

# Telemedicine as a Means of Effective Speech Evaluation for Cleft Palate Patients

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**Abstract:** Providing long-term multidisciplinary care for cleft lip/palate is a challenge for international humanitarian organizations that perform surgery across borders. The use of telemedicine as a means of evaluating speech in patients with cleft lip/palate has not been studied previously. We looked at determining whether a speech evaluation performed by a speech-language pathologist (SLP) using telemedicine would be equivalent to a speech evaluation performed in-person, in an international setting between Tijuana, Mexico and San Diego, CA. Spanish-speaking SLPs developed an informal protocol to evaluate several speech characteristics. Patients were simultaneously evaluated by 2 SLPs, one in-person in Tijuana and the other over telemedicine videoconference from San Diego, CA. In addition, we obtained data regarding the parents experience with telemedicine through a satisfaction survey. Results showed no statistically significant differences between the 2 methods of speech evaluation, particularly in oral muscle tone, resonance, lingual lateralization, oral pressure, and dentition. The satisfaction survey showed family satisfaction with the speech evaluation performed using telemedicine. Thus, telemedicine represents an effective medium for conducting speech assessment in patients with cleft lip/palate, allowing for increased access to care for underserved populations.

**Key Words:** telemedicine, international telemedicine, speech therapy, speech evaluation, cleft lip and palate

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The treatment of cleft lip/palate and craniofacial anomalies requires both surgery and long-term follow-up care from a large multidisciplinary team. Long-term follow-up care includes speech therapy performed by a trained speech-language pathologist (SLP). Some children who have received cleft lip/palate surgery may have difficulty with speech development and require years of speech therapy after surgery to overcome problems with articulation, resonance, and intelligibility.<sup>1</sup> SLPs are the primary means by which children who have received cleft lip/palate surgery work toward speech improvement. The multidisciplinary team also consists of plastic surgeons, nurses, pediatric otolaryngologists, dentists, orthodontists, audiologists, psychologists, social workers, geneticists, and anesthesia support. The causes of cleft lip and palate are multifactorial and involve both genetic and environmental influences.<sup>2</sup>

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Children who are born with cleft lip/palate in underserved nations frequently do not have access to all necessary aspects of treatment. Although many universities and international charity organizations work to provide the surgery portion of treatment across borders, unfortunately there is frequently a gap in long-term follow-up care because of the distances involved and time limitations of clinicians. Telemedicine can provide innovative solutions to the difficulties international humanitarian organizations face in providing multidisciplinary team care<sup>3</sup> and follow-up care, particularly for speech services. Through advances in videoconferencing and telecommunications technology, telemedicine has been increasingly recognized as a viable method to improve access to care at sites distant from the caregiver.<sup>4</sup> The American Telemedicine Association defines telemedicine as “the use of medical information exchanged from one site to another via electronic communications to improve patients’ health visits.”<sup>5</sup> Telemedicine has generally been shown to be both cost effective and accurate, improving care for patients in remote international locations.<sup>3</sup>

Telemedicine is currently used by an international multidisciplinary cleft palate and craniofacial team at the Hospital Infantil de las Californias (HIC) in Tijuana, Mexico in collaboration with the nonprofit organization, ConnectMed International, and the University of California, San Diego Division of Plastic Surgery. This collaboration is a unique setup that allows for constant interaction from team members on both sides of the border and includes surgeons, psychologists, dentists, and SLPs. Regularly scheduled clinics allow for interaction of all members of the team (some over teleconference) with one patient at a time. The HIC was established in 1994 to provide specialty medical care to underserved populations in Mexico as well as California. The HIC predominately functions as an outpatient pediatric medical specialty clinic, which serves approximately 2500 patients a month. The use of telemedicine as a means of providing a speech evaluation to cleft lip/palate patients has not previously been studied. We hypothesized that a speech evaluation performed via telemedicine would produce statistically similar results as a speech evaluation performed in person.

In addition, the children’s parents (or guardians) completed a satisfaction survey to evaluate their experience with the speech assessment provided via telemedicine. Previous studies have shown favorable satisfaction scores for pediatric patients participating in telemedicine.<sup>6,7</sup> These studies have found factors that have been shown to positively impact family and patient satisfaction; they include comfort with telemedicine, prior use of telemedicine, and ease of communication.<sup>7</sup> Previous reports have also documented successful international telemedicine efforts.<sup>8</sup>

By gathering data of parent/guardian impressions of the potential for speech therapy to be provided through telemedicine, we could determine if this form of treatment is a feasible option. Our hypothesis was that the parents/guardians would be accepting of the addition of speech therapy via telemedicine as an improvement to their current speech therapy, based at least in part on the increased frequency of telemedicine treatment versus in-person treatment.

