Clinical Article

Language Progress with an Auditory-Verbal Approach for Young Children with Hearing Loss

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Abstract

This discusses a Rhoades & Chisolm investigation that focuses on language growth rates of 40 heterogeneous children, hearing aid or cochlear implant users, who received intensive auditory-verbal intervention over a period of one to four years. A global language assessment instrument was administered to the children annually following initiation of auditory verbal services. Group performances in receptive and expressive language for each year indicate a reasonable overall expected growth rate should be 100% for each year of intervention, even for older preschool children. Language age-equivalency scores were subjected to ANCOVA; significant improvements in equivalent language ages were found as a function of each year in therapy. Performance of the 14 'graduates' show that the gap between chronological age and language age was closed; these children attained linguistic competency at levels commensurate with normally hearing peers. Several incidental findings are of interest and some hypothetical viewpoints are considered for discussion. *Int Pediatr. 2001;16(1).*

Key words: S. pneumoniae, septic arthritis, antibiotics, clindamycin, antibiotic resistance, and penicillin resistance.

Introduction

Languagelessness,[1] not deafness, is the primary handicap attributed to typical children with severe and profound prelingual hearing loss. Therefore, enabling these children to attain linguistic competency should be our highest priority.

A review of the literature indicates that there is ongoing disagreement as to which communication option is most effective for enabling children to effectively learn the English language.[2-4] Moreover, recent literature notes that children with hearing loss, in spite of current hearing aid technology and cochlear implants, continue to typically demonstrate overall language delays.[5]

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The auditory-verbal approach is a communication option that emphasizes the development of listening skills for children who are hard of hearing and deaf.[6-8] Beyond case histories, there is a dearth of published data as to the effectiveness of the auditory-verbal approach[9,10] in developing linguistic competency for children with hearing loss.

The purpose of this presentation is to present global language growth data as an outgrowth of a longitudinal study implementing the auditory-verbal approach with children who have hearing loss.[11] The following concerns were addressed in this investigation: Does the auditory-verbal approach present as a viable communication option for the average child with severe to profound deafness? What constitutes adequate global language progress in the habilitation for children with hearing loss within an early intervention auditory-verbal program? Can the gap between chronological age and language age narrow for these children?

Participants

Participants in this investigation received intervention services from a private non-for-profit auditory-verbal center-based program for families with children who are hard of hearing and deaf. The intervention program was a family-focused, child-driven, objective-guided, cognitively-oriented[12] auditory comprehension-based model developed with a functional language 'road map'.[13] Service providers were auditory-verbal therapists implementing at least one or two hours of weekly therapy sessions for children accompanied by their parents. The only criterion for inclusion in this program was the existence of at least bilateral moderate hearing impairment and participation in weekly intervention services for a minimum of one year.

A total of 40 children participated in this investigation. Etiology of deafness was determined for 57% of these children, with 28% having a known history of hearing loss. Three children were prelingual meningitic, four syndromic, and five who tested positive for CMV at birth or during infancy.

Demographic data indicate their mean age of identification was 17 months (range 0-37 months), with their mean age of initial amplification at 20 months (range 3-40 months). Their mean aided better ear pure tone average was 53 dB HL (range 15-120 dB HL), and their average age at which auditory-verbal intervention services were initiated was 44 months (range 4-100 months). Within this group of 40 children, 33% used only hearing aids (HA group), 38% used only cochlear implants (CI group), and 30% made the transition from hearing aids to cochlear implants (HA-CI group) during the course of this investigation.

For the HA group, the mean age of initial amplification was 24 months, with an unaided better ear pure tone average of 75 dB HL and an aided better ear pure-tone average of 30 dB HL.

For the CI group, the mean age of initial amplification was 18 months and all of them reportedly had either severe-profound or profound unaided hearing loss with a mean aided better ear pure-tone average of 78 dB HL. The average age of initial implant stimulation for the CI group was 43 months.

For the HA-CI group, the mean age of initial amplification was 17 months, again all of them reportedly had severe-profound or profound unaided hearing loss. For this group, a mean aided better ear pure-tone average of 48 dB HL was attained with the mean age of initial implant stimulation at 46 months.

For both the CI and HA-CI groups, all 27 implanted children employed speech processing strategies if either CIS or SPEAK. Fifteen children used the N-22, nine the Clarion, and two the N-24 devices; however, because three N-22 devices failed, one more Clarion and one more N-24 device were added during the study.

Parents of these children represented a well-educated group, with more than three-quarters holding at least a bachelor degree and the remaining 23% with a high school degree. English was not the primary language for 28% of the families, but all made the transition to speaking only English by the end of the first year of intervention. Multiple dysfunctions were readily apparent in 13% of the families with another 25% exhibiting poor management of child behaviors throughout most of the study.

