Prevalence of Tympanostomy Tube Placement in Relation to Cleft Width and Type

Steffen Jochen Schwarz, MD; Leonard Simon Brandenburg, MD; Julia Vera Weingart, MD, DDS; Wiebke Schupp, MD, DDS; Marc Anton Füssinger, MD, DDS; Chiara-Fabienne Pantke, DDS; Rainer Linus Beck, MD; Marc Christian Metzger, MD, DDS, PhD

Objectives/Hypothesis: The prevalence of tympanostomy tube surgery (TTS) in patients with a cleft deformity was investigated, in relation to cleft width and cleft type.

Study Design: Retrospective review of medical health records.

Methods: Retrospective review of medical health records. Seventy-eight patients with non-syndromic cleft deformity of the palate and/or alveolus and lip between 2003 and 2017 were investigated. All available medical documents were analyzed. The study group was divided into subgroups: 1) patients with isolated cleft palate (CP) and patients with a cleft palate with cleft lip and alveolus (CLP). 2) According to Veau’s classification I–IV, further subgroups were defined. Cleft width was measured using plaster cast models.

Results: TTS was performed in 55% of the patients (n = 43). Considering Veau’s classification, TTS was conducted as follows: Veau I 65.2% (n = 15/23), Veau II 55.0% (n = 11/20), Veau III 47.6% (n = 10/21), and Veau IV 50.0% (n = 7/14). Cleft classifications, maxillary arch width, and absolute/relative cleft width had no statistical impact on TTS occurrence. Although no significant correlation could be found, patients in our study group with CP (Veau I and II) underwent TTS more often (60.5%, n = 26/43) than patients with CPL (Veau III and IV; 48.6%, n = 17/35) during a three-year follow-up.

Conclusion: None of the cleft characteristics examined had a significant impact on the proportion of patients who received TTS. Nevertheless, patients with lower Veau classification and CP received tympanostomy tubes more often. Therefore, otolaryngologists and pediatricians treating children with cleft palate should maintain a high level of suspicion for chronic middle ear effusion, even in patients with small clefts.

Key Words: cleft palate, middle ear dysfunction, Veau, cleft width, tympanostomy tube, hearing loss.

Level of Evidence: 3

Laryngoscope, 00:1–6, 2021

INTRODUCTION

Patients with cleft palate often show middle ear dysfunction as an accompanying pathology due to the abnormal anatomy of the velopharyngeal muscles.1 It is understood that the tensor veli palatini muscle and the levator veli palatini muscle open the Eustachian tube during deglutition, guaranteeing adequate ventilation of the tympanic cavity in healthy individuals.2 Due to the incomplete fusion of these muscles in the median raphe,3 the Eustachian tube does not open correctly in patients with cleft palate.4 Subsequently, inflammatory and non-inflammatory effusion of the tympanic cavity can occur.5 In fact, more than 80% of patients with cleft deformity show pathologies of the middle ear in the first 2 years of their lives.6–9

Middle ear effusion results in reduced sound perception and adversely influences speech and language development.10 The first 12 months of life are particularly important for language acquisition and processing. Hearing impairment should thus be considered in the early care of patients with cleft palate.11 The relation between cleft malformations and hearing impairment was first identified in the middle of the 19th century.12 In the 1970s, Quante et al postulated a hearing loss frequency of 90% in patients with cleft palate.13

In current literature, different approaches are presented for the treatment of patients with cleft palate and with conductive hearing loss due to effusion in the tympanic cavity.14–17 Paracentesis and tympanostomy tube surgery (TTS) are the main treatment options for correcting middle ear dysfunction. This study evaluates the prevalence of tympanostomy tube placement in patients with cleft deformities in relation to the absolute and relative cleft width and cleft classification.
Clefts were classified based on 1. type (isolated cleft palate [CP] vs cleft palate with cleft alveolus and lip [CLP]) and 2. Veau classification (I–IV).

MATERIALS AND METHODS
At the University Hospital Freiburg, Germany, Department of Oral and Maxillofacial Surgery, all patients treated between 2003 and 2017, with either CP or CLP and who underwent surgical treatment, were reviewed.

There were three sets of inclusion criteria for this study: 1) The patients must have received a standardized palatoplasty according to the technique of Langenbeck-Veau-Ernst-Axhausen in their first year of life. Patients with a cleft malformation of the lip must have previously received lip closure using the Tennison Randall technique. 2) High-quality plaster cast models, which depict the entire upper jaw including the tuber maxillae and the whole cleft, must have been available. 3) A minimum clinical follow-up of 3 years had to be performed and properly documented.

