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Long-term and short-term effects of childhood hemispherectomies on language abilities

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Background

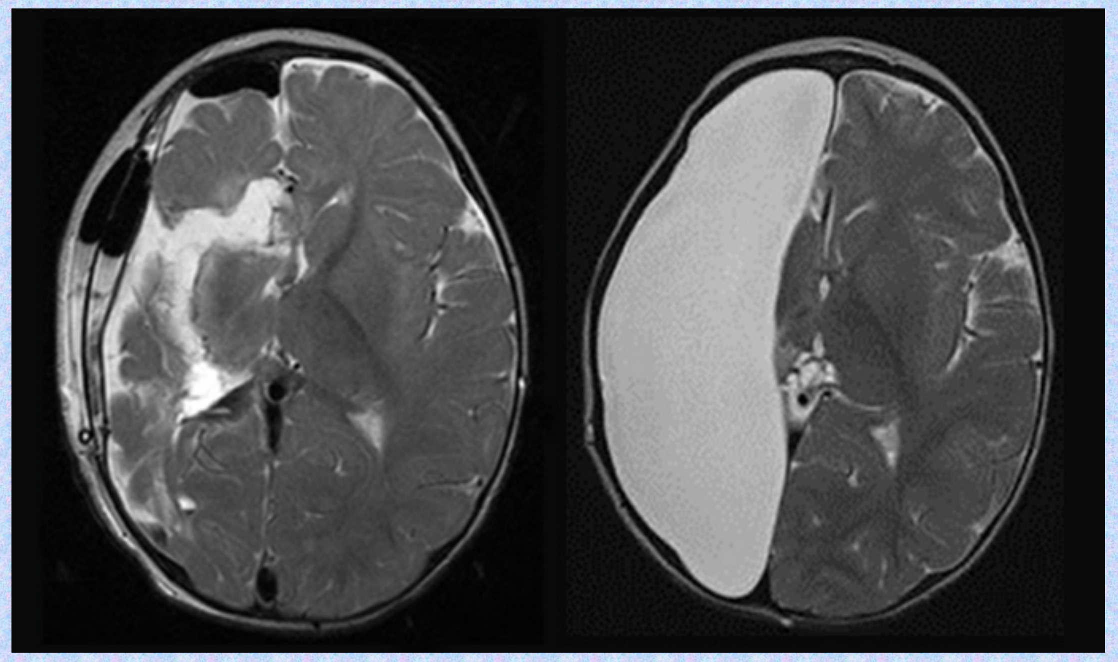
A cerebral hemispherectomy (X) is a surgical procedure in which either the left or right hemisphere of the brain is completely removed, and is undergone as a result of intractable seizures (de Bode, Chanturidze, Mathern, & Dubinsky, 2015). In most cases, cerebral X's are the final option for treating intractable seizures that are resistant to epilepsy medications (Chiricozzi et al., 2005). Most of the literature used for research purposes in this scoping review highlighted impacts on language following a left cerebral X, while the language abilities following right cerebral X's have been studied to a lesser extent (Chiricozzi et al., 2005).

Objectives

This scoping review seeks to identify literature that describes and researches the long-term and short-term linguistic factors, specifically morphology, phonology, syntax, semantics and pragmatics, that are associated with X's. The purpose of the review is to determine what categories of language improved after a X, and what categories declined. This review also sought to briefly identify the impact of age of onset, side of insult and the hemisphere removed on language outcomes following a X.

Methods

This scoping review was accomplished using a total of 13 articles that discussed the different language results following both left and right X's. The primary database used during the research process that yielded the highest number of results was Medline. Other databases used to identify different literature pieces included PubMed and Psychology & Behavioral Sciences Collection. The database ComDisDome was also used to find articles, but yielded older articles that were published between the years of 1997 and 2003.



MRI image of pre-X brain and post-X brain.
Retrieved from: Valappil, A., & Bingaman, W. E. (2019). The role of reoperation in postoperative seizure recurrence. Retrieved from https://consultqd.clevelandclinic.org/the-role-of-reoperation-in-postoperative-seizure-recurrence/

Short-Term Results (Right-X)

Reorganization processes typically recover spatial and linguistic abilities (Chiricozzi et al., 2005). Language disorders tend to be significantly less severe in comparison to left-X (Chiricozzi et al., 2005). More significant pragmatic impairments, delayed recall of words, and executive function difficulties tend to be present (Save-Pédebos et al., 2016). As a result of executive dysfunction, tasks such as planning, organizing, attention span, and prioritizing all prove to be difficult for patients following a right-X (Chiricozzi et al., 2005). No correlation was found between age at the time of surgery (Sx) and language abilities (Chiricozzi et al., 2005).

