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Otologic and Audiologic Outcomes With the Furlow and von Langenbeck With Intravelar Veloplasty Palatoplasties in Unilateral Cleft Lip and Palate

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Abstract

Objective—Cleft palate increases the risk of chronic middle ear disease and hearing loss. The goal of this report was to determine which of two palate surgeries and which timing of palate surgery were associated with better otologic and audiologic outcomes in children with unilateral cleft lip and palate at 5 to 6 years of age.

Design—Subjects were randomly assigned to the von Langenbeck with intravelar veloplasty or Furlow palate repair, to palate surgery at 9 to 12 months or 15 to 18 months of age, and to the Spina or Millard lip repair.

Setting—Centralized, tertiary care craniofacial treatment center.

Patients—A total of 673 infants with unilateral cleft lip and palate.

Interventions—Palate and lip were repaired using established techniques. Serial otoscopic and audiometric evaluations were performed.

Main Outcome Measures—Hearing and otoscopic findings at 5 to 6 years old.

Results—There were 370 children available for analysis. Hearing and need for tympanostomy tube placement did not differ by palatoplasty, age at palatoplasty, cheiloplasty, or surgeon. Risk of developing cholesteatoma or perforation was higher with Millard cheiloplasty (odds ratio = 5.1, 95% confidence interval = 1.44 to 18.11, $p = .012$). Type and age at palatoplasty were not significantly associated with either the rate of developing these sequelae or the rate of achieving bilaterally normal hearing and ear examinations.

Conclusions—Type of palatoplasty did not influence otologic and audiology outcomes in 5- to 6-year-olds with unilateral cleft lip and palate. The potential influence of lip repair on otologic outcomes warrants further investigation.

Keywords

cleft palate; clinical trial; ear; hearing

Chronic otitis media with effusion (COME) and its attendant hearing loss afflicts nearly all infants born with cleft palate (Stool and Randall, 1967; Paradise et al., 1969; Dhillon, 1988; Grant et al., 1988). This is felt to be due to eustachian tube dysfunction, which results primarily from tensor veli palatini (i.e., palatal) incompetence (Doyle et al., 1980; Casselbrant et al., 1988). Tensor veli palatini function improves after palate repair, but this may never normalize (Doyle et al., 1986). Thus, COME remains a common problem after palatal surgery (Dhillon, 1988; Tasaka et al., 1990; Matsune et al., 1991b; Robinson et al., 1992; Rynnel-Dagoo et al., 1992; Nunn et al., 1995). Persistent eustachian tube dysfunction is also thought to be the primary factor responsible for the higher rates of more serious middle ear pathology observed in children with cleft palate, such as middle ear atelectasis, tympanic membrane perforation, and cholesteatoma (Dominguez and Harker, 1988; Goldman et al., 1993; Muntz, 1993; Smith et al., 1994; Nunn et al., 1995; Bluestone and Klein, 1996).

Many factors related to palatal repair may impact eustachian tube function. These include the type of palatoplasty, the age at which it is performed, and the surgeon performing the repair. Speech, cephalometric, and occlusal outcomes have been shown to differ among techniques and age at repair (Gunther et al., 1998). Unfortunately, previous studies typically have been retrospective, have been underpowered, had multiple surgeons, or have failed to control for factors such as type of cleft, concomitant surgery (e.g., lip repair), and experience of the surgical team (Dreyer and Trier, 1984; Spauwen et al., 1992; McWilliams et al., 1996; Guneren et al., 2000). In 1994, we began a prospective, randomized, blinded, controlled study to compare the Furlow double-opposing Z-palatoplasty (FP) against the von Langenbeck palatoplasty with intravelar veloplasty (VLP) when performed at 9 to 18 months of age. The purpose of this report was to compare the otologic and audiology outcomes of these palatoplasty techniques at 5 to 6 years of age.

Materials and Methods

Study Design

This was a prospective, randomized, double-blind $2 \times 2 \times 2$ factorial study designed to compare the outcomes of two primary palatoplasty techniques in conjunction with the timing of palatal surgery. The goal was to determine whether the FP or the VLP resulted in

significantly different rates of velopharyngeal competency for speech. A more detailed report of the study design and primary outcome measures has been previously reported (Williams et al., in press). The factorial design of this study allowed for evaluation of multiple factors. The purpose of this article is to report the otologic and audiologic outcomes for all children who had otologic and audiologic evaluations at the age of 5 to 6 years.

