

INFLUENCES ON THE EARLY SPEECH OF CHILDREN WITH A CLEFT PALATE: HEARING LOSS AND INTERVENTION

Kino Jansonius-Schultheiss* and Anne E. Baker†

*Academic Medical Center

†Institute of General Linguistics/IFOTT
University of Amsterdam, The Netherlands

ABSTRACT

If baby's with a Cleft Palate are treated early, in the first year of life, for problems in *speech perception* (oral as well as auditory), a more normal speech and language production at the age of two years is found than in case such treatment is not given at all or late, in the second year of life. In our study 30 two-year old children with a Cleft Palate were examined. Some children with a complete cleft were treated from birth on with an oral plate. Some children with a Cleft Palate got middle ear drains in their first year or later. Children with both forms of intervention and early treatment in the first year of life showed normal values on lexical and phonological tests. These children were able to build up normal mental representations of speech and language at a time when the brain is sensitive for sensory input, integration and cognitive linguistic organization.

1. INTRODUCTION

In the literature hardly any information is available about the early speech development in Cleft Palate children. This group has articulatory as well as language problems, especially in phonology and lexical expression and these are not related to interaction or cognition. However, nearly all children have conductive hearing loss due to otitis media with effusion (OME), chronic in nature, as well as their speech motor disability. With respect to speech and language, the group is heterogeneous and the question is whether this can be explained by inadequate hearing and/or by the quality of intervention with respect to speech perception. In section 2 the research questions concerning our Ph.D. study [5] in early speech and language proficiency in two-year old Cleft Palate children are presented and the methodology of the study is explained. In section 3 the results are given. Finally, in section 4 implications of the results are discussed.

2. RESEARCH QUESTIONS AND METHODOLOGY

2.1 Research questions

Children with a Cleft Palate are well known for their speech motor disability, but they are also prone to conductive hearing loss, existing already at an early age in nature (McWilliams e.a., 1990). *In which specific variables of speech and language do two-year old children born with a complete Cleft or Cleft-Palate-Only differ with normal born peers? For those variables on which they differ, are these differences due to their speech motor disability or is it an effect of their impaired auditory speech perception?*

Children with a complete Cleft or a Cleft Palate are treated in Cleft Palate Treatment Teams. In the Netherlands, as elsewhere, the medical treatment is not uniform. Some children with a complete cleft get an orthopedic oral plate in order to guide the growth of the upper jaw pre-surgically, adapted directly after birth and worn night and day until their palatal surgery or until their second birthday. Some children are treated with middle ear drains to ventilate the middle ear and to diminish glue ears and hearing loss. These drains can be placed in the first year of life, or later on. In general, all children get a surgical procedure to close their lip and palate; some children get their surgery early, in the first year of life, while others get it later. Children, treated with an oral plate get a partial palatal closure. The last research question is: *In what way does this medical treatment, i.e. by an oral plate, middle ear drains and palatal surgery, contribute to speech and language proficiency at the age of two years and which role plays the timing or duration of these treatment procedures?* In this paper the results of the oral plate and treatment with middle ear drains on speech and language variables are discussed. The results of the timing of palatal surgery are not presented here, but in [5].

2.2 Methodology

2.2.1 Subjects

Thirty children, born with a complete Cleft and/or a Cleft-Palate-Only, were selected from four Cleft Palate Treatment Teams working independently in the Western part of the Netherlands (see Table 1). In children's case histories no other negative factors were present apart from the Cleft. Their parents were Dutch speaking, with a normal education and without medical or social problems. They came from different social economic classes: high (academic level), middle or low (skilled laboratory work). Some children were studied monthly, from birth on until their second birthday, while others had only a once-only examination at the age of two years.

Table 1. Distribution of subjects over groups: type of the Cleft (UCLP: unilateral cleft lip and palate; BCLP: bilateral cleft lip and palate; CPO: cleft palate only; Ref.: reference group)

	UCLP	BCLP	CPO	Ref	Total
Boys	8	6	6	4	24
Girls	4	3	3	5	15
Total	12	9	9	9	39

Along with this group, a reference group of originally ten, later nine, normally born children were selected. One child, studied

longitudinally, showed severe speech and language problems at the age of two years and was removed from the reference group.

