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A pilot study of telepractice delivery for teaching listening and spoken language to children with hearing loss

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Summary

Telemedicine ("telepractice") allows improved access to specialised early intervention services such as Auditory-Verbal Therapy (AVT) for children with hearing loss. We investigated the effectiveness of a tele-AVT programme (eAVT) in the spoken language development of a group of young children with hearing loss. In a retrospective study we compared the language outcomes of children with bilateral hearing loss receiving eAVT with a control group who received therapy In Person. Seven children in each group (mean age 2.4 years) were matched on pre-amplification hearing level for the better hearing ear, age at optimal amplification and enrolment in the AVT programme. The eAVT sessions were conducted via Skype. Results on the Preschool Language Scale-4 were compared at 2 years post optimal amplification. There were no significant differences in language scores between the two groups. Language scores for the children in the eAVT group were within the normal range for children with normal hearing. The results suggest that early intervention AVT via telepractice may be as effective as delivery In Person for children with hearing loss.

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Introduction

Auditory-Verbal Therapy (AVT) is an early intervention approach for teaching listening and spoken language to children with hearing loss. The therapy requires active participation by parents who are taught to develop their child's spoken language through listening. AVT is effective in promoting listening and spoken language when delivered with the parent, child and therapist in the same room. Children with hearing loss educated using AVT have developed skills in speech,[1–4] language,[1–6] self-esteem[4], reading and mathematics[4] in line with hearing peers. However, conventional in person AVT services may not be accessible for children with hearing loss living in rural and remote areas. Thus children in rural and remote areas are at risk of further isolation in their community as they struggle to achieve their full potential in education, vocation and society. Telemedicine (also known as telepractice in this context) may improve access to specialised treatment like AVT for children with hearing loss and a number of programmes are emerging.[7–12] However, no research studies have validated this mode of service delivery.

In Queensland, the Hear and Say organization provides both in person AVT and a telepractice programme (eAVT). The eAVT programme has previously been investigated for user satisfaction.[13] The present study aimed to investigate the effectiveness of the eAVT programme in promoting the spoken language development of young children with hearing loss.

Methods

The pilot study was a retrospective comparison of language outcomes in a group of young children in the eAVT programme and a matched group of children who received the conventional in-person service. All children had been enrolled in AVT from 2005. The study was approved by the appropriate ethics committees.

Participants were selected for inclusion in the study from the Hear and Say database. The parent or guardian of each participant provided written consent for their child's data to be accessed for the investigation. Children were included in the study if they had been identified with a bilateral hearing loss at birth via universal newborn hearing screening, optimally amplified with hearing aids and/or cochlear implants, and enrolled in AVT

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before 12 months of age. These criteria were consistent with hearing loss management in Queensland and followed best practice guidelines.[14]

eAVT group

Of the 16 children in the eAVT programme eligible for the study, two were excluded due to additional disabilities and seven were too young for their 2 years post-amplification assessment. The eAVT group consisted of 7 children (3 female, 4 male) meeting the inclusion criteria. Their families lived an average of 681 km from Brisbane (range 290-2048). Participant demographic details are summarised in Table 1. The aetiology of the hearing loss was either unknown (n = 5), or atresia and/or microtia (n = 2). The severity of hearing loss ranged from mild-moderate to severe-profound. Four children had been fitted with bilateral hearing aids and two children with a bone conduction hearing aid (mean age at fitting 0.15 years). One child had bilateral cochlear implants (age at hearing aid fitting 0.25 years, age at first implant 0.83 years, age at second implant 1.08 years). The mean age at enrolment in AVT was 6 months (range 3–10). The children in the eAVT group were scheduled to receive 40 fortnightly AVT sessions (between the therapist, parent and child) in the 2 year period from enrolment in the programme to their 2 years post optimal amplification assessment point. The mean number of sessions attended was 32 (range 29–34), with the main reasons for non-attendance being child, family or therapist illness.