For the group as a whole, 45% were female. Only 43% began intervention with the auditory-verbal approach, the rest either started with total communication (22%) or another oral option (35%). The average age of initial auditory-verbal services for the group was 44 months (range 4-100 months). All of these children were enrolled in a preschool or elementary school classroom for normally hearing children.

Six of the children were diagnosed as below average in cognitive abilities and two were diagnosed as ADHD with bipolar disorder. Sensorimotor dysfunctions were diagnosed for 78% and oral-motor dysfunctions were diagnosed for 50% of the children. These dysfunctions were diagnosed and treated by appropriately qualified professionals (ie licensed occupational therapists and Speech-Language pathologists) independent of the auditory-verbal program's staff.

During this four-year period of data collection, children began receiving treatment at different times. All 40 children received at least one year of auditory-verbal therapy, with 32 having received two, 14 three, and 6 four years of intervention services. Fourteen of these children were children continued with auditory-verbal therapy beyond the period of this study. Table 1 shows a breakdown of reasons as to why the remaining 12 children were lost to attrition; however, these 12 were included in the study because at least one year of data on language progress was obtained for each of them.

Of particular interest are the differences between the subgroup of 14 'graduates' and the group of 40 children. While the 'graduates' were similar in most ways to the group as a whole, more then half (57%) were hearing aid users throughout the course of this study, 29% were cochlear implantees from the outset, and 14% made the transition from hearing aids to cochlear implants during the course of this investigation. Moreover, the mean aided pure tone averages of these 'graduates' was 38 dB HL, compared to the mean pure tone averages of 58 dB HL for all 40 children. The 'graduates' clearly demonstrated more consistent hearing throughout the study than did the group as a whole. Furthermore, only one of these graduated children had a total communication background and only one presented with readily apparent family issues that had the potential to negatively impact on treatment.

Referrals for sensory integration and oral-motor therapy were made for 43% and 36%, respectively, of the 14 children as compared to 78% and 50% of the group as a whole. Otherwise, the two groups were similar in average ages of identification, etiology, amplification, initiation of auditory-verbal intervention, and parental education.

In summary, children in this study were not pre-selected, having ultimately represented a heterogeneous group in both biological and experiential differences. This is an important issue given that the populations of all children who are hard-of-hearing and deaf do not form a demographically homogeneous group. It is essential to have children with diverse backgrounds, including those who may be cognitively delayed, in a study to demonstrate the effectiveness of the auditory-verbal approach.

Table 1 - Program Status for 40 Children

Yrs AV Interv*	1	2	3	4	%
Relocated	0	2	1	0	7.50%
Referred	2	3	0	0	12.50%
Graduated	5	5	2	2	35.00%
Quit	1	3	0	0	10.00%
Continued	4	3	5	2	35.00%

*Unduplicated Count

Test Instruments and Data Collection

Three global language measures were employed to assess the language progress of children in this study: Sequenced Inventory of Communication Development-Revised[14] for children from birth to four years of age, Preschool Language Scale-3[15] for children from a one to seven year level, and the oral component of Oral Written Language Scale[16] from three to twenty-one years of age.

Each of these test instruments measures receptive and expressive language skills independently, yielding separate age-equivalent scores for comprehension and production of the English language. Each of these assessment tools is standardized on a wide sample of normally hearing children. All tests were administered in naturally spoken English, so that the children could employ any or all of their listening and/or speech-reading strategies. Because one purpose of this study is to determine the rate of spoken language progress over time, sign language was not employed during test administration. All administration and scoring procedures stated in test manuals were adhered to rather strictly. When the ceiling on one assessment measure was reached, a different global language test was administered. Therefore, the data collected in this study are the receptive and expressive language age-equivalent scores, regardless of assessment instrument used.

Upon entry into the auditory-verbal intervention program, each child was administered one of three global language measures. Subsequent to this baseline, progress was monitored on an annual basis, between 9- and 15-month intervals depending on such factors as scheduling and attrition. Data were collected for a minimum of one year and for as long as four years of treatment.

Results

Receptive and expressive language age equivalency data was obtained from 40 children as a function of number of years of intervention treatment, as illustrated in Figures 1 and 2, respectively. In each figure, there were five test intervals: baseline and at completion of each year of auditory-verbal therapy. The solid continuous line in each figure represents expected language growth rate for normally hearing children. It can be seen that actual growth rates for children in this study were similar to the expected growth rate. In particular, the slopes of actual growth rates were better than the expected growth rate for years one, two, and four.