The study was conducted at the Hospital de Reabilitação de Anomalias Craniofaciais, Universidade de São Paulo (HRAC-USP; University of São Paulo Hospital for Rehabilitation of Craniofacial Anomalies) in Bauru, Brazil. HRAC-USP is a world-class craniofacial center that annually cares for more than 1000 new cases of UCLP in ethnically diverse patients from across Brazil. This allowed for relatively rapid enrollment of the large numbers of subjects needed to meet the study's primary objectives. Institutional review board approval was obtained from both the HRAC-USP and the University of Florida prior to enrolling any subjects.

In brief, all subjects were born with complete unilateral cleft lip and palate (UCLP), were nonsyndromic, could undergo lip repair by 6 months of age, and did not have any known condition that could interfere with speech and language development other than their cleft. Four surgeons at the HRAC-USP performed all lip and palatal surgeries, and a block randomization plan was developed for each surgeon. The randomization plan ensured that each sequential set of eight children assigned to a surgeon was assigned to the eight study groups at random for the three study interventions (Furlow versus von Langenbeck with intravelar veloplasty palatoplasty [FP versus VLP]; palatoplasty at 9 to 12 months versus 15 to 18 months; and Millard versus Spina cheiloplasty). This plan also aimed to maintain comparable group size by surgeon throughout the study. The surgeons responsible for lip and palate repair were not involved in any postoperative evaluations described in this report.

Otologic Assessment and Treatment

Each patient underwent otoscopic evaluation prior to lip and palate surgery and at 6- to 12-month intervals thereafter by an experienced otolaryngologist who was blinded to the type of palatal repair. Tympanostomy tubes were placed if deemed necessary by the otolaryngologist (i.e., they were not routinely placed at the time of palatoplasty). Principal criteria for tympanostomy tube placement were persistence (i.e., at least 6 months) of effusion and conductive hearing loss on sequential evaluations (>5 dB conductive loss with >20 dB pure tone average). Additionally, recurrent acute otitis media and progressive atelectasis may have led to tympanostomy tube placement before the palatoplasty. Short-acting (Shepard) tympanostomy tubes were used when tube placement was indicated. The presence or absence of middle ear effusion, tympanostomy tube, tympanic membrane perforation, atelectasis, and cholesteatoma were recorded at each visit.

Audiologic Assessment

Audiologic assessments were performed as previously described (Seagle et al., 1998) prior to palatoplasty and at 6- to 12-month intervals. Sound-field testing with live voice was conducted for each patient until old enough (typically by 5 years of age) to cooperate with headphones for specific ear testing. Patients' behavioral responses (e.g., cessation of activity, head turning to localize the sound source) to the sound-field test were recorded. Responses were noted as present, absent, or uncertain. A patient's hearing was considered within normal limits if he or she responded to speech at a sound pressure level of 50 dB at 3 to 4 months, 20 dB at 4 to 7 months, 15 dB at 7 to 9 months, 8 dB at 9 to 13 months, and 5 dB at 14 months and older.

Patients 5 years of age and older received ear-specific audiometric testing with both pure tone and speech stimuli. Patients who had pure-tone average thresholds greater than 25 dB were assessed by bone conduction with appropriate masking. Speech discrimination scores were also measured.

A Grason-Stadler tympanometer (GSI-33, Grason-Stadler Inc., Eden Prairie, MN) was used to evaluate tympanic compliance, middle ear pressure, and impedance. Results were reported according to the classification of tympanogram shapes by Jerger (1970).

Statistical Analysis

Normal ears were defined by type A tympanograms, three frequency (500, 1000, and 2000 Hz) pure-tone average (PTA) air-conduction hearing thresholds <25 dB, and normal otoscopic exam on two consecutive assessments. Tympanic membrane perforation and cholesteatoma were categorized as surgical middle ear disease.

All statistical analyses to compare postoperative otologic responses were performed using SAS version 9 (SAS Institute, Inc., Cary, NC). Significance was declared for a particular comparison if $p < .05$ (two-sided). For the categorical response variables (normal/abnormal, present/absent, or yes/no), the multiple logistic regression procedure was used to compare otologic outcomes for each the three treatment interventions: (1) type of palate surgery, (2) timing of palate surgery, and (3) type of lip surgery. Multiple logistic regression analyzes proportions based on dichotomous response data and gives p values, odds ratio estimates, and 95% confidence intervals (CI) for each intervention, controlling for the other two. Note, the CI contains the value "1" if and only if the differences between the two treatments of an intervention are not significantly different ($p > .05$ two-sided). For the numerical response variables (e.g., audiometric thresholds) the general linear model was used to compare otologic outcomes for each of the three treatment interventions. Groups were analyzed "as randomized." Results were qualitatively the same when analyzing the data "as randomized" and "as treated."