2.2.2 Intelligence and hearing acuity

At two years of age all children received a psychological examination (Bayley test, Mental Scales, Dutch edition) as well as a hearing test at the audiological department of an academic hospital.

As found earlier in the Dutch literature [4] Cleft Palate children do not show intellectual problems. If their verbal scores are lower than the scores in the reference group, it is an effect of the condition of the Cleft and the diminished speech perception by hearing loss [3]. Our experimental group (see also [5]) showed no intellectual problems, although their verbal scores were lower than in the reference group (median 144 versus 155).

All children had a free field play hearing test. The results of this kind of test (and at this age) has to be considered as an estimation of hearing acuity rather than an exact measurement. In general, the children with a Cleft showed a mild conductive hearing loss in the range of 20 to 40 dB (N=19). Children had not been selected on the base of hearing acuity; there is therefore an unequal distribution of children over cells (see Table 2).

Table 2. Distribution of subjects over groups of hearing: good (to 20 dB loss), mild loss (20-40 dB) or moderate loss (40-55 dB).

	Good hearing	Mild loss	Moderate loss
Reference	7	2	0
Cleft Palate	2	19	9
Total	9	21	9

2.2.3 Medical intervention

In children with a complete cleft (N=21), some received an oral plate, adapted directly at birth (N=13); others did not (N=8). The duration of wearing a plate was on average 71 weeks (range 39-104 weeks). Some children had middle ear drains (N=13), on average in week 59 (range 39-98 weeks), others not (N=15) (see Table 3).

Table 3. Cleft Palate children and treatment with middle ear drains (MED); early: before week 59; late: in/after week 59

	Mild loss	Moderate loss
Without MED	10	5
With MED late	4	1
early	5	3
Total	19	9

The timing of palatal surgery (nearly in all cases a partial one) was executed on average in week 54 (range 38-90 weeks); two children received a total palatal closure.

2.2.4 Collection, transcription and analysis of data

For this cross-sectional descriptive explanatory study, data were collected in the spontaneous mother-child interaction at the age of two years of the child. Mother and child were videotaped continuously during twenty minutes in the laboratory setting, playing with each other in an unstructured way; only a specific play set was given. A group of well-trained clinical phoneticians,

clinical linguists and speech therapists were involved in two double blind listening experiments to judge child's intelligibility as well as its deviant articulation (Cleft Palate speech). The mother's and child's utterances were transcribed at the phonemic level by trained transcribers and then checked by the main researcher. An interjudge reliability study was carried out between the main researcher and the Dutch phonologist Mieke Beers (see Table 4).

Table 4. Interjudge reliability in word and consonant recognition

	Words		All Cons		Initial C	Final C
	%	N	%	N	%	%
Reference	95	506	84	411	87	78
Cleft group	88	332	79	268	81	65

There was a high level of agreement in word recognition; for consonants the reliability was adequate, not lower than 65% .

All spontaneously uttered (not self-repeated) meaningful words of the child were categorized in minors, content and function words (types and tokens). Two Dutch standard tests were used in order to assess the children's grammatical ability [2] and their phonological proficiency [1] .

The children are unevenly distributed over type of hearing loss and treatment with middle ear drains (MED) (see Tables 2 and 3). The statistical effects of a speech motor disability or hearing loss on speech and language variables could only be examined if cells were combined. For example, in order to study the effect of the speech motor disability (the Cleft) on the language variables, the children with good hearing and mild hearing loss, but without MED, in the reference group were combined in one group and compared with the same group of children with a cleft. In order to examine the influence of hearing acuity, the Cleft Palate children with a mild hearing loss, with or without MED, were compared with the group with a moderate hearing loss, with or without MED.

