Critical Review:
In children with Childhood Apraxia of Speech (CAS), does the use of augmentative and alternative communication (AAC) impede speech and language development?

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This study presents a critical review of research examining the effectiveness of implementing augmentative and alternative communication (AAC) on the speech and language development for children with Childhood Apraxia of Speech (CAS). This critical review includes the evaluation of one systematic review, one qualitative research methodology (in the form of an online focus group), four single-subject research designs, and one case study. The results of this review suggests that implementation of AAC facilitates natural speech production, functional language and communication development in children with Childhood Apraxia of Speech; however, as a result of the heterogeneous population, more comprehensive research on this topic is compulsory.

Introduction

The American Speech Language Hearing Association (ASHA) defines childhood apraxia of speech (CAS) as "a neurological childhood speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits" (ASHA, 2007). The core impairment involves an inconsistent pattern of speech sound errors, causing a reduction in overall speech intelligibility (ASHA, 2007).

Augmentative communication is referred to as any approach designed to support, enhance, or supplement the communication of individuals who are not independent communicators (ASHA, 2007). Alternative communication is referred to as any communication techniques other than natural speech (ASHA, 2007). Augmentative and alternative communication (AAC) provides children with extremely limited verbal expression competencies the ability to communicate more efficiently. AAC can also afford children with CAS an opportunity to independently and functionally interact with communication partners while significantly decreasing motor demands.

It is commonly believed that AAC implementation 'hinders' natural speech and language development, though according to Blischak, Lombardino and Dyson (2003), AAC enhances general communication effectiveness, speech production, and overall intelligibility for children with CAS. The purpose of AAC for children with CAS is to 'supplement' the child's limited verbal expression, providing an alternative method of communication, while facilitating communication interactions (Bornman, 2001). Although there has been no published evidence reporting decreased speech production subsequent to the implementation of AAC, there is a lack of sound empirical evidence highlighting the positive effects that AAC has on the speech and language development for children with CAS (Blischak *et al,* 2003).

Objectives

The primary objective of this paper is to critically analyze the existing literature relating to AAC intervention for children with CAS and evaluate the impact on natural speech and language development. The secondary objective is to provide recommendations for speech-language pathology practice, as well as to guide future research.

Methods

Search Strategy

Online databases such as: PubMed, Informa Healthcare, Google Scholar and ASHA publications were searched using the following terms: [(AAC) OR (augmentative communication) OR (dual paradigm approach to intervention) OR multi-modal intervention) AND (childhood apraxia of speech)]. Reference lists of previously searched articles were also used to obtain other related studies on the topic.

Selection Criteria

Papers selected for inclusion were required to describe the development of natural speech production and/or language development for children with CAS following implementation of an AAC intervention. Subjects described in each study were required to have a diagnosis of CAS and be receiving AAC intervention from a certified speech-language pathologist. No specifications on the type of AAC device, intervention, or the severity of the disorder were made.

Data Collection

Results of the literature search generated seven research articles consisting of one systematic review, one

qualitative research article, four single-subject research designs, and one case study.

Results

Systematic Reviews of the Literature

A systematic review critically examines and collects information from multiple research studies, and analyzes the existing literature on a specific topic. It presents an overview of primary studies on a subject, and is often used as a more efficient and cost effective way of generating answers to research questions.

Blischak, Lombardino & Dyson (2003) explored the use of speech-generating AAC devices in support of natural speech development in a systematic review, compiling research from researchers in the field. No information regarding inclusion criteria, exclusion criteria or critical analysis was included. The review provides a summary of current research highlighting how AAC intervention does not 'impede' on natural speech development. Findings suggest that AAC enhances overall communication effectiveness and natural speech production, while increasing intelligibility in children with CAS. AAC methods are being introduced earlier in intervention as a means of promoting communication, accessing language and literacy, and supporting natural speech production.

This study presents an equivocal argument concerning the effectiveness of AAC intervention on natural speech production in children with CAS. Individuals who use AAC, their families/caregivers, and other support personnel need more evidence to validate this intervention method.

Qualitative Research

Qualitative research is used to gain understanding and insight to underlying reasons, opinions, and motivations. It is inquiry based research helping to develop ideas or hypotheses for possible quantitative research on a particular subject. Given the heterogeneous nature of the CAS population, qualitative research provides valuable information presenting rich descriptions of the complex population.