In person group

Each child in the In person group was matched to a child in the eAVT group based on age at fitting of optimal amplification (within 2 months) and severity of pre-amplification hearing loss (within 10 dB for the unaided 4 frequency pure tone average, PTA, and individually, on the pure tone thresholds at 0.5, 1, 2 and 4 kHz for the better hearing ear). Participants were also matched for age at enrolment in AVT (within 5 months). We also attempted to match participants on gender, although this could not be achieved for participant E1. As it was not possible to find matches based on aetiology of hearing loss, the children were matched on type of amplification (i.e. hearing aids or cochlear implants).

The participants in the In person group consisted of 7 children (4 female, 3 male; see Table 1) with the aetiology of the hearing loss either unknown (n = 5), Connexin 26 genetic origin (n = 1) or intrauterine cytomegalovirus (n = 1). The severity of hearing loss ranged from mild-moderate to profound. Six children had been fitted with bilateral hearing aids (mean age at fitting 0.18 years), and one participant with bilateral cochlear implants (age at fitting of hearing aids 0.08 years, age at first implant 0.83 years, age at second implant 1.0 year). The mean age at enrolment in AVT was 0.36 years (range 1–9). The children in the In person group were scheduled to receive 40 fortnightly AVT sessions (between the therapist, parent and child) in the 2 year period from enrolment to the 2 years assessment point. The mean number of sessions attended was 33 (range 30–39 sessions), with the main reasons for non-attendance also being child, family or therapist illness.

Mann-Whitney U tests were performed to determine if there were any differences between the two groups on the matching criteria.

AVT programme

Both the eAVT and In person programmes conformed to the 10 AVT principles[15] and with recommended practice.[14,16,17] In each one-hour session, parents taught their child specific skills through listening under the guidance of an Auditory-Verbal Therapist. Individual goals for each child were planned on a six-monthly basis, incorporating listening, early communication, language, speech, cognition, social interaction (communicative competence), and fine and gross motor milestones expected for children with normal hearing of the same age. Goals from each category were integrated into the session and taught through themed activities. All In person sessions were conducted at one of the Hear and Say centres in Queensland.

eAVT programme

The eAVT programme was conducted in the same manner as In Person, with the following alterations: (1) sessions were delivered between the therapist in Brisbane and the parent and child at home via PC-based videoconferencing; (2) planning sessions involving the therapist and parent were held via videoconferencing on the alternate weeks to enable planning and discussion of the next session's goals and carryover into the child's everyday environment; (3) materials to support lessons and carryover were mailed out to families to ensure that all families had access to the appropriate learning activities; (4) every six months therapist visits were made to the child's home and educational setting (if applicable) for in person contact, lessons, standardised speech and language assessment and monitoring of progress; and (5) every six months family visits were made to the Brisbane centre for in person contact, lessons, assessment and attendance of Auditory-Verbal Playgroup and parent education. Therapy sessions were delivered using Skype.

Assessment of outcomes

All children were assessed in person at 6-month intervals following optimal amplification, using informal and formal speech and language assessments to track spoken language progress. Results from the the Preschool Language Scale- 4 (PLS-4)[18] obtained at approximately 2 years post optimal amplification were used to provide a measure of Auditory Comprehension, Expressive Communication and Total Language ability of the

Table 1. Characteristics of children in the two groups.