The Cleft Palate group of children showed a remarkable variation in scores. A Mann Whitney Univariate Test had to be chosen to get insight in the effect of the cleft and/or hearing acuity and/or hearing correction by MED on the different speech and language variables. In testing the effect of the timing or duration of medical intervention, Spearman's rank order correlation test was used.

3. RESULTS

3.1 Differences in the total group versus the reference group

Two-year-old Cleft Palate children (the whole group) differed in our study [5] from peers in the reference group in intelligibility ($p \leq .001$) and Cleft Palate speech symptoms ($p \leq .001$). Significant differences also occurred in lexical ability: in content word types ($p \leq .01$), in content word tokens ($p \leq .001$), in function word types ($p \leq .001$) and in function word tokens ($p \leq .01$). In those cases in which children produced sufficient grammatically analyzable utterances (only in 20 children), no problems in grammatical proficiency were found. In MLU and MLUL all children, except two, scored within normal ranges. Phonology, as measured with FAN [1], showed an interesting picture. Only 19 children produced 100 differently uttered word types, necessary for this analysis. In

this test, a phoneme, and therewith also a contrast, is considered to be acquired if an individual child has pronounced it for 75% or more correctly in a specific word position (initial or final) in at least four different spontaneously uttered words (the individual frequency criterion for an acquired phoneme type). Half of these Cleft children had a delayed or abnormal phonology; their grade in the complexity of contrasts was less than in the reference group. They possessed Grade 1, consisting of [sonorant], [labial], [coronal] and [consonant]. At age two years, the children should have Grade 3 (of 5 possible grades in contrast complexity), consisting of [plosive], [sonorant], [labial], [coronal], [dorsal] and [fricative].

Compared to the reference group, the Cleft children also showed a reduced number of acquired phonemes. The initial phonemes /p/, /t/, /j/, /m/, /n/, /k/ and /h/ are found in the reference group at two years of age [1]. Cleft Palate children as a group (group criterion: more than 50% of the children in the group have reached the individual frequency criterion for a particular phoneme) had only acquired /m/, /n/ and /k/.

In general, the total Cleft Palate group exhibited a remarkable heterogeneity in speech and language proficiency.

One third of the children (N=11) could be considered as severely speech and language retarded; neither a phonological, nor a grammatical analysis could be carried out, due to lack of data. They uttered on average 31 utterances (range 5-192) during twenty-minutes of mother-child interaction; in the reference group the lowest end of the range of a child was 235 utterances. This was not due to the verbal behavior of their mothers. In neither group of children, the cleft group nor the reference group, did the mothers differ from each other in the amount of speaking time in minutes or in the total number of utterances.

One third of the children were delayed in phonology (N=9) and one third (N=10) were within normal ranges on all language measures.

3.2. The role of speech motor disability and/or hearing acuity

The difference found in intelligibility and Cleft Palate speech symptoms was primarily due to the speech motor disability (the Cleft). Children with better and/or corrected hearing by middle ear drains did however show higher values in intelligibility and a lower score in the number of Cleft Palate speech symptoms. This is an interesting result. With better hearing the children can overcome their speech motor disability in some respects. Their speech production is guided by their auditory speech perception.

The lexical ability suffered primarily from the diminished auditory speech perception and the amount of hearing loss. With respect to the types and tokens of content words and tokens of function words, but not with respect to the number of types of function words. These findings do not give support to the avoidance theory [7] that an articulatory disability leads to less lexical expression and has an influence on cognitive-linguistic skills; impaired speech perception is important. In types of function words, influence of the speech motor disability (the Cleft) was found.

Compared with the reference group with good hearing (N=7) the Cleft Palate children who produced enough data for phonological analysis (N=19) differed in the number and types of acquired phonemes, as was stated above. This appeared to be

influenced by hearing quality. The Cleft Palate children with a normal contrast grade had fewer acquired phonemes if they had a moderate loss or a mild loss without MED (see Table 5).