**MATERIALS AND METHODS**

Spanish-speaking SLPs volunteered to collaborate with the international multidisciplinary cleft palate and craniofacial team, at the HIC in Tijuana, Mexico. To assess the patient’s speech, SLPs developed an informal protocol to evaluate several speech characteristics on single-word naming tasks. The evaluation occurred simultaneously in real-time by 2 SLPs, one in-person at the HIC in Tijuana and the other via telemedicine videoconference in San Diego, CA. Simultaneous evaluation allowed for the determination of whether an SLP could effectively assess speech through telemedicine.

The speech evaluation protocol was used to record various aspects of the patient’s speech, including oral pressure, resonance, and articulation. Although there are multiple methods of objectively and subjectively evaluating speech in patients with cleft lip/palate, there is no universal test for evaluating speech samples in these patients. In collaboration with the SLPs, we chose a standardized articulation test, the Medida Espanola de Articulacion (MEDA) test by Mason Smith and Hinshaw (1976), which provides a set of picture prompts for the patients to name. The Medida Espanola de Articulacion test tests articulation skills at the single word level in Spanish. This provided consistent target words for the SLPs to use for their informal protocol evaluation.

Subjects consisted of 9 patients ages 5 to 14 years ( $n = 9$ ), who had surgical cleft palate repair and were receiving follow-up care in the HIC clinic. The children and their parents agreed to participate in the study via informed consent. The parents of the subjects completed a satisfaction survey that addressed the impact of telemedicine on their child as a tool for evaluating their speech and assessed the degree to which the parents accepted or were amenable to this mode of interaction. Survey questions included how well the subject’s parents could see and hear the SLP, whether they understood the instructions of the SLP, the comfort level of their child, and whether they felt like they were getting adequate testing using telemedicine compared with in person.

Equipment included 2 HIPAA compliant telemedicine video-conference systems on a dedicated Internet line, one located in a physician’s office at University of California, San Diego or the Fresh Start Clinic at Rady Children’s Hospital in San Diego, CA, and the other located in a patient examination room of the HIC clinic. An important technical requirement for creating an effective telecommunication session is creating a telecommunication setup that allows for optimum sound and picture quality. Although telemedicine technology is constantly improving, technical difficulties remain a barrier to patient-provider communication, especially regarding audio and video quality in underserved regions. The impact of technical difficulties on the interaction is addressed in the satisfaction survey, where the occurrence of technical difficulties had an impact on parent perspectives of the speech assessment via telemedicine.

**RESULTS**

Speech evaluation data was calculated using a Cohen’s kappa coefficient. This is a statistical measure of inter-rater agreement for qualitative (categorical) items. Results are shown in Table 1, which illustrates percent agreement between the in-person speech evaluation versus the telemedicine evaluation. Results indicate little difference between in-person and telemedicine speech evaluations for oral muscle tone, resonance, lingual lateralization, oral pressure, and dentition. Results for lingual elevation, nasal/facial grimacing, palatal movement, and nasal air emission showed a positive correlation between in-person and telemedicine speech evaluation, but these correlations were not statistically significant.

Results of the satisfaction survey were analyzed using frequency distribution with median as the central tendency mea-