The following characteristics led to exclusion from the study: 1) Previous surgical or orthodontic interventions or 2) patients with syndromic malformations. 3) The width of the cleft also had to be detectable in the intertuberosity region to be captured by the performed measurement. Clefts which hardly crossed the connecting line of the tuber maxillae (line T-T') or were located dorsally of the tuber maxillae were excluded from the study (see below). And lastly, 4) inaccurate plaster cast models or insufficient documentation were reasons for exclusion.

Ethical approval for the implementation of this study was obtained from the Ethics Committee of the University of Freiburg, Germany. Generally applicable informed consent for the scientific use of data and models was obtained at the time of patient admission or prior to the start of treatment when taking the patient’s medical history at our clinic.

The study group was separated into a group with isolated cleft malformation of the palate (CP, see Fig. 1) and patients with cleft palate with CLP (see Fig. 2). The study group was also separated, according to the classification of Veau, into four alternate subgroups (Veau I–IV).

Dental impressions were taken before operative closure of the palate, using Alginoplast® (Kulzer Mitsui Chemicals Group, Hanau, Germany). Special hard plaster picroma soft® type 3 DIN EN ISO 6873 (Picodent, Wipperfürth, Germany) was used to make the plaster cast models.

The following landmarks were set on the plaster cast models: T and T’, representing the right and left maxillary tuberosity at the highest point of the alveolar ridge, and C and C’, representing the intersection of the line T-T’ with the right and left ridge of the palatine cleft. The relative cleft width was calculated as a quotient of the distance T-T’ and C-C’, describing the proportion of the cleft width (C-C’) to the total width of the maxillary arch (T-T’) (see Figs. 1 and 2). To measure the distances between the landmarks, a digital Vernier calliper (Alpha Tools, Mannheim, Germany) was used, in which values were specified to two decimal places. A detailed review of the medical records of each patient was performed. Age, sex, date of operation, TTS, the corresponding date of intervention, and the cleft-classification were then determined.

If recurrent tympanic effusions and otitis media with associated hearing loss were detected during the first months of life, TTS and/or paracentesis was recommended. This was done in cooperation with the Department of Otorhinolaryngology at the University Hospital of Freiburg, Germany. For an acute, serous fluid level paracentesis was performed because it can be assumed that further secretion can drain via the natural path of the Eustachian tube and serous effusions are more likely to resolve spontaneously.18 Chronic tympanic effusions and serous-mucosal secretions indicated TTS. Depending on the otoscopic and tympanometric findings, an otolaryngologist determined whether paracentesis or TTS should be performed. The status was checked again intra-operatively. This protocol is based on the S2k guideline for tympanic middle ear effusion (AWMF 017-004). TTS was conducted during anesthesia caused by palatoplasty or in a separate approach.

The collected data were documented using Microsoft Excel® Version 16.0. Subsequent statistical analyses were carried out in

Fig. 1. Dental cast of a patient with cleft deformity of the palate (Veau I). The distances C-C' (red) and T-T' (blue) are shown schematically. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

Fig. 2. Dental cast of a patient with bilateral cleft deformity of the lip, alveolus, and palate (Veau IV). The distances C-C' (red) and T-T' (blue) are shown schematically. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]
collaboration with the Institute for Medical Biometry and Statistics at the University of Freiburg, Germany, using Stata Version 14.0 (Statacorp LP, College Station, TX). Mean, median (p50), range, and standard deviation were calculated for all continuous variables. Logistic regression models with TTS as dependent variable were performed, and the results were given as odds ratios with the corresponding P-value. Fisher’s exact test was used to compare the categorical variables. A confidence interval (CI) of 95% was given. To analyze the differences between two mean values, unpaired t-test statistics were calculated. For testing more than two means, single factor analysis of variance was performed. Additionally, the Scheffe procedure was used as a post-hoc test. Two-sided test statistics were used, and a P-value smaller than .05 was considered statistically significant.