Oommen & McCarthy (2015) conducted a qualitative research study through an online focus group recruited across a wide geographic region. The study included eight AHSA-certified speech-language pathologists implementing both AAC and natural speech services (dual-paradigm) simultaneously for children with CAS. This approach was described as a valuable 'intermediate' step in achieving a broader picture of communication intervention for children with CAS. Participants were asked to subjectively rate their level of experience working with this population. A total of six online focus group discussions were completed. These sessions involved open-ended discussion topics facilitated by a moderator, and were designed to elicit responses regarding clinical implications, benefits, and challenges of adopting a dual-paradigm approach to intervention while working with children with CAS. Methods for transcribing and coding of the qualitative data were described in detail, and appropriate and acceptable inter-rater reliability for the generation of thought units was reported.

The results highlighted eight themes: treatment philosophy, history, benefits, challenges in simultaneous treatment, key decision-making factors, therapy goals, strategies and activities, generalization through collaboration with team members, and recommendations for new clinicians.

Limitations of the study include insufficient detail about specific client characteristics and intervention details available in a focus group format. In addition, conducting focus groups aimed at understanding the macro-view of the CAS population impacts on the results, as it does not account for the heterogeneous nature of the population. Although the study recruited self-reported participants indicating significant experience with implementing the dual-paradigm approach to intervention for children with CAS, it was beyond the study's scope to ensure best-practice was established across the therapists.

Overall, this study presents somewhat suggestive evidence to support the effectiveness of AAC intervention in conjunction with natural speech therapy for children with CAS as a platform for intervention honoring multiple modalities in communication.

Single-Subject Design

A single-subject design involves participant(s) being exposed to control and treatment conditions. It is an appropriate method for exploring a hypothesis, though it presents limitations. Single-subject designs lack control groups that establish a baseline for the subjects to be compared to. As a result, the ability to draw generalizable conclusions from this type of study is limited. For this topic of research, single-subject designs are an appropriate research method providing a foundation for future research.

King, Hengst & DeThorne, (2013) conducted a multiple-probe, single-subject research design examining the effectiveness of an integrated multimodal intervention approach (IMI) for three young boys with severe speech sound disorders (SSD) including CAS. Methods for intervention included individual baseline sessions and IMI sessions for up to 14 weeks.

Procedures for the IMI and baseline sessions were described in detail and were conducted consistently across multiple environments (at school, home, or within a university clinic). Each treatment session included three activities: shared storybook reading, natural speech target drill, and structured play. Change was measured at regular intervals using valid constructs of child speech and language development, and attempts were made to control for additional factors that could have impacted results. Methods for transcribing and coding of the data and data analysis were described in detail, and sufficient inter-rater reliability was reported. Participant selection criteria were outlined in detail and acceptable fidelity checks were reported. The studies methodology was transparent and replicable despite the inherent weakness of a single-subject design. Results suggested that implementation of multi-modal intervention for all three boys led to an increase the amount of speech produced (quantity) and an increase in the production accuracy of target speech sounds (quality).

Participant criterion was unrepresentative of the CAS population at large as the three participants portrayed an ability to imitate prior to intervention and revealed varying comorbid disorders which might have contributed to the results post intervention. The authors addressed and answered the research question in the study providing a highly suggestive level of evidence to support the effectiveness of multi-modal intervention on the communicative abilities for children with CAS, suggesting that this approach could be effective.

Lüke (2014) investigated the impact of speech-generating devices (SGD) on the communication and language development of a 2;7-year-old boy with severe CAS through a single-subject (AB) design. The AB design was conducted over a one-year period including fifty treatment sessions that were analyzed and divided into three phases of intervention. Appropriate detail outlining each phase of intervention was provided. Outcomes were analyzed using language related measures including mean length of utterance (MLU) and lexical development (productive vocabulary), and speech related measures including intelligibility of speech productions and consistency of speech productions. Adequate inter-rater reliability was reported and data analysis allowed for adequate interpretation of statistical significance.

Results showed significant increases across speech and language competencies after a delay of eight to nine treatment sessions and implementation of SGD's. Data regarding intelligibility, consistency of speech productions and lexical grammatical development were collected following completion of all phases, revealing percentages highlighting the effectiveness of the intervention program.

