impossible to evaluate dysarthria and measure consonant accuracy because of the asymmetry of the left and right lips and difficulty in producing a voice during rest. After the first evaluation, speech therapy was administered three times per week.

Even after the patient was discharged from our hospital, the continued to receive speech therapy three times a week for 6 years through outpatient clinic treatment, and follow-up K-WAB evaluations were performed. Based on the initial evaluation date, the K-WAB scores were 0.8/100 AQ 2 months later, 4.2/100 AQ 3 months later, 14.5/100 AQ 6 months later, 15.2/100 AQ 14 months later, 15.4/100 AQ 30 months later, and 15.7/100 AQ 55 months later (**Table 1**).

Table 1. The results of the Korean-Western Aphasia Battery on 2, 3, 6, 14, 30, and 55 months after the time of transfer

Category	Time of transfer	2 months	3 months	6 months	14 months	30 months	55 months
Expression	N/A	0%	5%	15%	15%	15%	15%
Comprehension	N/A	4%	10%	27.5%	28%	29%	33.5%
Repetition	N/A	0%	1%	8%	8%	6%	6%
Naming	N/A	0%	0%	7%	10%	12%	9%
Reading	N/A	N/A	23%	15%	15%	13%	10%
Writing	N/A	N/A	3%	17%	15%	11%	21.5%
Aphasia quotient	0%	0.8%	4.2%	14.5%	15.2%	15.4%	15.7%
Language quotient	N/A	N/A	8.3%	16.4%	16.4%	15.4%	17.5%

N/A, not available.

https://doi.org/10.12786/bn.2023.16.e23

DISCUSSION

To the best of our knowledge, this is the first case report in Korea to describe the long-term speech therapy and treatment progress of a patient with CA following right MCA infarction. According to the previously published literature, the longest duration of speech therapy for patients with CA in Korea is approximately 10 months [3]. Because the patient and his family had a good relationship and intimacy with the treatment team and good motivation for speech therapy, such therapy could last a long time.

CA following a right hemispheric lesion is rarely observed. The prevalence of CA in right-handed patients is reportedly between 0.38% and 3% of all aphasic syndromes [2]. The diagnostic criteria for vascular CA include aphasia, a lesion of vascular origin in the right unilateral hemisphere, strong right-handed preference with no family history of left-handedness, structural integrity of the left hemisphere, and absence of brain damage in childhood [4]. In this case report, the patient was right-handed and had no family history of left-handedness, and he had been constantly using his right hand from an early age. No previous brain lesions were observed. Brain MRI and SPECT revealed only cerebral infarction in the right MCA territory, and no lesions in the left cerebral hemisphere were observed. All other criteria were consistent with the diagnostic criteria of CA.

Alexander et al. hypothesized that CA occurs in two types: mirror image and anonymous. Mirror image CA indicates that the pattern of aphasia that results from right hemisphere lesions is a mirror of that that would have resulted if the lesion had been in the left hemisphere. Anomalous CA cannot be predicted accurately [6]. In the case of mirror image, all language functions are lateralized in the right brain, resulting in poor reading and writing skills and severe symptoms due to slow recovery. In addition, the function of the dominant parietal lobe is completely crossed, resulting in Gerstmann syndrome [7]. In contrast, in anomalous CA, symptoms of aphasia are mild and transient. Reading and writing skills are relatively less impaired than expression and compression skills, and the function of the dominant parietal lobe is preserved [3]. In this case report, despite long-term speech therapy for 6 years, recovery from aphasia was slow, and global aphasia persisted. Considering this, the patient was thought to have mirror image CA. In addition, considering that right–left disorientation and agraphia are associated with Gerstmann syndrome at onset, it can be estimated that the function of the dominant parietal lobe was partially crossed.

Patients with poststroke aphasia may be accompanied by cognitive deficits, and there may be a possible association between language and cognitive measurement. For efficient aphasia treatment and rehabilitation, detection and treatment of concurrent cognitive impairment in aphasia patients is helpful [8].