RESULTS

A total of 187 patients received palatoplasty between 2003 and 2017. Eighty-seven were excluded because inclusion criteria could not be fulfilled: Five patients had unspecified operation reports, four patients showed a velum cleft, which was not captured by the performed measurement, and 78 patients were excluded because of inadequate quality of the plaster model. Further measurement, and 78 patients were excluded because of inclusion criteria could not be fulfilled: Four patients had CP (48.6%). The odds ratio calculated from both relative cleft widths were significantly different in t-tests

| TABLE I. Mean and Standard Deviation Comparing Children Receiving Tympanostomy Tube Surgery (TTS) and Without Receiving TTS. |
|--------------------------------------------------|
| Cleft Width | Maxillary Arch Width | Relative Cleft Width |
| Received TTS (n = 43) | 8.36 ± 3.64 | 35.02 ± 3.19 | 0.2368 ± 0.0968 |
| No TTS (n = 35) | 8.29 ± 3.43 | 34.68 ± 2.99 | 0.2377 ± 0.0925 |
| P-value | .933 | .627 | .964 |

A review of all consecutive medical charts from 2003 to 2017 yielded 78 patients who met the inclusion criteria. Thirty-two of those patients were female and 46 were male. In all children, surgical closure of the cleft palate was performed in the first year of life (mean: 9.53 ± 1.18 months). Forty-three patients received TTS during the follow-up time. There was little age difference between the time of cleft closure for the group who received TTS (9.49 ± 1.29 months) and those who did not (9.58 ± 1.05 months).

The mean cleft width hardly differed between patients who received TTS (8.36 ± 3.64) and those who did not (8.29 ± 3.43 mm). The mean width of the maxillary arch was comparable in the TTS-group (35.02 ± 3.19 mm) and the non-TTS group (34.68 ± 2.99 mm). The resulting relative cleft widths were therefore equally similar with 23.68 ± 9.7% in the TTS-group and 23.77 ± 9.3% in the non-TTS-group. There was no significant difference found for the cleft width (P = .933), the width of the maxillary arch (P = .627), and the relative cleft width (P = .964) between the two groups (see Table I).

Forty-three of the patients had CP (55%) and 35 had CLP (45%). Age, cleft width, maxillary arch width, and relative cleft width were significantly different in t-tests (see Table II). The relative risk to receive TTS was 1.53 for patients with CP (60.5%) and 0.94 for patients with CLP (46.6%). The odds ratio calculated from both relative risks was 0.62 (95% CI = 0.251–1.521). There was no significant difference between the two groups regarding TTS (P = .362, see Table II).

Twenty-three patients (29.5%) in the study group could be assigned to Veau-I, 20 (25.5%) to Veau-II, 21 (27%) to Veau-III and 14 (18%) to Veau IV classification. Age, cleft width, maxillary arch width, and relative

| TABLE II. Mean and Standard Deviation for Age, Cleft Width, Maxillary Arch Width, and Relative Cleft Width and Percentage of Receiving Tympanostomy Tube Surgery (TTS) in Children with Incomplete Cleft Palate (ICP) and Cleft Palate of Alveolus ± Lip (CP ± L). |
|--------------------------------------------------|
| Age | Cleft Width | Maxillary Arch Width | Relative Cleft Width | % Received TTS |
| ICP (n = 43) | 9.15 ± 1.23 | 6.91 ± 3.30 | 33.93 ± 3.15 | 0.2035 ± 0.094 | 60.5% (n = 26) |
| CP ± L (n = 35) | 10.01 ± 0.89 | 10.08 ± 2.90 | 36.04 ± 2.53 | 0.2786 ± 0.075 | 48.6% (n = 17) |
| P-value | .001 | <.0001 | .002 | <.0001 | .362 |

| TABLE III. Mean and Standard Deviation for Age, Cleft Width, Maxillary Arch Width, Relative Cleft Width, and Percentage of Receiving Tympanostomy Tube Surgery (TTS) in the Groups Veau I–IV. |
|--------------------------------------------------|
| Age | Cleft Width | Maxillary Arch Width | Relative Cleft Width | % Received TTS |
| Veau I (n = 23) | 8.69 ± 1.20 | 5.19 ± 2.36 | 33.27 ± 3.29 | 0.1583 ± 0.073 | 65.2% (n = 15) |
| Veau II (n = 20) | 9.68 ± 1.05 | 8.89 ± 3.25 | 34.69 ± 2.78 | 0.2556 ± 0.091 | 55.0% (n = 11) |
| Veau III (n = 21) | 9.9 ± 0.69 | 9.33 ± 2.15 | 35.74 ± 2.76 | 0.2606 ± 0.057 | 47.6% (n = 10) |
| Veau IV (n = 14) | 10.19 ± 1.01 | 11.21 ± 3.63 | 36.48 ± 2.05 | 0.3056 ± 0.095 | 50.0% (n = 7) |
| P-value | .0002 | <.0001 | .006 | <.0001 | .669 |