Language age-equivalency scores, as a function of year in therapy, were subjected to repeated measures analyses of covariance, with the actual number of months between test time as the covariate. The main effect of time was significant in each; that is, significant improvements in equivalent language ages were found as a function of each year in therapy. Interestingly, the growth in receptive language was quite a bit higher than the growth in expressive language during the first

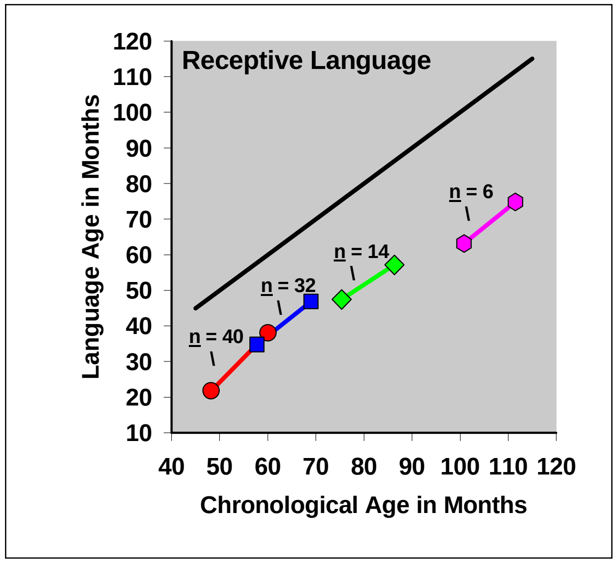

Fig. 1 - Equivalent receptive language ages for children receiving one, two, three, and four years of auditory-verbal therapy. Solid line indicates expected language growth for normally hearing children.

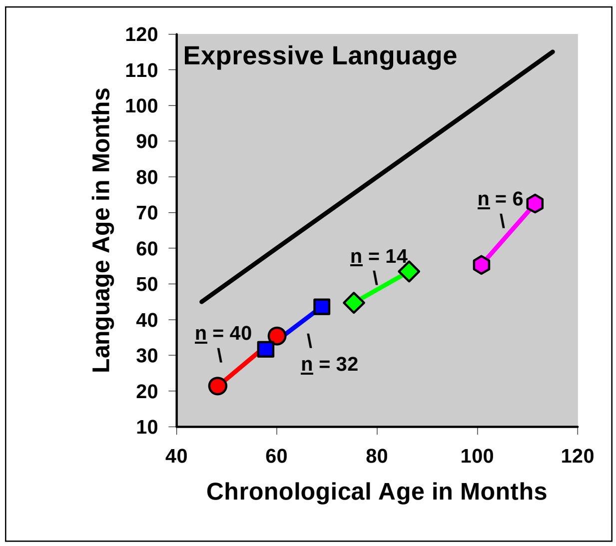

Fig. 2 - Equivalent expressive language ages for children receiving one, two, three, and four years of auditory-verbal therapy. Solid line indicates expected language growth for normally hearing children.

year of intervention, whereas expressive language age was considerably higher than the mean growth in receptive language age during the fourth year of intervention. During the second and third years of therapy, the average receptive language growth and average expressive language growth were similar.

Figure 3, showing the rates of receptive and expressive language growth as a function of year in auditory-verbal therapy, indicates mean growth rates greater than 100% for intervention years one, two, and four and just under 100% for year three. Average receptive language growth rates of

139%, 124%, 86% and 128% follow the same general pattern of average expressive language growth rates of 121%, 115%, 94%, and 163% over the four-year period of time.

To examine whether language growth can occur so that language ages become equivalent to chronological ages, data from the 14 'graduates' were examined. It can be seen in Figure 4 that average baseline language age-equivalency score was significantly less than the children's average chronological age. However, at the time of graduation, there was little difference between these measures; this finding reflects greater changes in receptive and expressive language over time than in chronological age. The significant improvements in language ages over time were confirmed by subjecting the data to a repeated measure analysis of variance. This demonstrates that the gap between language age and chronological age was narrowed for 14 children who participated in an auditory-verbal intervention program.

Discussion

The first observation of note relates to etiology. Although a review of the children's files for etiologic considerations indicated that 42% were unknown, the incidence of genetic deafness was still found to be twice as high as that reported in a study by Billings & Kenna.[17] This can be explained by the fact that many of the children in this study were tested for connexin-26. The incidence of hereditary deafness will likely increase as will our expanding knowledge from ongoing genetic research.