As a distinct concept from aphasia, cognitive-communication disorder (CCD) is a term used to describe communication difficulties caused by cognitive defects. CCD is mostly caused by right hemisphere stroke, traumatic and non-traumatic brain injury, Alzheimer's disease, and other dementia. The most commonly reported deficits in CCD patients following right hemisphere damage are impairments of attention, neglect, perception, learning, and memory. It also includes impairment of the communication components such as lexical-semantic, prosody, discourse, and pragmatics [9-11]. CCD caused by right cerebral hemisphere damage requires evaluation of cognitive and communication skills. Cognitive areas include attention, visual perception, memory, higher order cognition, execution,

https://doi.org/10.12786/bn.2023.16.e23

problem-solving and communication areas include comprehension and expression, reading and writing [11]. For formal evaluation of CCD, standardized tests are used, including the Ross Information Processing Assessment, the Cognitive Linguistic Quick Test, or the Scales of Cognitive Assessment Test Battery [9].

Visual-motor function is the integration between visual perception and motor skills, allowing people to draw or copy shapes, perform constructive tasks, and coordinate vision with the body movements. The parietal cortex is known to process and integrate somatosensory, visual and auditory information. Additionally, the cerebellum, brainstem, and frontal lobes are involved in visual-motor function. Tools to assess visual-motor integration abilities include the Bender Visual Motor Gestalt Test, Second Edition (BG-II), Beery-Buktenica Developmental Test of Visual Motor Integration (Beery VMI), and the Wide Range Assessment of Visual-Motor Abilities [12]. In this case, the Beery VMI Test was performed to evaluate the patient's visual-motor integration ability. As a result of the test, the visual-motor integration ability was very impaired, and the equivalent age was evaluated as 6 years and 10 months. The patient had difficulty copying the directional arrows and vertical diamond accurately and showed severe perseveration.

The executive function is centrally involved in processing visual and spoken language information, and is directly linked to functional communication in daily life. Impairment of executive function prevents patients from adopting new rules, and leads to adherence to old standards. And, it is difficult to switch the response and to suppress responses based on the previous standard. Therefore, the lack of executive function makes it difficult to do things like classify by category or topic [11]. In this case report, severe perseverance was observed, such as writing his name repeatedly and drawing figures repeatedly, which can be considered as a symptom of executive function deficit.

In patients with CA, it has been reported that typical non-dominant hemisphere symptoms such as left visuospatial neglect and visuoconstructural apraxia are common [13, 14]. According to a report by Castro-Caldas et al. [15], left visuospatial neglect was found in 82% of the 66 CA cases reviewed, which is twice the case for right hemisphere lesions and left hemisphere language dominance. In this case, the right hemisphere appeared to play a role in both language and visuospatial cognitive functions, aligning with the findings of Ha et al. [16].

For individuals experiencing both aphasia and language dysfunction, it is still unclear to identify whether reduced cognitive function scores result from reduced overall cognitive function or reduced language function. The least affected nonverbal test for aphasia patient is the block design, in which this visual construction task can be assessed relatively independently of language function [17]. In this case report, we performed a block design test that is part of the K-WAIS-IV. Five points were found in the test and the visual construction was partially impaired. And, the K-WAIS-IV showed a significant discrepancy between VIQ and PIQ, which is thought to be due to a decrease in language function, especially impaired comprehension and speech fluency. The patient has a mild intellectual impairment with 68 points of FSIQ. Therefore, it seems that there is a severe decline in language function that cannot be explained by mild cognitive deficiency, which suggests CA.

Comprehension tends to recover to a greater degree than expression in patient with aphasia [18]. And, spontaneous recovery of auditory comprehension continues beyond the first year post-stroke [19]. El Hachioui et al. [20] observed different rates of recovery in aphasia

https://doi.org/10.12786/bn.2023.16.e23

in a one-year follow-up study of 147 aphasia patients. Study assessment measures included verbal communication, receptive disturbance, and linguistic components such as semantics, phonology, and syntax. In the case of semantics and syntax, notable improvement ceased after a span of six weeks. Phonology and receptive language ability exhibited improvement for up to six months, while recovery of verbal communication reached a plateau at the six-month [20].