Laryngoscope 00: 2021

Schwarz et al.: Correlation of Cleft Type and Tympanostomy
TABLE IV.

| Veau  | No TTS | TTS Total | Concurrent | 1a Post | 2a Post | 3a Post |
|-------|--------|-----------|------------|---------|---------|---------|
| I (n = 23) | 8      | 15        | 10         | 0       | 3       | 2       |
| II (n = 20) | 9      | 11        | 4          | 2       | 2       | 3       |
| III (n = 21) | 11     | 10        | 8          | 1       | 0       | 1       |
| IV (n = 14) | 7      | 7         | 2          | 2       | 2       | 1       |

Cleft deformities are accompanied by anatomical changes in the soft palate and corresponding muscles. With cleft palates, muscles of the soft palate are not united at the median raphe and middle ear ventilation is not guaranteed. Inflammatory and non-inflammatory effusion can therefore develop in the tympanic cavity and lead to hearing impairment.

In this study, 78 patients with cleft palate were included. Out of those, 43 patients had CP and 35 had CLP. The intention of this study was to analyze the relationship between cleft type and width by measuring the cleft size on plaster cast models and the prevalence of TTS.

The applied measurement method (using a manual vernier calliper) was chosen because it has been shown to be reliable in previous studies. The selected landmarks were introduced by Hellquist and Skoog 1976. To ensure comparability with recent studies, the landmarks T and T' were selected. One disadvantage of the selected measurement method is depicted in Fig. 1. It represents a Veau-I cleft which extends T-T' only with its apical part. Especially in small cleft deformations like these, the selected measurement method tends to underestimate cleft width because the cleft apex is very close to T-T'. This may have affected the measured cleft width values in Veau-I patients, leading to a lower mean cleft size. On the contrary, a measurement further dorsally is problematical due to the lack of tray support of alginate impression and the consequent distortions in plaster models. 3D surface analyses were not applied. Three-dimensional evaluation of the anatomy is required when measurements are made that go beyond one plane. In this study, only two-dimensional distance lines were measured, so that the presented method using a vernier calliper appeared to be sufficient.

TTS has shown itself to be an effective tool for treating middle ear effusion in cleft patients. Some authors suggest TTS to be performed concomitant to palatoplasty, as it can improve hearing development in the patient. Even early long-term tympanostomy tubes prior to palatoplasty are considered a treatment option for increasing middle ear ventilation. However, the risks of TTS should not be underestimated: myringosclerosis, segmental atrophy, purulent otorrhea, and other complications can occur after TTS, and should be considered when deciding to opt for TTS.

The age of the patients at the date of surgery varied between CP and CLP patients (see Table II) and also among the Veau groups I–IV (see Table III). Even if these differences were statistically significant, the maximum difference in age (mean) was comparably small with 1.5 months at the time of palatoplasty. Such a difference may be due to the surgical plan or the interval between previous surgeries (in case of CLP it would be lip correction).

In our study group, 43 patients (55%) received TTS. In this group, 24 patients (55.8%) received TTS concurrently to palatoplasty and 19 patients (44.2%) received TTS subsequent to palatoplasty and 19 patients (44.2%) received TTS prior to palatoplasty. Thirty-five of the patients (45%) received palatoplasty alone and did not require TTS during the follow-up. It remains to be seen if the 19 patients who received TTS subsequent to palatoplasty could have profited from TTS placement concurrently to palatoplasty. Additional surgery and anesthesia could presumably have been avoided. We explored a group of 35 patients who were treated successfully without TTS during the follow-up. In these cases, TTS was not necessary and no additional risks from TTS placement were taken. Therefore, it seems possible to improve middle ear ventilation with palatoplasty in some (but not all) of our patients.

DISCUSSION

Cleft deformities are accompanied by anatomical changes in the soft palate and corresponding muscles. With cleft palates, muscles of the soft palate are not united at the median raphe and middle ear ventilation is not guaranteed. Inflammatory and non-inflammatory effusion can therefore develop in the tympanic cavity and lead to hearing impairment.