The AB design with extension through continued therapy in three follow-up sessions reflects the best controlled design for this particular case, offering evidence to suggest that AAC (specifically SGD) enhances the communicative abilities for children with CAS. Standardized measures of language and cognitive function were completed prior to the study, and administration of these measures post study could have strengthened the overall results. The study does not account for the impact of external factors on the facilitation of communication development throughout treatment, presenting as a significant limitation.

Lüke (2014) provided highly suggestive evidence suggesting that the use of SGDs can lead to improvements in several areas of language for children with CAS, offering an alternative mode of communication.

Culp (1989) examined the effects of the Partners in Augmentative Communication Training program (PACT) for an 8-year-old girl with CAS in a short-term single-subject design. Consistency of testing procedures through the use of controlled instructions and materials for pre and post-test procedures is reported. The intervention program and methods for collecting data are described in sufficient detail allowing for future replication. Data regarding message frequency ratio (i.e., child messages/partner messages), child intelligibility ratio (i.e., successful child messages/total child messages), and the frequency of communicative functions (i.e., socializing, answering yes/no questions, answering other questions, offering information, requesting action, object, or assistance, requesting information, expressing feelings and attitudes, teases or pretends) were collected pre and post-test (Culp, 1989). The subject's communication interaction skills show some improvement in the results of the study. Data revealed an increase in intelligibility, communication interactions and a more evenly distributed conversational control between the subject and her mother comparing the pre and post test results, highlighting the effectiveness of the intervention program. Informal observations and structured measurements reveal that the subject's involvement in the PACT program was communicatively productive.

Limitations of the study include restricted detail on the timing of AAC implementation for participants and a lack of external validity and generalizability as a result of the small sample size presented in the study. Results of the study are specific to the PACT training program and also presented an absence of follow-up after the

two-month post-test, presenting questionable generalizability and maintenance of communication skills post intervention.

As a result, this study provides somewhat suggestive evidence that multi-modal communication intervention positively impacts communicative interactions for children with CAS, though the results are extremely program specific and must be viewed with caution.

Bornman, Alant, & Meiring (2001) also conducted a single-subject design study examining the effectiveness of using a digital voice output device (Macaw) on the facilitation of language development of a 6;5-year-old boy with CAS. Detailed descriptions regarding the subject's medical history and previous speech-language pathology services were provided. Baseline measurements were described in detail with a schedule for training and evaluation clearly outlined. Post training measurements and post-withdrawal evaluations were appropriately presented, and methods for transcribing the data and data analysis were described in detail. Adequate inter-rater reliability was reported, though, measures of intra-rater reliability were not taken or reported. Results indicate that the Macaw speech generating AAC device facilitated communication and language development for the subject in terms of knowledge, comprehension, application, synthesis, and evaluation. The presented data supported the research indicating that digital voice output devices effectively facilitated higher cognitive language functioning for the subject with CAS, while reducing motor pressures involved in natural speech production.

A more advanced level of response was elicited as a result of the increased cognitive complexity of questions presented towards the subject in intervention. Responses were easier communicated through AAC resulting in an increase in AAC communication and a decrease in verbal productions. Although the goal of treatment was to encourage natural speech production, stagnating towards a lower cognitive level can result in delays in language development. Access to higher level functioning was particularly important as the subject was entering into formal schooling. The small sample size presents as another study limitation, restricting external validity and generalizability of the research. The subject's mother's high level of education should be noted as a limitation, as it can limit generalizability of parent training to the larger population.

This study provided somewhat suggestive evidence on the effectiveness of AAC on speech and language development, highlighting positive outcomes particularly in the facilitation of higher level communication development. Although the results present a decrease in verbal productions, the researchers provide significant explanations for these results, highlighting that access to voice output systems should be considered a tool to facilitate speech and language development for children with CAS.

Case Studies

Case studies are limited in their external validity, though they provide comprehensive qualitative research outlining descriptive information about the subjects included in the study, the disorder, and management. Case studies provide a sufficient amount of information on a topic, guiding future research in the area being studied.

Cumley & Swanson (1999) used a case study format to analyze the impact that using a multi-modal AAC communication system had for three individuals with CAS ranging in age (from preschool age to junior high). A combination of low and high technology aids were incorporated in the children's intervention plans. The studies methodology describes a baseline of therapy records for each child prior to the study. The participant's communication systems were described in appropriate detail allowing for replication in future research. Results reveal that multimodal AAC aids successfully supplemented natural speech production, providing greater communicative opportunities for facilitating language development, academic achievement, and communicative competence while enhancing success and flexibility for repairing communication breakdowns.