According to the quantitative analysis of aphasia by Mariën et al. [14], among the 33 CA patients studied, more than half (57.6%) exhibited distinct differences in the impairment of oral and written language. Notably, written language was more extensively affected than oral language in all cases of dissociated impairment. However, since there are no comparable studies in cases of uncrossed aphasia, it is impossible to say whether or not such disproportionately severe written language impairment is a "cardinal feature" of vascular CA [14].

Meanwhile, in individuals with CCD in right hemisphere brain damage, difficulties in narrative comprehension is commonly observed. This can be explained through the following hypotheses: Firstly, coarse coding deficits would reduce or delay the activation of meanings and features that are particularly distant from the dominant meaning or image of encountered words. Secondly, suppression deficits would slow the comprehension mechanism that dampens contextually irrelevant mental activation, regardless of considerations like semantic distance. It is possible that both coarse coding and suppression deficits coexist in patient with right hemisphere brain damage [21, 22].

Previous studies have shown that CCD in right hemisphere brain damage typically shows difficulties in narrative comprehension, whereas aphasia recovers better in comprehension than other areas. In our case report, patient had gradual improvements in comprehension areas over a speech therapy period of about 6 years. And, the last K-WAB showed difficulties in other areas such as repetition, naming. These facts suggest that the patient is more likely to be CA than a typical CCD.

The prognosis of aphasia caused by stroke in the left hemisphere is predicted by the initial severity of aphasia [23]. In this case, the patient showed a severe degree of global aphasia with a 0/100 AQ in the initial K-WAB. During the initial 6 months of speech therapy, the AQ improved to 14.5/100. Despite continuous speech therapy, the AQs at 14, 30, and 55 months were 15.2/100, 15.4/100 and 15.7/100, respectively, showing no significant change from the AQ of 14.5/100 at 6 months. The recovery of aphasia reached a stationary language function within 6 months and then formed a plateau (**Fig. 3**).

Language recovery from standard, uncrossed aphasia caused by stroke in the left hemisphere continues even after the initial 6–9 months after onset and well into the chronic stage. As recovery progresses into the chronic phase, establishing new pathways and developing compensatory mechanisms for lost function ultimately determine the degree of long-term recovery. Recovery in the subacute and chronic phases involves a complex interplay between the residual left and intact right hemisphere regions, which involves the reorganization of connections to promote improved language recovery over time [24]. In this case, the temporal course of language function in CA was similar to a previously reported language recovery pattern in standard uncrossed aphasia. The prevalence of crossed aphasia is extremely rare; therefore, research on the progress and recovery patterns of crossed aphasia according to speech therapy is limited. Further study on the progress and long-term functional recovery of patients with CA is needed.