Short-Term Results (Left-X)

Language abilities remain consistent or improve (postoperative) post-op, with a few exceptions in which participant language scores decrease (Liégeois, Connelly, Baldeweg, &Vargha-Khadem, 2008). Later seizure onset, fewer seizures, and older age at surgery and Sx correlate with better language abilities post-X (de Bode, Smets, Mathern, & Dubinsky, 2015; Save-Pédebos et al., 2016). Pragmatic skill impairments may be present independent from receptive language abilities (Save-Pédebos et al., 2016).

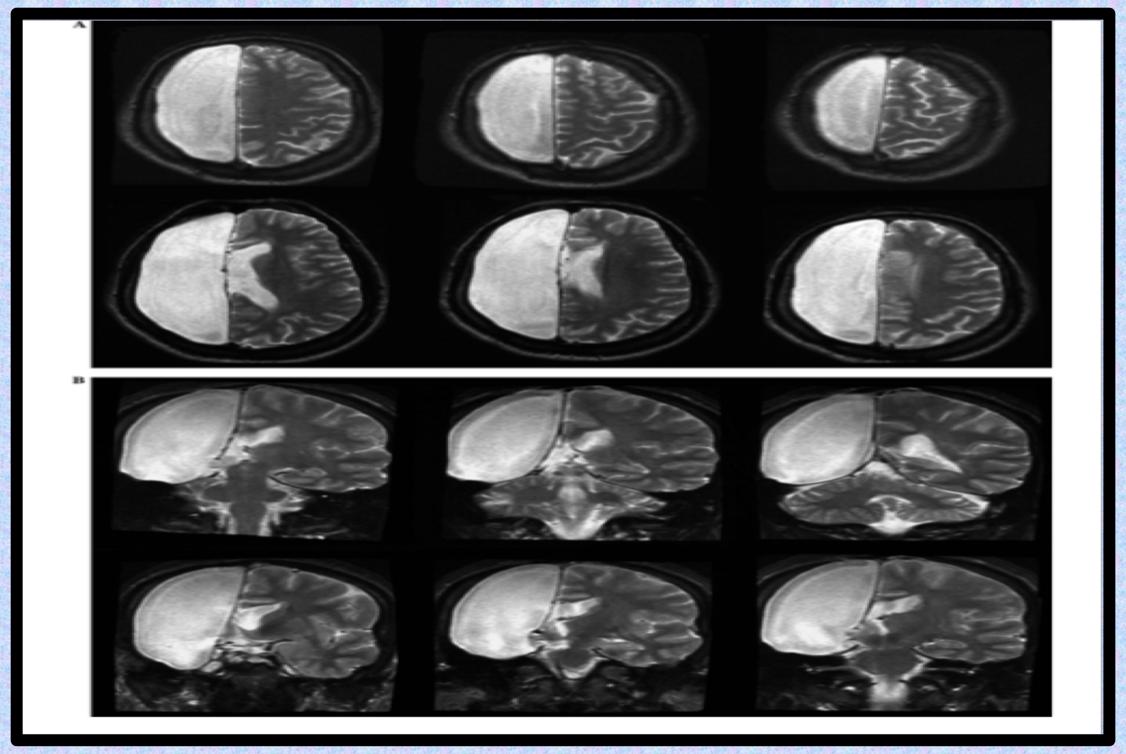
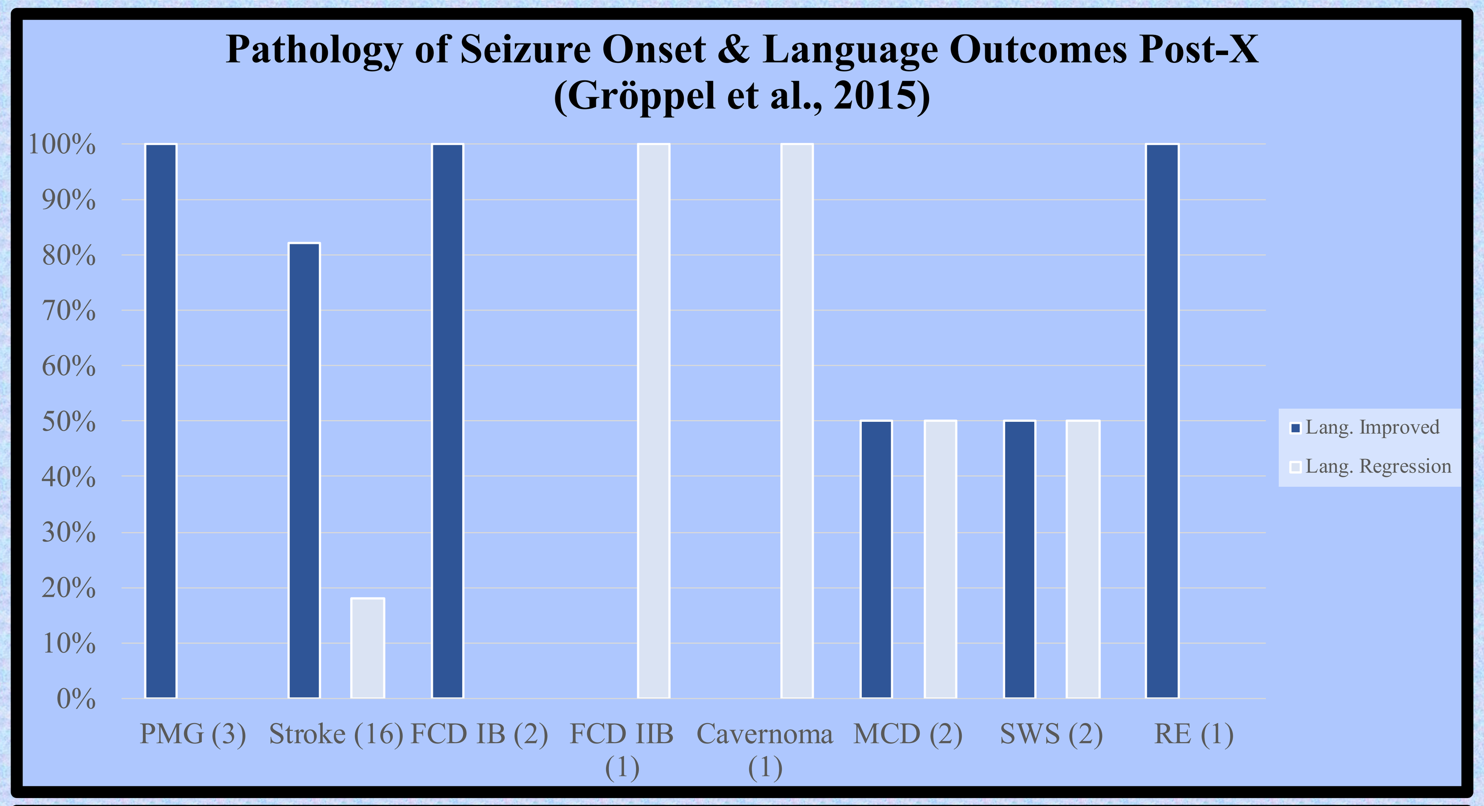