Results

The study demographics are shown in Table 1. At the time of this analysis, 370 children (195 children VLP and 175 FP) had reached 5 years of age, constituting the population eligible for this analysis. Audiometric and/or otologic data were available on 286 subjects at age 5 to 6 years. Gender and age distribution of the children with otologic and audiologic evaluations at 5 to 6 years were in line with the overall study population. Distribution of patients by study group is shown in Table 2. Age at palatoplasty and type of cheiloplasty were similarly distributed.

Audiometric results are summarized in Figure 1 and Tables 3 through 5. Mean PTA air-conduction thresholds were slightly better in the right ears of children treated with the FP (Table 3, $p = .048$). This finding was not, however, associated with similar differences for the air-bone gap. Hearing ipsilateral and contralateral to the cleft were not significantly different. With only four surgeons, analysis of surgeon handedness relative to hearing could not be conducted. Audiometric thresholds were otherwise not significantly different between treatment groups. Few bone conduction thresholds were done, and few had PTAs greater than 25 dB. Bilateral sensorineural hearing loss was identified in one child from each of the palatoplasty treatment groups. Unilateral mixed hearing loss was found in three of the VLP and two of the FP subjects.

Tympanometric findings were not significantly different between groups (Table 4). The likelihood of developing type A tympanograms was not significantly associated with any of

the treatment variables (Table 5). Children with a PTA less than or equal to 25 dB and type A tympanograms in both ears were found with similar frequency in the VLP and FP groups (22% versus 26%, $p = .40$).

The need for tympanostomy tube placement did not differ significantly between treatment groups at age 5 to 6 years (Table 6). There was no significant association between palate surgeon and the need for tympanostomy tube placement, either at age 5 or 6 years (Table 7). Just over half of all children, 54.2%, ever received tympanostomy tubes. The mean age at tube placement was 40 months, with only one child receiving tubes when younger than 1 year. Of the children who received tubes, 29% received tubes twice and 3% a third time through 5 to 6 years of age. Tubes were placed bilaterally in 93% of children at their first tube surgery and in 85% at the second tube surgery.

Otologic outcomes were not significantly associated between VLP and FP treatment groups (Table 8). More than 60% of children in both palatoplasty groups continued to exhibit abnormal otoscopic findings at age 5 to 6 years. Of the 18 children who showed tympanic membrane perforations or cholesteatoma with evaluations at age 5 to 6 years, only six showed such findings before the age of 5. The type of palatoplasty and age at palatoplasty did not have significant associations with the development of potentially serious middle ear disease, tympanic membrane perforation, or cholesteatoma (Table 9). However, children treated with the Millard cheiloplasty had a significantly higher rate of development of such potentially serious middle ear pathology ($p = .012$, odds ratio = 5.1). The distribution of tympanic membrane perforation and cholesteatoma is shown by treatment group in Table 10.

Children without abnormalities on otoscopy, PTA ≤ 25 dB, and type A tympanograms, were somewhat uncommon, ranging from 9.5% of children treated with a Spina lip repair and Furlow palatoplasty at 9 to 12 months, to 23.3% of children treated with a Millard lip repair and VLP at 9 to 12 months. There were no significant differences in the development of normal ears across treatment groups (Table 11).

Discussion

Middle ear function is highly dependent on palatal integrity (Doyle et al., 1980; Casselbrant et al., 1988; Ghadiali et al., 2003). Therefore, differences in middle ear outcomes may be expected with different palatoplasty techniques. However, eustachian tube dysfunction commonly persists after palatoplasty (Doyle et al., 1986; Dhillon, 1988; Tasaka et al., 1990; Robinson et al., 1992; Rynnel-Dagoo et al., 1992; Nunn et al., 1995). Past studies comparing palatoplasty techniques (Gureren et al., 2000; Kane et al., 2000) have generally failed to demonstrate a clear impact of different palatoplasty techniques. In a retrospective analysis of 101 children followed through an average age of 4 to 5 years, Smith and colleagues (2008) observed significantly reduced need for tympanostomy tube placement in children treated with the FP compared with the VLP. The rationale for the difference between their findings and our observations is unclear.