https://doi.org/10.12786/bn.2023.16.e23

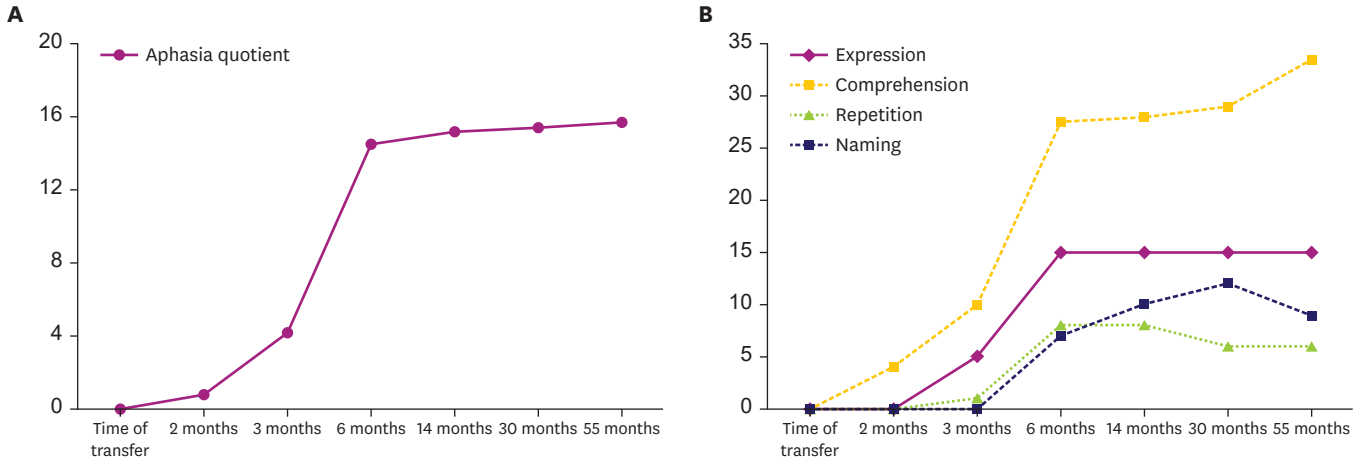

Fig. 3. The recovery of language function reached a stationary within 6 months. (A) Six-year change in the AQ of the Korean-Western Aphasia Battery. (B) Six-year change in the four subdomains of AQ. The x-axis denotes the time of follow-up evaluation, and the y-axes reflect the percentage of AQ (A) and subdomains (B). AQ, aphasia quotient.

Limitations to our study include the absence of detailed imaging and neuropsychological evaluations over subsequent periods. In addition, in evaluating cognitive deficits in patient with post-stroke aphasia, a close evaluation through a nonverbal cognitive evaluation tool was not performed. Cognitive impairment could often be obscured by language impairment. If it had gone through this process, it would have helped to understand the underlying cognitive function of CA patients' language problems. Finally, this report is a case report of one patient with CA and describes the long-term progress of speech therapy, and there may be limitations in generalizing the result.

In conclusion, this is the first case report in Korea to conduct 6 years of long-term speech therapy in a case of a patient with CA. The patient exhibited global aphasia caused by extensive acute infarction in the right MCA territory. Language function recovered in the first 6 months and then plateaued.

REFERENCES

1. Bramwell B. On "Crossed" aphasia and the factors which go to determine whether the "Leading" or "Driving" speech-centres shall be located in the left or in the right hemisphere of the brain, with notes of a case of "Crossed" aphasia (aphasia with right-sided hemiplegia) in a left-handed man. Lancet 1899;153:1473-1479.
CROSSREF
2. Kim WJ, Yang EJ, Paik NJ. Neural substrate responsible for crossed aphasia. J Korean Med Sci 2013;28:1529-1533.
PUBMED | CROSSREF
3. Kim JY, Chang WK, Kim WS. Crossed aphasia after intracranial hematoma in the right temporoparietal lobe: a case report. Commun Sci Disord 2021;26:874-883.
CROSSREF
4. Ishizaki M, Ueyama H, Nishida Y, Imamura S, Hirano T, Uchino M. Crossed aphasia following an infarction in the right corpus callosum. Clin Neurol Neurosurg 2012;114:161-165.
PUBMED | CROSSREF
5. Schenkenberg T, Bradford DC, Ajax ET. Line bisection and unilateral visual neglect in patients with neurologic impairment. Neurology 1980;30:509-517.
PUBMED | CROSSREF