Table 5. Influence of hearing acuity (good, mild or moderate loss) and intervention (MED) in Cleft Palate children with a normal (N=10) or an abnormal (N=9) phonology: mean, standard variation of the grade as well as number of acquired consonant types (C).

	Good			Mild +MED			Mild -MED			Mod +MED		Mod -MED		
	m	sd	N	m	sd	N	m	sd	N	score	N	m	sd	N
<i>Normal</i>														
Grade				4	1	5	3	0	4	3	1			
N acq. C				7	3	5	6	3	4	4	1			
<i>Abnorm</i>														
Grade	1	0	2	1	0	1	0	0	3	0	1	0	1	2
N acq. C	3	1	2	3	0	1	3	1	1	2	1	2	3	2

However, the two children with a Cleft without hearing loss at two years of age did not possess a normal phonological acquisition. They showed, similar to other Cleft Palate children, a delayed or abnormal picture of phonology. In the Cleft children with an abnormal phonology, better hearing (good or mild loss with MED) was related to a higher grade and/or more phoneme types acquired (see also Table 5). Also in this group, hearing played a role.

3.3 The role of medical intervention

In this paper only the effects of the medical intervention with an oral plate and middle ear drains on the speech and language variables are discussed. The influence of the palatal closure is discussed in [5]. In children for whom a phonological analysis (N=19) could be carried out, some, those with a complete Cleft, were treated from birth on with an oral plate, worn day and night. This group showed in our study [5] a positive effect in phonology. Phonemes with the contrast [plosive] and [coronal] were produced at the age of two years more often correctly ($p \leq .05$). These children showed a high grade in the complexity of contrasts and in the acquired number of phonemes (see Table 6).

Table 6. The influence of an oral plate (N=19): median and range of contrast grade and the number of acquired phonemes (C: consonant types); long: > 71 weeks; short: ≤ 71 weeks; not at all

	Long		Short		No plate		FAN-test	
	m	range N	m	range N	m	range N	m	N
Grade	3	1-5	2	0-3° 4	1	0-4* 10	3	12
N phones	6	2-11	4	4-10° 4	3	0-6* 10	9	12
Total	5		4		10			

Two children scored high, although they were not treated with an oral plate (*) or only for a short time (°). Child ° with grade 3 and 10 acquired phonemes got an early closure of the hard and soft palate; child * with grade 4 and 6 acquired phonemes had also a plate, but only a feeding plate.

In the study [5] also the selection of words and phonemes was studied. The children with an oral plate also targeted longer words

in their communication with their mother, consisting of more oral consonants ($p \leq .01$) and more syllables ($p \leq .05$).

This group showed also a higher number of tokens of content words ($p \leq .05$). It appears that if children possess more mental knowledge about the phonology of words, in our group of children as a result of an oral plate, the number of word tokens in their production is enlarged. No positive effects were found with respect to Cleft Palate speech symptoms. The articulation did not benefit of the plate.

Both children with a good hearing at two years of age did not get an oral plate or wore it for a short period of time. They had lacked the continuing benefits of oral speech perception, which other children had had from birth on, and lacked therewith the better facilities for speech production. Their good hearing could not compensate their insufficient oral capacities.

Earlier, in Table 5, the effect of hearing acuity and intervention in relation to normal or abnormal phonology was presented. In Table 7 the effect is given of middle ear drains in the whole group of children, who participated in the phonological analysis (N=17).

Table 7. The influence of middle ear drains (N=17): median and range of contrast grade and number of acquired phonemes (C: consonant types); early: < 59 weeks); late: \geq 59 weeks; not at all

	Early		Late		No MED		FAN-test	
	m	range N	m	range N	m	range N	m	N
<i>Grade</i>							3	12
mild loss	3	1-5 5	3	3-3 1	3	0-4 7		
moderate	1	1-1 1	3	3-3 1	0	0-1 2		
<i>N acq. C.</i>							9	12
mild loss	6	3-11 5	5	5-5 1	4	2-10 7		
moderate	2	2-2 1	4	4-4 1	2	0-5 2		

The two children with good hearing are naturally excluded. Especially with respect to the number of acquired phonemes, early intervention with middle ear drains is effective; more phonemes are acquired. In children with more severe (moderate) hearing loss (40-50 dB), middle ear drains showed no effect. In that case, middle ear drains do not normalize hearing as in children with mild conductive hearing loss.