No prior study has thoroughly, *prospectively* compared middle ear outcomes with two of the most widely used palatoplasty techniques, FP and VLP. Our observations suggest that these two palatoplasty techniques and the age at which they are performed do not significantly impact middle ear outcomes when assessed at 5 to 6 years of age.

These observations raise two key considerations. First, it is possible that the 5 to 6 years may be too early to see differences in key measures, such as the development of surgical middle ear disease. Very few tympanic membrane perforations and cholesteatomas were

found before the age of 5 to 6 years. With further observation, more changes in outcomes resulting from more subtle differences in palatal function may become apparent. Alternatively, congenital clefting of the palate may cause irreversible tubal dysfunction that is not sufficiently amenable to intervention with conventional palatoplasty techniques. Matsune and colleagues (1991a, 1991b, 1992) have demonstrated numerous such abnormalities in the cartilaginous portion of the eustachian tube of subjects with cleft palate. Improvement in middle ear status after palatoplasty may result as much or more from other factors, such as growth and maturation of tubotympanic immunity.

Finding significantly higher rates of surgical middle ear pathology in children treated with the Millard cheiloplasty was quite unexpected. Randomization based on cheiloplasty was done primarily to evaluate speech outcomes, which is the subject of another report. We can discern no clear reason why such an association was found. One possible explanation is it may be an artifact of the large number of statistical tests conducted for this study. Even so, this association should be viewed as real, unless and until a large verification study refutes it. Normal otologic status (i.e., normal hearing and absence of otoscopic abnormalities) was observed most often in children treated with the Millard cheiloplasty and VLP. Although the latter observation did not reach statistical significance, it calls into question the association between surgical middle ear disease and the Millard technique and highlights the need to weigh all middle ear outcome measures.

The low rate of achieving “normal otological status” is evidence of the long-standing nature of middle ear disease in children with cleft palate. Recovery of normal tubal function in our 5- to 6-year-old subjects was similar to that reported by Smith et al. (1994). The latter publication showed continued improvement in tubal function of children with cleft palate through age 12. This highlights the need for their ongoing evaluation and treatment. It also suggests progressive changes that are dependent on chronic tubal dysfunction could still manifest well after the period of study in our analysis.

Finally, observations from our study may be unique to the study population. Patients at HRAC-USP receive care from an outstanding group of health care professionals at a modern, national craniofacial center of excellence. More than 1000 new patients with cleft lip and palate are treated each year at USP-HRAC. In contrast, many cleft palate centers in the United States treat only dozens of new patients each year. Given that surgical outcomes have been shown to vary with surgical volume, the results from this study may be biased toward better outcomes. Eustachian tube function and otitis media are well known to be dependent on many factors, including race and socioeconomic status. The study population is largely poor and ethnically diverse, from across Brazil. This might bias results toward worse middle ear outcomes. The benefits derived from such a large, well-designed, and well-conducted study more than likely outweigh any possible biases resulting from these differences.

Conclusions

Furlow and von Langenbeck with intravelar veloplasty palatoplasties yield similar audiologic and otologic outcomes in children with cleft palate at 5 to 6 years of age. The Millard cheiloplasty appears to increase the risk of serious middle ear disease relative to the Spina procedure. Evaluation of the middle ear status and hearing in this study population over an extended period of time (e.g., 15 years) will be necessary to more fully understand this unexpected and possibly serendipitous observation.

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Figure 1. Distribution of pure-tone threshold averages (500, 1000, and 2000 Hz) in children with cleft palate at 5 to 6 years of age following Furlow and von Langenbeck with intravelar veloplasty palatoplasties for the right (A) and left (B) ears

Table 1
Study Population Treated With Either the von Langenbeck With Intravelar Veloplasty or Furlow Palatoplasty

	von Langenbeck	Furlow	Total
Enrolled, randomized	344	329	673
Active at analysis	248	219	467
Children at least 5 years of age	195	175	370
Gender, n (%)			370
Male	122 (62.6)	95 (54.3)	
Female	73 (37.4)	80 (45.7)	
Cleft side, n (%)			370
Right	62 (31.8)	55 (31.4)	
Left	133 (68.2)	120 (68.6)	
Children with ear evaluations at 5 to 6 years of age	149	137	286
Gender, n (%)			286
Male	93 (62.4)	74 (54.0)	
Female	56 (37.6)	63 (46.0)	
Cleft side, n (%)			286
Right	46 (30.9)	46 (33.6)	
Left	103 (69.1)	91 (66.4)	