In this study, 78 patients with cleft palate were included. Out of those, 43 patients had CP and 35 had CLP. The intention of this study was to analyze the relationship between cleft type and width by measuring the cleft size on plaster cast models and the prevalence of TTS.

The applied measurement method (using a manual vernier calliper) was chosen because it has been shown to be reliable in previous studies. The selected landmarks were introduced by Hellquist and Skoog 1976. To ensure comparability with recent studies, the landmarks T and T' were selected. One disadvantage of the selected measurement method is depicted in Fig. 1. It represents a Veau-I cleft which extends T-T' only with its apical part. Especially in small cleft deformations like these, the selected measurement method tends to underestimate cleft width because the cleft apex is very close to T-T'. This may have affected the measured cleft width values in Veau-I patients, leading to a lower mean cleft size. On the contrary, a measurement further dorsally is problematical due to the lack of tray support of alginate impression and the consequent distortions in plaster models. 3D surface analyses were not applied. Three-dimensional evaluation of the anatomy is required when measurements are made that go beyond one plane. In this study, only two-dimensional distance lines were measured, so that the presented method using a vernier calliper appeared to be sufficient.

TTS has shown itself to be an effective tool for treating middle ear effusion in cleft patients. Some authors suggest TTS to be performed concomitant to palatoplasty, as it can improve hearing development in the patient. Even early long-term tympanostomy tubes prior to palatoplasty are considered a treatment option for increasing middle ear ventilation. However, the risks of TTS should not be underestimated: myringosclerosis, segmental atrophy, purulent otorrhea, and other complications can occur after TTS, and should be considered when deciding to opt for TTS.

The age of the patients at the date of surgery varied between CP and CLP patients (see Table II) and also among the Veau groups I–IV (see Table III). Even if these differences were statistically significant, the maximum difference in age (mean) was comparably small with 1.5 months at the time of palatoplasty. Such a difference may be due to the surgical plan or the interval between previous surgeries (in case of CLP it would be lip correction).

In our study group, 43 patients (55%) received TTS. In this group, 24 patients (55.8%) received TTS concurrently to palatoplasty and 19 patients (44.2%) received TTS 1–3 years after surgery. Thirty-five of the patients (45%) received palatoplasty alone and did not require TTS during the follow-up. It remains to be seen if the 19 patients who received TTS subsequent to palatoplasty could have profited from TTS placement concurrently to palatoplasty. Additional surgery and anesthesia could presumably have been avoided. We explored a group of 35 patients who were treated successfully without TTS during the follow-up. In these cases, TTS was not necessary and no additional risks from TTS placement were taken. Therefore, it seems possible to improve middle ear ventilation with palatoplasty in some (but not all) of our patients.
patients. Thus, no general guideline for conducting TTS in cleft patients can be derived from our data. It seems instead that TTS remains an individual case decision which has to be made by the surgeon, otolaryngologist, and pediatrician.

Nevertheless, to enable the clinician to estimate the necessity of TTS in patients with cleft palate, we examined if there was a relation between cleft configuration and the prevalence of TTS. Intuitively, one would expect that a pronounced deformation of the cleft would lead to increased middle ear dysfunction, and that TTS would appear to be a helpful treatment option. However, the opposite could be found in our study group: CP patients received TTS more often (60.5%, n = 26) than CLP patients (48.6%, n = 17). The odds ratio of 0.62 for TTS in CLP patients, indicates a lower risk for TTS in patients with CLP compared to patients with CP. Statistical significance for the odds ratio could not be obtained (P = .362).

A low Veau classification appears to be a factor which leads more likely to TTS. While patients with Veau I cleft deformity received TTS in 65.2% of cases, only 55.0% of Veau II, 47.6% of Veau III, and 50.0% of Veau IV classified patients underwent TTS. No significant differences could be determined between the groups.

The negative trend of cleft width and the prevalence for TTS could be explained with postoperative tissue tension: patients with wide clefts and pronounced cleft stages have higher soft tissue deficiency. The surgeon must therefore mobilize the existent tissue more extensively and conduct the adaption under a higher tissue drag. The drag on the Eustachian tube may then increase more in patients with wider clefts, enabling better middle ear ventilation.