4. DISCUSSION

Early intervention by an oral plate, worn until the second birthday, had a remarkable effect on phonology, whereas the early treatment with middle ear drains enhanced lexical ability as well as phonology. In children with better hearing, Cleft Palate speech symptoms were less present and intelligibility was enhanced. Especially the children with a mild hearing loss and early middle ear drains, placed in their first year of life, showed normal speech and language values, comparable to the reference group. Auditory speech perception was enhanced at an early point in time and promoted a fast rate in speech development.

An oral plate was seen as a device to ameliorate tactile-kinesthetic speech perception and speech production. However, in the level of articulation, an oral plate did not ameliorate phonetic output; the Cleft Palate Speech symptoms were not diminished by it either. Phonology, the mental organization of children's sound

system, was enhanced, in selection (the words targeted) as in production.

Due to the relatively small number of children across cells, a cluster analysis to test effects of the interventions and timing of it, could not be properly executed. However, the results support the thought, that children with a sufficient and early medical intervention for speech perception show in their far better speech and language production at age two years, the effect of better and early sensory input and a timely mental sensory integration. At the age of two years, normal values in lexical ability and phonology were found in the adequately treated group. If baby's are not able to build up in time, in their first year of life, normal representations of speech and language, there can be a risk of communicative problems later on. The children with a severe delay (N=11), without adequate and timely treatment, were far less communicative with their mothers. In our opinion, this is not due to less motivation of the children to speak, but to less mental representations of speech and language to speak easily from off.

ACKNOWLEDGMENTS

This Ph.D. study was granted by Care Research the Netherlands (formerly Dutch Preventive Fund), project 28-1042. It was carried out with support of the Institute of Phonetic Sciences (Prof.dr.ir L.C.W. Pols and Dr. F.J. Koopmans-van Beinum), the Institute of General Linguistics (Prof.dr A.E. Baker) and LOT: IFOTT (Netherlands Graduate School of Linguistics: Institute for Functional Research on Language and Language Use), in which series the study appeared (see [5]) as number 17.

REFERENCES

- [1] Beers, M. (1995). *The phonology of normally developing and language impaired children*. IFOTT: Studies in Language and in Language Use: 20. Ph.D. study University of Amsterdam. The Hague: Holland Academic Graphics.
- [2] Bol, G.W. and F. Kuiken. (1988) *Grammaticale analyse van taalontwikkelingsstoornissen* (Grammatical analysis of language disorders, with an English summary). Ph.D. study. University of Amsterdam: Institute of General Linguistics.
- [3] Broen, P.A., M.C. Devers, S.S. Doyle, J. McCauley Prouty and K.T. Moller. (1998). Acquisition of linguistic and cognitive skills by children with Cleft Palate. *J. Speech Hearing Research*, 41, 676-687.
- [4] Heineman-de Boer, J.A. (1985). *Cleft Palate children and intelligence; Intellectual abilities of Cleft Palate children in a cross-sectional and longitudinal study*. Ph.D. study, University of Groningen. Lisse: Swets and Zeitlinger.
- [5] Jansonius-Schultheiss, K. (1999). *Twee jaar spraak en taal bij schisis* (Two years of speech and language in Cleft Palate Children, with an English summary). LOT: IFOTT-series number 17. Ph.D. study University of Amsterdam. The Hague: Holland Academic Graphics.
- [6] McWilliams, B.J., H. L. Morris and R.L. Shelton. (1990). *Cleft Palate Speech*. Toronto: Deckers, Inc.
- [7] Schwartz, R.G. and L.B. Leonard. (1982). Do children pick up and choose: An examination of phonological selection and avoidance. *J. Child. Lang.*, 9, 319-336.