The three case studies presented in the research provide evidence to support that a multi-modal AAC intervention approach enhances successful communicative opportunities for children with CAS. However, the small sample size limits generalization to the CAS population at large. Limited information regarding inclusion criterion for the participants was outlined, and as a result, the influence of specific confounding variables was not accounted for.

Overall, this study presents reasonably suggestive evidence highlighting the effectiveness of a multi-modal AAC intervention approach, and the role that is has on facilitation and development of natural speech and language for children with CAS.

General Discussion/Recommendations

How AAC implementation influences speech and language development for children with CAS is an important clinical question for speech-language pathologists. There is presently limited evidence on the subject. The available research provides limited

generalizability to the population at large. The current review described studies revealing evidence to suggest that AAC intervention facilitates and enhances natural speech, communication and language development for children with CAS supporting the question at hand. Though the research does not explicitly indicate the most effective AAC device or the most successful intervention approach for children with CAS, there are a wide range of AAC aids and treatment approaches described, all of which indicate positive outcomes for speech and language development. Collectively, the studies provide evidence to support the benefits of AAC use for children with CAS, highlighting the positive impact of implementing AAC intervention in conjunction with natural speech therapy.

The studies explored in this critical review are in the form of case study reviews, systematic reviews, qualitative research and single subject research designs without controls presenting methodological limitations. Limited conclusions and generalizations can be drawn as a result of small sample sizes, and a lack of longitudinal data was collected to support or deny the maintenance and generalizations following AAC intervention for children with CAS. Limited internal validity was presented in the single-subject (AB) research designs. While an ABA design would establish causality more effectively, this was not possible for this population as it is unethical to withdraw the AAC device implemented in treatment, and the only option for withdrawal would be the support from a speech-language pathologist.

The participant selection criteria presented limitations due to population variability. Selection criteria was impacted by the differences in severity of CAS, comorbidities, and other external factors that contributed to treatment. As a result, despite the suggestive and equivocal evidence offered in the research, conclusions beyond the subjects described in the studies must be drawn with caution.

Similar results across the studies highlighted that speech, language, and communication development are effectively facilitated by AAC intervention for children with CAS. Further single-subject studies, or if possible, small group studies with control groups should be conducted to confirm the significance of AAC use on speech and language development for the heterogeneous CAS population. Practitioners are urged to continue collecting data highlighting the quality and quantity of natural speech production and language development for children with CAS in pre and post-test intervention measures when AAC aids are implemented. While there is existing evidence highlighting the positive impact that using AAC can have on speech, language and communication development for children with CAS, continued research on both the behavioural and neurological evidence supporting AAC use for children with CAS will guide future clinical practice, better informing families of the benefits of AAC use for their children (Blischak *et al,* 2003).

Future Research Considerations

Additional research on the topic to address the limitations presented in the studies reviewed will deliver more reliable results. In future studies, the following recommendations should be considered to strengthen the level of evidence:

I. Research designs with a control group to control for external factors and the use of larger sample sizes to enhance validity and generalizability.
II. More detailed research highlighting the most effective types/forms of AAC for children with CAS.
III. Comparison of outcome measures for different intervention techniques for children with CAS (i.e. dual-paradigm approach vs. just AAC, or just traditional speech therapy targeting natural speech production).
IV. More detailed research highlighting the influence that severity of CAS has on the success of AAC intervention.
V. Inclusion of thorough follow up measures post treatment to account for skill maintenance.

Clinical Implications

There is some knowledge about the effectiveness of AAC use on the speech and language development for children with CAS, offering a predominantly suggestive level of evidence. The evidence provided by the seven articles critically reviewed afford clinicians with a valuable foundation to direct future research and enhance clinical practice, though the results from the studies must be interpreted with caution. No evidence to support the commonly believed notion that AAC intervention impedes speech and language development for children with CAS was reported in the research. By and large, results suggest that AAC facilitates and enhances the speech and language development for children with CAS.

Future research will reinforce the current evidence while presenting more reliable conclusions to suggest that AAC improves the functional communication skills of children with CAS, facilitating significant gains in speech and language development.

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