Table 2
Treatment Stratification of Patients Who Were Evaluated at 5 to 6 Years of Age (N = 286)
Following Von Langenbeck With Intravelar Veloplasty or Furlow Palatoplasty

	von Langenbeck (n = 149)	Furlow (n = 137)
Palatoplasty at 9–12 mo		
Spina cheiloplasty, n (%)	36 (12.6)	31 (10.8)
Millard cheiloplasty, n (%)	43 (15.0)	32 (11.2)
Palatoplasty at 15–18 mo		
Spina cheiloplasty, n (%)	32 (11.2)	38 (13.3)
Millard cheiloplasty, n (%)	38 (13.3)	36 (12.6)

Table 3
Audiometric Outcomes Stratified by Type of Palatoplasty (Von Langenbeck With Intravelar Veloplasty or Furlow) for Children Who Had Completed Testing at Age 5 to 6 Years*

	von Langenbeck	Furlow	p Value
PTA, air, right	n = 108 17.5 (11.0) dB	n = 91 14.7 (8.3) dB	.048
PTA, air, left	n = 107 19.2 (10.9) dB	n = 91 17.8 (9.8) dB	.38
PTA, air, ipsilateral to cleft	n = 107 17.6 (9.7) dB	n = 91 16.3 (9.4) dB	.38
PTA, air, contralateral to cleft	n = 108 19.1 (12.0) dB	n = 91 16.2 (9.0) dB	.06
PTA, bone, right	n = 32 3.6 (4.9) dB	n = 20 2.2 (2.4) dB	.22
PTA, bone, left	n = 35 2.8 (3.0) dB	n = 29 3.7 (4.3) dB	.29
PTA, air-bone gap, right	n = 32 25.7 (12.3) dB	n = 20 24.2 (7.7) dB	.61
PTA, air-bone gap, left	n = 34 26.6 (8.6) dB	n = 29 25.5 (9.2) dB	.74
Conductive hearing loss	n = 143	n = 126	.67
None	79 (55.2%)	66 (52.3%)	
Both	40 (28.0%)	40 (31.8%)	
Right	7 (4.9%)	5 (4.0%)	
Left	17 (11.9%)	15 (11.9%)	

* PTA = pure-tone average (mean). Matched-pair analysis for PTA, air conduction: von Langenbeck with intravelar veloplasty group with ipsilateral versus contralateral, $p = .0755$; Furlow palatoplasty group with ipsilateral versus contralateral, $p = .8636$.

Table 4
Tympanometric Outcomes Stratified by Type of Palatoplasty for Children Who Had Completed Testing at Age 5 to 6 Years

	von Langenbeck	Furlow	p Value
Type A	n = 143	n = 128	.19
Neither	87 (60.8%)	71 (55.5%)	
Both	27 (18.9%)	32 (25.0%)	
Right	16 (11.2%)	16 (12.5%)	
Left	13 (9.1%)	9 (7.0%)	
Type B	n = 143	n = 128	.66
Neither	95 (66.4%)	88 (68.8%)	
Both	26 (18.2%)	13 (10.2%)	
Right	13 (9.1%)	8 (6.3%)	
Left	9 (6.3%)	19 (14.8%)	
Type C	n = 143	n = 128	.89
Neither	96 (67.1%)	86 (67.2%)	
Both	14 (9.8%)	12 (9.4%)	
Right	15 (10.5%)	10 (7.8%)	
Left	18 (12.6%)	20 (16.6%)	

Table 5
Influence of Palatoplasty and Cheiloplasty on Developing Normal, Type A
Tympanograms in Both Ears at Evaluation Age of 5 to 6 Years *

	Type A Tympanograms, n (%)	Total Number (N = 271)	Odds Ratio Estimate (95% Confidence Interval)	p Value
Furlow	32 (25.0)	128	0.68 (0.38–1.21)	.19
von Langenbeck	27 (18.9)	143		
Spina	28 (21.9)	128	1.01 (0.57–1.81)	.96
Millard	31 (21.7)	143		
Palatoplasty at 9–12 mo	32 (25.4)	126	0.65 (0.36–1.17)	.15
Palatoplasty at 15–18 mo	27 (18.6)	145		

* Odds ratio of 1.0 implies equivalency. Unit of analysis is the child, for both ears.