Participant	Sex	Aetiology of hearing loss	Severity of hearing loss in left ear	Severity of hearing loss in right ear	PTA for better ear (dB HL)	Amplification	Age at optimal amplification (years)	Age at enrolment (years)
eAVT group (n = 7)								
E1	Male	Unknown	Mild-moderate	Moderate	52.50	Bilateral HA	0.08	0.25
E2	Male	Unknown	Moderate	Moderate-moderately severe	53.75	Bilateral HA	0.08	0.58
E3	Female	Unilateral microtia	Severe-profound	Moderate-severe	61.25	Unilateral bone conduction HA	0.25	0.42
E4	Male	Bilateral microtia and atresia	Mild-moderate	Mild-moderate	48.75	Unilateral bone conduction HA	0.25	0.58
E5	Male	Unknown	Moderate-severe	Moderate-severe	62.50	Bilateral HA	0.08	0.83
E6	Female	Unknown	Severe-profound	Severe-profound	95.00	Bilateral CI	0.83	0.58
E7	Female	Unknown	Moderate	Moderate-moderately severe	57.50	Bilateral HA	0.17	0.25
Mean (SD)					61.61 (15.51)		0.25 (0.27)	0.50 (0.21)
In Person group (n = 7)								
F1	Female	Unknown	Mild-moderate	Mild-moderate	55.00	Bilateral HA	0.17	0.08
F2	Male	Unknown	Moderate	Moderate	52.50	Bilateral HA	0.17	0.17
F3	Female	Connexin 26	Moderate	Severe	55.00	Bilateral HA	0.17	0.42
F4	Male	Intrauterine CMV	Moderate	Mild-moderate	46.25	Bilateral HA	0.25	0.75
F5	Male	Unknown	Moderate	Moderate-severe	53.75	Bilateral HA	0.17	0.42
F6	Female	Unknown	Profound	Profound	100.00	Bilateral CI	0.67	0.42
F7	Female	Unknown	Moderate	Moderate	51.25	Bilateral HA	0.17	0.25
Mean (SD)					59.12 (18.28)		0.25 (0.19)	0.36 (0.22)

Note: AVT = Auditory-Verbal Therapy; CMV = cytomegalovirus; PTA = Pure tone average, calculated on the average of unaided pure tone thresholds at 0.5, 1, 2 and 4 kHz; dB HL = decibels hearing level; HA = hearing aid; CI = cochlear implant.

Table 2. Assessment results at approximately 2 years post amplification and comparison between the two groups on the Preschool-Language Scale, Fourth Edition.

		Total language		Auditory comprehension		Expressive communication	
Participant	Age (years)	Standard score	Age equivalent (years)	Standard score	Age equivalent (years)	Standard score	Age equivalent (years)
eAVT group (n = 7)							
E1	2.42	75	1.67	77	1.67	87a	1.92
E2	2.42	88[a]	1.92	87[a]	1.92	91[a]	2.00
E3	2.67	86[a]	2.25	85[a]	2.25	89[a]	2.33
E4	2.33	92[a]	2.00	94[a]	2.17	91[a]	2.00
E5	2.08	82	1.75	78	1.75	89[a]	1.92
E6	2.83	87[a]	2.33	81	2.25	95[a]	2.58
E7	2.42	119[a]	2.83	120[a]	3.08	114[a]	3.75
Mean (SD)	2.45 (0.24)	89.86[a] (13.92)	2.11 (0.40)	88.86[a] (14.92)	2.15 (0.42)	93.7[1] (9.29)	2.36 (0.66)
In Person group (n = 7)							
F1	2.75	97[a]	2.58	98[a]	2.67	97[a]	2.67
F2	2.25	123[a]	2.83	117[a]	2.75	123[a]	3.08
F3	2.75	103[a]	2.67	98[a]	2.67	107[a]	2.75
F4	2.25	91[a]	1.83	75	1.50	109[a]	2.25
F5	2.08	74	1.50	67	1.25	85[a]	1.83
F6	2.67	120[a]	3.58	121[a]	3.92	114[a]	3.25
F7	2.25	112[a]	2.50	109[a]	2.42	112[a]	2.67
Mean (SD)	2.43 (0.28)	102.86[a] (17.28)	2.5 (0.68)	97.86[a] (20.4)	2.45 (0.88)	106.7[1] (12.37)	2.64 (0.48)
Comparison between groups							
Mann-Whitney U statistic		24.5		18.0		11.5	
P-value		>0.999		0.406		0.096	

Note: AVT = Auditory-Verbal Therapy

[a] Standard score within or above the normal range (SS ⩾ 85).

children in the two groups. This time was chosen as it was the latest consistent point at which all children had been assessed at the time of data extraction.