https://doi.org/10.12786/bn.2023.16.e23

6. Alexander MP, Fischette MR, Fischer RS. Crossed aphasias can be mirror image or anomalous. Case reports, review and hypothesis. Brain 1989;112:953-973.
PUBMED | CROSSREF
7. Mastronardi L, Ferrante L, Maleci A, Puzzilli F, Lunardi P, Schettini G. Crossed aphasia. An update. Neurosurg Rev 1994;17:299-304.
PUBMED | CROSSREF
8. Lee B, Pyun SB. Characteristics of cognitive impairment in patients with post-stroke aphasia. Ann Rehabil Med 2014;38:759-765.
PUBMED | CROSSREF
9. Fager SK, Hakel M, Brady S, Barlow SM, Nordness A, Delgado A, et al. Adult neurogenic communication and swallowing disorders. In: Cifu DX, ed. Braddom's Physical Medicine & Rehabilitation. 5th ed. Philadelphia, PA: Elsevier; 2016: 53-69.
10. Ferré P, Joanette Y. Communication abilities following right hemisphere damage: prevalence, evaluation, and profiles. Perspect ASHA Spec Interest Groups 2016;1:106-115.
CROSSREF
11. Lee MS, Kim BS, Lim JS. Reliability and validity of the brief test of cognitive-communication disorders. Commun Sci Disord 2020;25:872-889.
CROSSREF
12. Stevens A, Bernier R. Visual-motor function. In: Volkmar FR, ed. Encyclopedia of Autism Spectrum Disorders. New York, NY: Springer New York; 2013: 3318-3319.
13. Mariën P, Engelborghs S, Vignolo LA, De Deyn PP. The many faces of crossed aphasia in dextrals: report of nine cases and review of the literature. Eur J Neurol 2001;8:643-658.
PUBMED | CROSSREF
14. Mariën P, Paghera B, De Deyn PP, Vignolo LA. Adult crossed aphasia in dextrals revisited. Cortex 2004;40:41-74.
PUBMED | CROSSREF
15. Castro-caldas A, Confraria A, Poppe P. Non-verbal disturbances in crossed aphasia. Aphasiology 1987;1:403-413.
CROSSREF
16. Ha JW, Pyun SB, Hwang YM, Sim H. Lateralization of cognitive functions in aphasia after right brain damage. Yonsei Med J 2012;53:486-494.
PUBMED | CROSSREF
17. Gonzalez R, Rojas M, Ardila A. Non-linguistic abilities in aphasia. J Neurolinguist 2020;56:100916.
CROSSREF
18. Sarno MT, Galgano J. Neurogenic disorders of speech and language. In: O'Sullivan SB, Schmitz TJ, Fulk G, eds. Physical Rehabilitation. 7th ed. Philadelphia, PA: F.A. Davis Company; 2019: 1224-1250.
19. Lwi SJ, Herron TJ, Curran BC, Ivanova MV, Schendel K, Dronkers NF, Baldo JV. Auditory comprehension deficits in post-stroke aphasia: neurologic and demographic correlates of outcome and recovery. Front Neurol 2021;12:680248.
PUBMED | CROSSREF
20. El Hachioui H, Lingsma HF, van de Sandt-Koenderman ME, Dippel DW, Koudstaal PJ, Visch-Brink EG. Recovery of aphasia after stroke: a 1-year follow-up study. J Neurol 2013;260:166-171.
PUBMED | CROSSREF
21. Tompkins CA, Fassbinder W, Lehman-Blake MT, Baumgaertner A, eds. The Nature and Implications of Right Hemisphere Language Disorders: Issues in Search of Answers. New York, NY: Psychology Press; 2002.
22. Tompkins CA. Rehabilitation for cognitive-communication disorders in right hemisphere brain damage. Arch Phys Med Rehabil 2012;93:S61-S69.
PUBMED | CROSSREF
23. Lazar RM, Minzer B, Antoniello D, Festa JR, Krakauer JW, Marshall RS. Improvement in aphasia scores after stroke is well predicted by initial severity. Stroke 2010;41:1485-1488.
PUBMED | CROSSREF
24. Kiran S, Meier EL, Johnson JP. Neuroplasticity in aphasia: a proposed framework of language recovery. J Speech Lang Hear Res 2019;62:3973-3985.
PUBMED | CROSSREF