It can therefore be stated that palatoplasty may improve middle ear ventilation, but does not guarantee the prevention of middle ear effusion. TTS was not performed more often in patients with advanced cleft deformity. By contrast, none of the cleft characteristics examined had a significant impact on the performance of TTS in patients with TTS. The medical practitioner should therefore pay equal attention to hearing and speech development, as well as audiometric diagnostics in children with a low deformity of the secondary palate. In our study group, patients with lower Veau classifications and smaller cleft dimensions were more likely to develop a middle ear effusion. Future studies should investigate a larger population to prove the statistical significance of these findings. 3D analyses of the plaster models would also give additional information about spatial anatomical alterations and its impact on middle ear ventilation in patients with cleft deformities.

CONCLUSION
This study investigated the correlation of cleft configuration and TTS. No statistical significance could be found for a difference in the prevalence of TTS and cleft configuration. In the study, patients with clefts of the secondary palate appeared more likely to receive TTS than patients with a combined defect of the secondary and primary palate. Palatoplasty and TTS are valuable treatment options for preventing hearing loss; therefore, we recommend performing a thorough clinical examination and additional diagnostics (such as tympanometry and audiometry) in patients with cleft palate, regardless of the severity of the cleft configuration.

ACKNOWLEDGMENT
Open access funding enabled and organized by Projekt DEAL.

REFERENCES
1. Alper CM, Losee JE, Seroky JT, Mandel EM, Richert BC, Doyle WJ. Resolution of otitis media with effusion in children with cleft palate followed through five years of age. Cleft Palate Craniofac J 2016;53:607–613. https://doi.org/10.1597/15-130.
2. Ishijima K, Sando I, Balaban CD, Miura M, Takasaki K. Functional anatomy of levator veli palatini muscle and tensor veli palatini muscle in association with eustachian tube cartilage. Ann Otol Rhinol Laryngol 2002;111:530–536. https://doi.org/10.1177/000348490211100609.
3. George TN, Kotelkarel KJ, Kuehn DP, Sutton BF, Perry JL. Differences in the tensor Veli Palatini between adults with and without cleft palate using high-resolution 3-dimensional magnetic resonance imaging. Cleft Palate Craniofac J 2018;55:697–705. https://doi.org/10.1177/105857117752902.
4. Funamula JL, Said M, Lin SJ, McKinney S, Tollefsen TT. Eustachian tube dysfunction in children with cleft palate: a tympanometric time-to-event analysis. Laryngoscope 2020;130:1044–1050. https://doi.org/10.1002/lary.29763.
5. Parmar S, Daressel JR, Singh G, Arora N, Kansal L, Singh J. Prevalence of otitis media with effusion in children with hearing loss. Indian J Otolaryngol Head Neck Surg 2019;71:1276–1281. https://doi.org/10.1007/s12070-018-1310-y.
6. Sharma RK, Nanda V. Problems of middle ear and hearing in cleft children. Indian J Plast Surg 2009;42:514–518. https://doi.org/10.4103/0970-3583.57198.
7. Ungkanont K, Boonyamb hit P, Komoltrit C, Tanphachitr A, Vathanophas V. Surveillance of otitis media with effusion in Thai children with cleft palate: cumulative incidence and outcome of the management. Cleft Palate Craniofac J 2018;55:590–595. https://doi.org/10.1177/1055665617730361.
8. Böhm G. Sprach-, Sprech-, Stimm- Und Schluckstörungen: Band I: Klinik Von, https://www.medimops.de/gerhard-boehm-sprech-stimm-und-schlussstorungen-band-i-klinik-taschenbuch-m00343731940.html. Accessed November 13, 2020.
9. Brgeo MS, Dodson KM, Kim TC, Kim DM, Trivelpiece R, Rhodes JL. Timing of Tympanostomy Tube Placement and Efficacy of Palatoplasty Technique on the Resolution of Chronic Otitis Media: A Cross-Sectional Analysis. Eplasty 2015;15:e32.
10. Krasnova M, Knebel JP, El Ezzi O, Artax M, de Buys Roessingh AS, Richard C. Influence of infancy care strategy on hearing in children and adolescents: a longitudinal study of children with unilateral lip and/or cleft palate. Int J Pediatr Otorhinolaryngol 2018;114:80–86. https://doi.org/10.1016/j.ijporl.2018.04.031.
11. Penner Z, Weissenborn J, Friederici AD. In: Karnath H-O, ed. Sprachentwicklung: Kognitive Neurowissenschaften: Springer; 2012 https://www.amazon.de/Kognitive-Neurowissenschaften-Springer-Lehrbuch-Hans-Otto-Karnath/dp/3642255264. Accessed June 15, 2020.
12. Alt A. Heilung Der Taubstumme Erzielt Durch Beseitigung Einer Otstarre Und Einer Angeborenen Gaumenapla. Arch Angenheilkunde; 7. Karlsruhe, Germany: Carlsruhe Müller'sche Hofbuchhandlung; 1878.
13. Quante M, Eser G, Koch H, Kogge J. Mittelohrrhegisse Als Regelbedarf Bei Lippen-Kiefer-Gaumenspalten. Arch.
14. Rivelli RA, Casadio V, Bennun RD. Audiological alterations in patients with cleft palate. J Craniofac Surg 2018;29:1486–1489. https://doi.org/10.1053/j.jcxs.2017.07.027.
15. Teblick S, Buymaekers M, Van de Casteele E, Nadjmi N. Effect of cleft palate closure technique on speech and middle ear outcome: a systematic review. J Oral Maxillofac Surg 2019;77:405.e1–405.e15. https://doi.org/10.1016/j.joms.2018.09.027.
16. Yang C-H, Lai J-P, Lee A-C, Cheng L-H, Hwang C-F. Prognostic factors for hearing outcomes in children with cleft lip and palate. Plast Reconstr Surg 2019;143:368e–374e. https://doi.org/10.1097/PRS.00000000000056219.
17. Jin M, Takahashi H, Iino Y, et al. Clinical practice guidelines for the diagnosis and management of otitis media with effusion (OME) in children in Japan, 2015. Auris Nasus Larynx 2017;44:501–508. https://doi.org/10.1016/j.anl.2017.03.018.
18. Lautermann J, Begall K, Hilger G, et al. Leitlinie Sero/Mukotympanon. S2k-Leitlinie 017-004: Seromukotympanon. Karlsruhe, Germany: Carlsruhe Müller'sche Hofbuchhandlung; 1878.
19. Desmedt DJ, Mael TJ, Kuijpers MA, Bronkhorst EM, Kuijpers-Jagtman AM, Fudalej PS. Nasolabial symmetry and esthetics in cleft lip
and palate: analysis of 3D facial images. Clin Oral Investig 2015;19:1833–1842. https://doi.org/10.1007/s00784-015-1445-0.