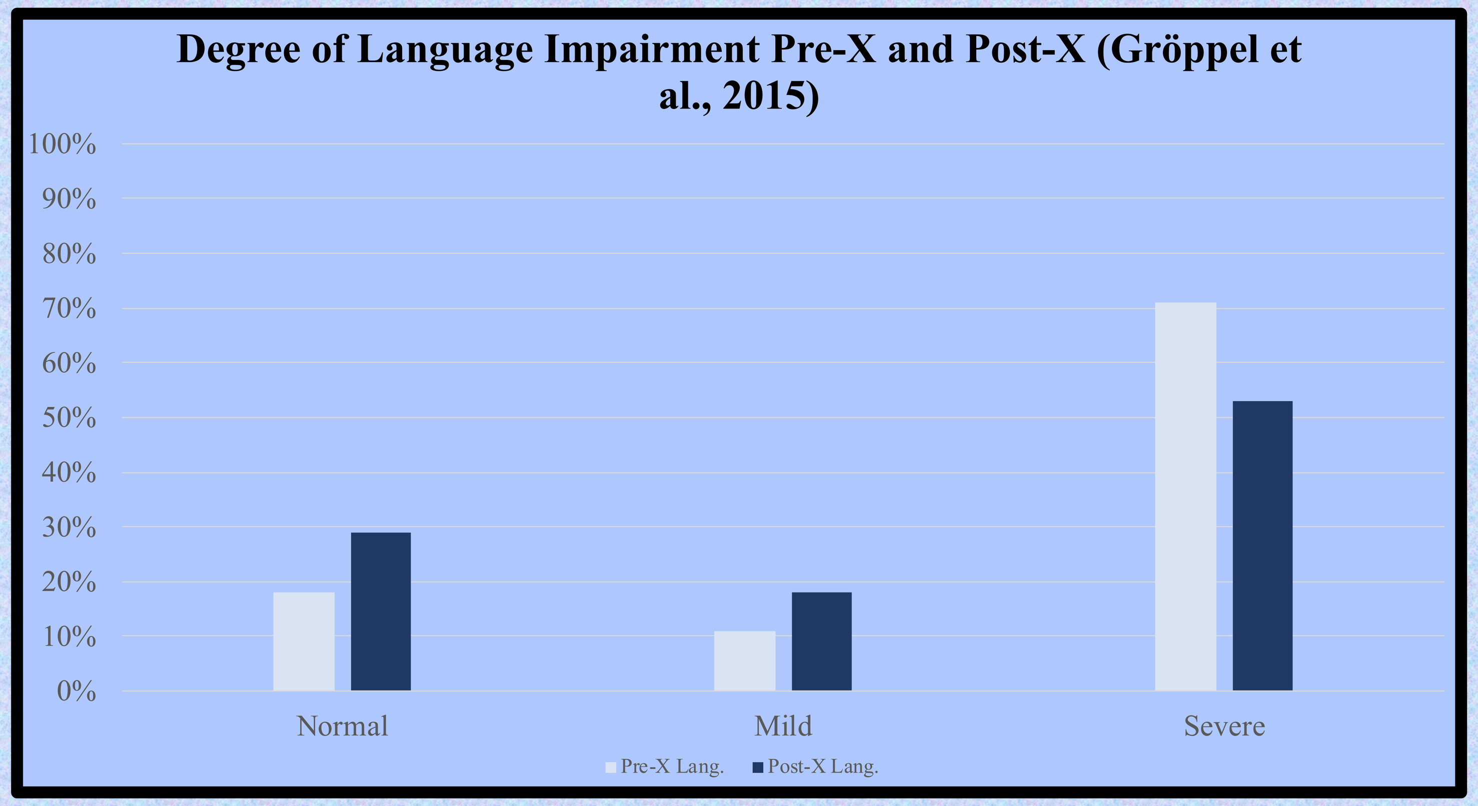
Fig. 1 MRI scan of adult who underwent a Left H in childhood: (A) axial view (B) coronal view
Retrieved from: Vanlancker-Sidtis, D. (2004). When only the right hemisphere is left: Studies in language and communication. *Brain and Language,* 91(2), 199-211. doi:10.1016/j.bandl.2004.02.006