A second observation has to do with average age of children upon initial diagnosis of hearing loss. The state in which this investigation was conducted had not yet mandated universal newborn hearing screening. The average identification age of 17 months in this study supports earlier study findings.[18,19] It is expected that age of identification will soon become considerably lowered wherever neonatal hearing testing is implemented.

Still another observation is that of the parental educational level for the children in this study, where approximately three-fourths of the parents were college-educated. Recent evidence suggests that parental educational level, a stable variable, is a highly significant influence on language growth performance for normally hearing children.[20] It is reasonable to hypothesize that the factor of parental education should likewise have some influence the language growth of children with hearing loss and account, at least partially, for some of that variability.

Finally, it is reported in the literature that approximately 30% to 42% of deaf children have an additional disability[21,22] that synergistically impacts on the effects of auditory deprivation. Reported additional disabilities are typically based on educational and/or medical diagnoses, and do not often consider factors such as sensory integration status or oral-motor function.

The importance of considering sensorimotor status is highlighted through research data suggesting that maturation of motor systems plays an active and significant role in the early development of language,[23-25] as well as through evidence suggesting that motor planning, sequencing, rhythmicity, and timing are relevant to auditory attentional and language problems.[26] At the very least, neurological and psychological theories[27-29] are confirming what auditory-verbal therapists, Speech-Language pathologists, and occupational and physical therapists have intuitively known for years - that other developmental systems, including the vestibular system as well as rhythmic motor planning, sequencing, and temporal patterning, play a central role in language development. This prevalent perception of language develop-

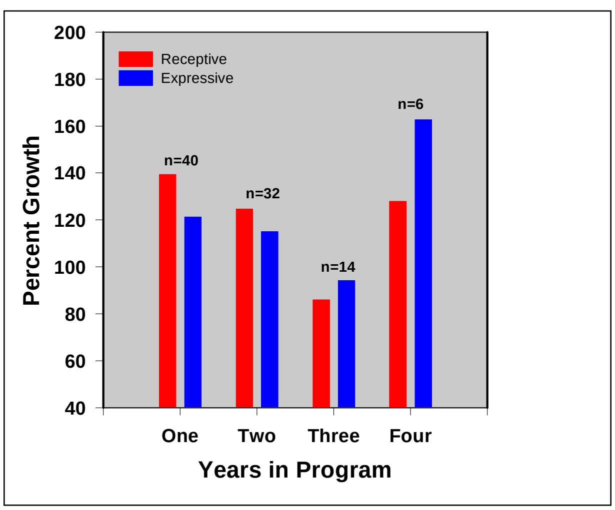

Fig. 3 - Rates of receptive and expressive language growth as a function of year of treatment.

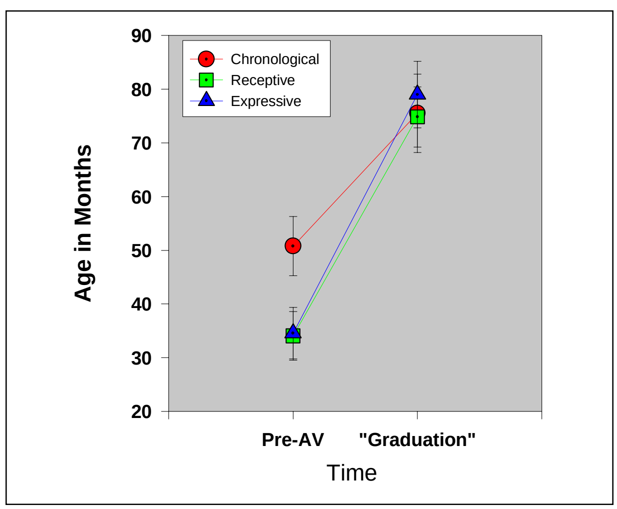

Fig. 4 - Change in chronological age and receptive and expressive language ages for the NQ= Öê~Çì~íÉëK

ment should be considered along with the likelihood that many children with hearing impairments have traumatized vestibular systems.

In this study, 78% of the children were diagnosed as having some degree of sensory integrative dysfunction. Additionally, 50% of the children were diagnosed with some degree of oral-motor dysfunction. Whether the children would have most benefited from sensory integration or other motoric or rhythmic therapies is beyond the scope of this discussion. The important point, however, is the recognition that most children in this study were in need of a therapy involving rhythmic sensorimotor and/or oral-motor activities.

Beyond the above issues, several important results emerged from this study. First, findings confirm the auditory-verbal approach to be a highly viable communication option for children, both hard of hearing and deaf, regardless of prosthetic device usage. In spite of wide individual variability in test performance, receptive and expressive language growth typically continued rather steadily over a four year period of auditory-verbal intervention. The average rates of language learning indicate that, at least for three of four years of intervention, these children have a faster than normal rate of language acquisition. The pattern of growth for receptive language (139, 124, 86, 128%) was greatest during year one and for expressive language (121, 115, 94, 163%) during year four.