For the comparison of the two groups, Mann-Whitney U tests were calculated on the Auditory Comprehension, Expressive Communication, and Total Language standard scores (SS) of the PLS-4.

Results

There were no significant differences between the two groups on the matching criteria of pre-amplification PTA for the better hearing ear ($P = 0.41$), age at optimal amplification ($P = 0.59$) and age at enrolment in AVT ($P = 0.192$). There were no significant differences between groups for age at assessment ($P = 0.65$) or age at fitting of hearing aids ($P = 0.89$).

In the eAVT group, the mean scores for Total Language (89.86), Auditory Comprehension (88.86) and Expressive Communication (93.71) were within the normal range for hearing peers (SS between 85 and 115), see Table 2. The mean language age for each measure (2.11 years for Total Language; 2.15 years for Auditory Comprehension; 2.36 years for Expressive Communication) was also similar to the mean chronological age equivalent of the children (2.45 years) at the time of assessment. Two children did not score within the normal range for both Total Language and Auditory Comprehension and an additional child for Auditory Comprehension only.

In the In person group, the mean scores were within the average range for all measures of Total Language (102.86), Auditory Comprehension (97.86) and Expressive Communication (106.71). The mean language age for each measure (2.50 years for Total Language; 2.45 years for Auditory Comprehension; 2.64 years for Expressive Communication) was also in line with the mean chronological age equivalent of the children (mean 2.43 years). One child achieved a score below the average range for both Total Language and Auditory Comprehension, and an additional child for Auditory Comprehension only.

The Mann-Whitney U tests revealed no significant differences between the eAVT and In person groups for Total Language, Auditory Comprehension or Expressive Communication SS, see Table 2.

Discussion

Children who received eAVT achieved similar language outcomes at the two-year assessment to a matched

group of children who received conventional In person AVT. There were no significant differences in outcomes between the two groups. These findings provide some support for telepractice as a method for AVT delivery to children with hearing loss. Larger scale studies are needed to confirm the findings.

Another encouraging study finding was that the eAVT group performed within the normal range on all standard language variables on the PLS-4 (Auditory Comprehension, Expressive Communication and Total Language), indicating that their language development was similar to that of hearing peers. This attainment is also in line with in person reports of AVT outcomes for children with hearing loss[2–6] and further supports the use of telepractice for the delivery of AVT.

While both groups achieved age-appropriate outcomes, five children in the study demonstrated lower than average individual assessment results on one or more measures. Clinical assessment reports suggested that middle ear issues affected the outcomes of three children in the study (E1, E5, F4) who demonstrated standard scores below the average range on Total Language and/or Auditory Comprehension (Table 2). These children were under medical review for recurrent middle ear problems in the previous 12 months and scheduled for insertion of grommets. Furthermore, as the middle ear problems were reported for children in both groups, it is likely that performance was independent of the treatment environment. Middle ear problems occur universally in a paediatric population and require consideration when working in an early intervention setting in general. For the other two children (E6, F5), there may have been other clinical factors to consider such as a language delay or disorder.

Overall, the positive findings in the study complement the high parent and therapist satisfaction previously reported with the eAVT programme.[13] In particular, the present study provides objective data that mirrors the high parent rating (92%) in the satisfaction study of being confident or very confident that the therapist can gain an adequate understanding of the child's development and progress with eAVT. Further studies where family and therapist satisfaction is measured alongside the child's assessment outcomes are required.

The pilot nature of the study, including the small sample size, self-selection of participants due to geographical location and assessment results at a single time, make it difficult to generalise the findings. The environment in which the services were delivered (in the clinic for the In person group and at home for the eAVT group) is also a weakness of the study. Further research in the form of large scale, randomised studies is needed in order to validate the delivery of AVT via telepractice.

In conclusion, the results of the present study provide preliminary support for the use of telepractice in teaching listening and spoken language to children with hearing loss.

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