20. Seckel NG, van der Tweel I, Elema GA, Speeken TF. Landmark positioning on maxilla of cleft lip and palate infant—a reality? Cleft Palate Craniofac J 1995;32:434–441. https://doi.org/10.1597/1545-1569_1995_032_0434_lpmor_2.3.co_2.

21. Hellquist R, Skoog T. The influence of primary periosteoplasty on maxillary growth and deciduous occlusion in cases of complete unilateral cleft lip and palate: a longitudinal study from infancy to the age of 5. Scand J Plast Reconstr Surg 1976;10:197–208. https://doi.org/10.3109/02844317609012969.

22. Parwaz MA, Sharma RK, Parashar A, Nanda V, Biswas G, Makkar S. Width of cleft palate and postoperative palatal fistula – do they correlate? Journal of Plastic, Reconstructive & Aesthetic Surgery 2009;62:1559–1563. https://doi.org/10.1016/j.bjps.2008.05.048.

23. Edetanlen EB, Saheeb BD. Otitis media with effusion in Nigerian children with cleft palate: incidence and risk factors. British Journal of Oral and Maxillofacial Surgery 2019;57:36–40. https://doi.org/10.1016/j.bjoms.2018.11.015.

24. Huang M, Zhao S, Li Y, Peng X, Kuang Y, Long S. The effect of tympanostomy tube surgery in cleft palate children with secretory otitis media. Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi 2012;26:1017–1019.

25. Shaffer AD, Ford MD, Choi SS, Jabbour N. Should children with cleft palate receive early long-term tympanostomy tubes: one institution's experience. Cleft Palate Craniofac J 2018;55:389–395. https://doi.org/10.1177/1055665617736775.

26. Vlastarakos PV, Nikolopoulos TP, Korres S, Tavoulari E, Tzagaroulakis A, Ferekidis E. Grommets in otitis media with effusion: the most frequent operation in children. But is it associated with significant complications? Eur J Pediatr 2007;166:385–391. https://doi.org/10.1007/s00431-006-0367-x.