While there is no clear explanation for the finding that mean receptive and expressive language growth rates for children in year three of auditory-verbal therapy were less than 100%, it is possible this reflects a growth plateau, typical phenomena due to internalization of great structural alterations in the child's linguistic knowledge in the learning process for normally hearing children.[30]

Variability of language growth rates across the years is not surprising, given the common knowledge among psycholinguistics that there is enormous variability present at the start of language production. Likewise, it is often observed that if a normally hearing child comprehends a substantive body of language, he or she is likely to be within the normal range of language production, even if a bit later in expression.

More importantly, it appears that the auditory-verbal children were learning language similarly to normally hearing children, who typically do not begin to express themselves using compound and complex sentences until the fourth year of life. This has been described as 'the flowering period of language' when "the child discovers the transcendent power of words and the excitement of using them to control or to enrich all types of situation."[31] Regardless, an overall expected language growth rate of approximately 100% during each year is considered realistic and a somewhat accurate benchmark for effective language intervention with typical children who are deaf or hard-of-hearing.

There were 14 children who 'graduated' from the program during the course of the study, becoming listening and naturally speaking children who entered the mainstream of regular education. Like the group as a whole, the mean age of these graduates was 44 months when they started auditory-verbal therapy. Regardless of prosthetic device used, they demonstrated acquisition of linguistic competency in English and showed that language delays resulting from auditory deprivation can be made up completely. Interestingly, each of these 'graduates' attained receptive and expressive language age equivalency scores of at least four years, a milestone since the basic syntactic structure at this age level appears similar to that of adult grammar.

The major finding is that auditory-verbal intervention appears to be a highly effective programming option, even for children beyond the first three years of life. While auditory deprivation research findings indicate the plasticity of the developing auditory system is most pronounced during the first years of life,[32] children in this study largely represented an older preschool age population when auditory-verbal therapy was started. The late average age of just over three and a half years at time of auditory-verbal intervention initiation did not preclude them from either attaining better than 100% rates of language growth or from attaining language ages equivalent to chronological ages. These findings appear to substantiate physiological findings[33] in that auditory maturational processes occur well after auditory stimulation is introduced beyond the first three years of life.

The Auditory-Verbal Approach

The auditory-verbal approach is more than a compilation of techniques and strategies and certainly more than a 'method' of communication. The auditory-verbal approach involves parents and therapist working together as partners, in conjunction with other professionals, to implement a dynamic interactional perspective in order to meet each child's individual needs. Such a viewpoint embraces both medical and behavioral models in terms of treating the language handicap.

The medical model attacks the cause of the handicap that is lanaguagelessness. An effectively managed hearing prosthetic system, whether it be cochlear implant or hearing aid, as well as assertive listening therapy are intended to work in conjunction with one another toward minimizing the effects of deafness. Sensory integration therapy is designed to minimize sensory dysfunction so that the child can better attend to and process the incoming auditory stimuli. Oral motor therapy is designed to maximize the child's ability to vocalize the sounds that are being heard and processed. Concomitantly, techniques and strategies designed to reinforce each child's unique sensory integration and oral-motor needs are integrated within listening therapy activities. The medical model, then, incorporates the disciplines of physiology, anatomy, and neurology.

The behavioral model treats the language handicap by describing, analyzing, and comparing each child's language progress with normal language behavior. Parent participation is of necessity in order to implement consistently effective management of child behaviors as well as consistently effective language learning principles. Moreover, assessments are necessary for monitoring progress and developing therapy objectives according to developmental schedules of language development. Psychology and linguistics, therefore, are disciplines incorporated within the behavioral model.

The Charge

It is of paramount importance for practitioners to ensure that all children with hearing loss develop communicative competency. When children are not developing language at a rate commensurate with normally hearing children of the same language age, then administrators, therapists, and teachers should seriously consider, review and implement other language intervention strategies. Research findings with normally hearing children suggest that some children benefit more from certain language teaching strategies than others,[34] so such findings should also apply to children who are hard of hearing or deaf. While researchers are re-examining issues in current education and offering recommendations for improving practice,[35] ongoing accountability and objective monitoring in language progress should be mandated.[36] Routine administration of standardized assessment instruments should enable practitioners to best serve each child's language needs.[37] Despite the many interacting factors impacting on delivery of intervention services, each and every child with hearing loss, regardless of age, deserves the full opportunity of learning to hear and speak the prevailing language.

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