Table 6
Influence of Palatoplasty and Cheiloplasty on the Need for Tympanostomy Tubes in Children Evaluated at Ages 5 to 6

	Tubes, n (%)	Total Number (N = 279)	Odds Ratio Estimate (95% Confidence Interval)	p Value
Furlow	13 (9.8)	133	0.78 (0.36–1.66)	.51
von Langenbeck	18 (12.3)	146		
Spina	15 (11.1)	135	0.99 (0.47–2.09)	.98
Millard	16 (11.1)	144		
Palatoplasty at 9–12 mo	16 (11.8)	136	1.12 (0.53–2.36)	.78
Palatoplasty at 15–18 mo	15 (10.5)	143		

Table 7
Influence of Palate Surgeon on the Need for Tympanostomy Tube Placement in Children
5 to 6 Years of Age*

Surgeon	Tubes, n (%)	Total Number (N = 279)	Odds Ratio Estimates (95% Confidence Interval)	p Value
1	9 (12.3)	73	1.46 (0.49–4.36)	.50
2	9 (13.0)	69	1.51 (0.51–4.53)	.46
3	7 (10.0)	70	1.13 (0.36–3.56)	.83
4	6 (9.0)	67		

* Surgeons 1, 2, or 3 versus Surgeon 4. Odds ratio of 1.0 implies equivalency.

Table 8
Otologic Outcomes Stratified by Type of Palatoplasty for Children Who Had Completed Testing at Age 5 to 6 Years

	von Langenbeck	Furlow	p Value
N = 281	n = 147	n = 134	.89
Normal otoscopy	55 (37.4%)	52 (38.8%)	
Abnormal otoscopy	92 (62.6%)	82 (61.2%)	
N = 286	n = 149	n = 137	.52
Otitis media with effusion	36 (24.2%)	29 (21.2%)	
N = 286	n = 149	n = 137	.10
Retraction	70 (47.0%)	51 (37.5%)	
N = 280	n = 147	n = 133	.29
Perforation	10 (6.8%)	5 (3.8%)	
N = 276	n = 143	n = 133	.94
Cholesteatoma	0 (0%)	3 (2.3%)	

Table 9
Influence of Palatoplasty and Cheiloplasty on the Development of Potentially Serious Middle Ear Disease (Either Tympanic Membrane Perforation or Cholesteatoma) in Children 5 to 6 Years of Age*

	Perforation/Cholesteatoma, n (%)	Total N = 280	Odds Ratio Estimate (95% Confidence Interval)	p Value
Furlow	8 (6.0)	133	0.62 (0.23–1.68)	.82
von Langenbeck	10 (6.8)	147		
Spina	3 (2.2)	135	5.1 (1.44–18.11)	.012
Millard	15 (10.3)	145		
Palatoplasty at 9–12 mo	7 (5.1)	137	0.89 (0.33–2.37)	.35
Palatoplasty at 15–18 mo	11 (7.7)	143		

* A bolded *p* value indicates significance. Odds ratio of 1.0 implies equivalency.

Table 10
Treatment Group Distribution of Potentially Serious Middle Ear Disease (Either Tympanic Membrane Perforation or Cholesteatoma) in Children 5 to 6 Years of Age*

Lip	Palate	Palate Age	Affected n	Total n	%
Millard	Furlow	Early	1	30	3.30
	Furlow	Late	6	36	16.70
	von Langenbeck	Early	4	42	9.50
	von Langenbeck	Late	4	37	10.80
Spina	Furlow	Early	0	29	0.00
	Furlow	Late	1	38	2.60
	von Langenbeck	Early	2	36	5.60
	von Langenbeck	Late	0	32	0.00

* Numbers (n) represent subjects either affected or total in treatment group.

Table 11
Frequency of Patients With Bilaterally Normal Ears at Their 5- to 6-Year Evaluation,
Stratified by Treatment Group (i.e., Hearing Thresholds ≤ 25 dB, Type A Tympanograms,
and No Evidence of Middle Ear Pathology in Both Ears), N = 219*

	von Langenbeck (N = 112)	Furlow (N = 107)
Palatoplasty at 9–12 months		
Spina cheiloplasty	5/29 (17.2%)	2/21 (9.5%)
Millard cheiloplasty	7/30 (23.3%)	5/24 (20.8%)
Palatoplasty at 15–18 months		
Spina cheiloplasty	4/27 (14.8%)	6/33 (18.2%)
Millard cheiloplasty	3/26 (11.5%)	4/29 (13.8%)

* Numbers represent subjects with bilaterally normal ears over the total subjects in the treatment group.