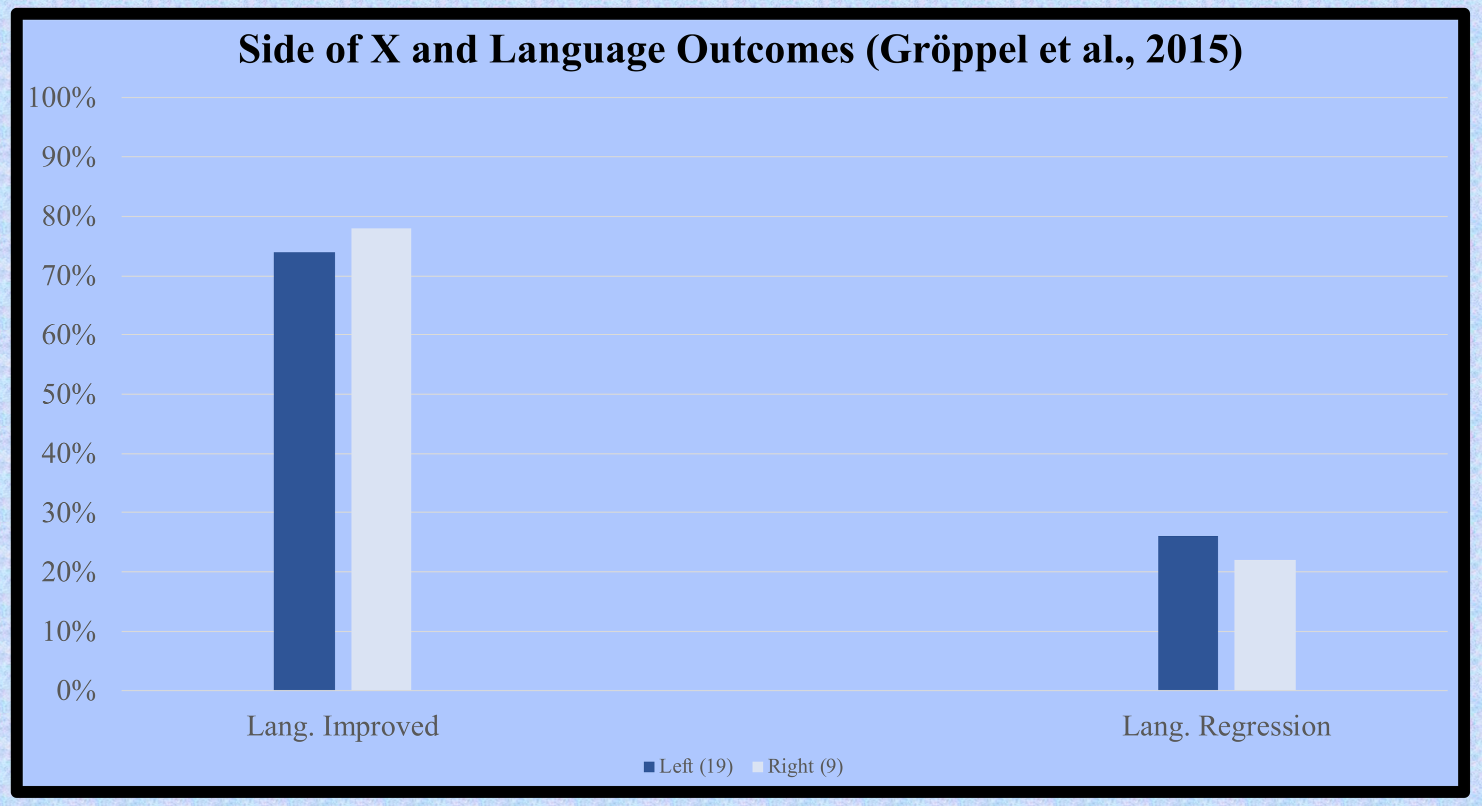
Long-Term Results

Minimal research has examined the long-term effects of right-X's. The vast majority of research has focused on the long-term outcomes of left-X's. Functional communication develops with deficits in phonological awareness, linguistic contrasts in prosody, and syntax (Vanlancker-Sidtis, 2004; Bulteau et al., 2015). Other aspects of language, including verbal comprehension, semantic fluency, and word repetition tend to develop within normal limits (Bulteau et al., 2015).



Acronym Key
PMG, polymicrogyria; FCD, focal cortical dysplasia; SWS, Sturge–Weber syndrome; RE, Rasmussen encephalitis; MCD, mild cortical dysplasia (Gröppel et al., 2015)
The numbers in parenthesis next to the listed pathology represents the overall number of patients with that pathology.





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Discussion

The long-term outcomes of cerebral X's are not yet well enough understood. More extensive research is necessary in order to better understand the linguistic factors that need to be addressed instantaneously following a X (Ivanova, Zaidel, Salamon, Bookheimer, Uddin, & de Bode, 2017). Because individual factors impact results of language abilities post-X, it is crucial to consider these factors when examining results of studies (Curtiss, de Bode, & Mathern, 2001). Although results were indicative of persistent difficulties with language, the overall improvement post-X for both left and right hemispheres following the termination of seizures is eminent (Save-Pédebos et al., 2016). Because such improvements typically take place, limited language therapy may be put in place following Sx. This is problematic due to the fact that long-term impacts have not been studied in depth, therefore it is crucial to advocate for patients to receive the appropriate therapy interventions soon after a X takes place.

Future Research

Since there is a limited amount of research on both long-term results of a X, and the language outcomes following a right X, future research is required to identify these outcomes. Limitations on research regarding post-X language services, requires future research and further investigation.
Suggestions for future research that could prove beneficial are as follows:

- Identify the prevalence of post-X language services that are provided to patients (Liégeois, Cross, Polkey, Harkness, & Vargha-Khadem, 2008).
- Further investigation into the language impairments associated with a right X (Vanlancker-Sidtis, 2004).
- Since language impairments are comorbid with childhood Xs, longitudinal studies into the impact of these language impairments throughout pediatric patients lives into adulthood may aid in future services provided (Bulteau et al., 2017).