**TABLE 1.** Speech Evaluation Comparison Results Between In-Person and Telemedicine Speech Evaluation

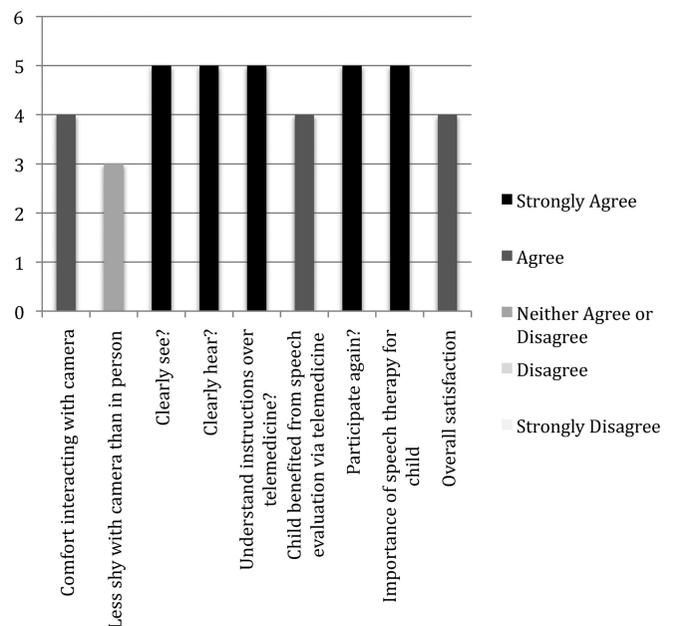
Measurement	Percent Agreement	Kappa	P
Oral muscle tone	100.00%	1	0.001
Resonance	100.00%	1	0.003
Lingual lateralization	88.89%	0.471	0.001
Breath support	88.89%	0.609	0.024
Oral pressure	66.67%	0.426	0.037
Dentition	55.56%	0.455	0.0008
Lingual elevation	77.78%	0.125	0.646
Nasal/facial grimacing	66.67%	0.372	0.076
Palatal movement	66.67%	0.174	0.715
Nasal air emission	55.56%	0.308	0.052
Articulation	44.44%	0.274	0.057

surement. A 5-point scale was used with the most positive response being 5 (eg, strongly agreed), a neutral response being 3, and most negative being 1 (eg, strongly disagree). Results are shown in Figure 1.

In summary, parents believed that their child was comfortable interacting with the camera and could clearly see, hear, and understand the directions of the SLP on the other end of the videoconference. Parents believe speech therapy in general is very important for their child, that their child benefited from the session of speech evaluation provided by telemedicine and would participate in speech evaluation or speech therapy provided through the video conference again. Overall, satisfaction regarding telemedicine to evaluate speech was positive.

**DISCUSSION**

This study illustrates that it is feasible to evaluate speech using telemedicine with patients located remotely from the SLP. The lack of consistent, uninterrupted audio and video transmission at times impacted the quality of the telemedicine experience. Improv-



**FIGURE 1.** Satisfaction survey results.

ing the internet connection to provide larger transmission bandwidth and using brand new 4G technology would make telemedicine encounters more clear and make it easier for the patient and the SLP to interact more efficiently and without interruption. Due to site technology limitations, high definition video was not used but this would be an obvious improvement to video quality. This might allow for better visualization of elements of the speech evaluation that rely on assessing the patient's face and mouth, (eg, dentition, lingual elevation, palatal movement, and nasal-facial grimacing).

We found that there was no statistically significant difference in speech evaluation for examining oral muscle tone, resonance, lingual lateralization, oral pressure, and dentition. Due to the small *n* we cannot draw statistically significant conclusions for a number of the speech evaluation parameters; however, our data suggest that telemedicine speech evaluation is very similar to in-person speech evaluation. Data will continue to be collected when more appropriate patients come for treatment at the HIC. We believe, however, that adequate speech evaluation could be performed via telemedicine in situations where in-person evaluation is not available.

As mentioned in the methods section, our assessment was based on an informal evaluation that was put together by experienced SLPs and covered elements of speech that are characteristic of patients with cleft lip/palate. Our results show, that subjectivity of evaluation by different SLPs did not impact the study. The data suggests there is little difference between in-person and telemedicine speech evaluation. Possible future applications of this study would use the same speech evaluation tool to compare clinical improvement after multiple speech therapy sessions provided through telemedicine versus through traditional in-person therapy. The eventual goal for integrating telemedicine as a tool in providing speech therapy would be to assess whether it is possible to improve clinical outcomes in patients with cleft lip/palate patients.

Overall, the patients and their families were satisfied with the speech evaluation provided via telemedicine and believe it was beneficial to their child. Parents believe that speech therapy is

important in the care of their children with cleft lip/palate. They would take advantage of and participate in more telemedicine speech sessions if provided the opportunity. Our study supports prior studies that evaluated patient satisfaction with telemedicine in aiding to provide clinical care. Telemedicine has the capacity to increase use of speech therapy for patients that have frequently not been able to access care. As technology improves and patients become more familiar with this mode of treatment, quality of care will likely improve, moving toward the standard of care.

Telemedicine, by facilitating access to multidisciplinary care, may help improve access to treatment for cleft lip/palate and craniofacial anomalies in underserved populations. This study portrays an application of telemedicine as a potential tool in providing long-term care.

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## AUTHOR QUERIES

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