EPG and Palatometry Use in Treatment

Abstract: Electropalatography (EPG) has been used in research for more than 30 years to understand the production of typical speech sounds in multiple languages. It has also been used to explore disordered sound production in a wide variety of ages and conditions. It has useful applications in both assessing and treating a variety of speech-related disorders, including: Cleft-palate, hearing impairment and cochlear implants, developmental articulation and phonological disorders, apraxia of speech, dysarthria, swallowing, and fluency. It has been used successfully in children, adolescents and adults.

EPG provides the user with a real-time visual representation of lingua-palatal contact patterns. This information has been useful to researchers in exploring typical and disordered sound production in a variety of languages. For examples see (Gibbon, Lee, & Yuen, 2007; McAuliffe & Cornwell, 2008; McAuliffe & Ward, 2006). This information has also proven to be useful in both assessing and treating articulation difficulties.

EPG use in treatment was first reported in 1977 by Abe, Fukusako, and Sawashima. Their publication described the treatment of 60 patients with cleft palate. Since that time, researchers and designers have worked together to make EPG more practical, affordable and accessible to clinicians, for examples see (Barry, 1989; Gibbon & Paterson, 2006; Hamlet, 1973; Hamlet & Stone, 1978; Hardcastle, Gibbon, & Jones, 1991; Hardcastle, Jones, Knight, Trudgeon, & Calder, 1989; Schmidt, 2007; Wrench, 2007).

Treatment of Articulation and Phonological disorders

Numerous studies have been published concerning the use of EPG in the treatment of many articulation and phonological disorders in both children and adults. These studies include those for rhotic sounds (Schmidt, 2007); velar and alveolar plosives, fricatives and affricates (Carter & Edwards, 2004; Dent, 2001; Dent, Gibbon, & Hardcastle, 1995; Friel, 1998; Gibbon, 1999; Gibbon, Dent, & Hardcastle, 1993; Gibbon, Hardcastle, Dent, & Nixon, 1996; Gibbon, Mcneil, Wood, & Watson, 2003; Hardcastle, Barry, & Clark, 1987; Hardcastle et al., 1991; McAuliffe & Ward, 2006; Schmidt, 2007); velar nasal ng (Gibbon et al., 2003; Schmidt, 2007); lateralization of sibilant fricatives and affricates (Dagenais, Critz-Crosby, & Adams, 1994; Dent et al., 1995; Gibbon & Hardcastle, 1987; Gibbon et al., 1996; Gibbon, Hardcastle, & Moore, 1990; Syder, 1998); phonological disorders (Dagenais, 1995; Dent, 2001; Dent et al., 1995; Hardcastle et al., 1987; Hardcastle et al., 1991; McAuliffe & Ward, 2006).

In 2006, Gibbon surveyed speech-language therapists in Scotland who treated children with articulation disorders or cleft-palate over the course of 10 years. The results indicated that speech-language therapists judged that the majority of participants had improved their articulation to some extent, and almost all had increased awareness of their own articulation difficulties.

Accent Modification (Bright, 1999; Gibbon, Hardcastle, & Suzuki, 1991; Hazan, 2005; Schmidt & Beamer, 1998)

Cleft-palate (Abe et al., 1977; Bernhardt, Bacsfalvi, Gick, Radanov, & Williams, 2005; Butcher, 1996; Dent et al., 1995; Fujiwara, 2007; Gibbon, 2004; Gibbon et al., 1998; Gibbon, Ellis, & Crampin, 2004; Gibbon & Hardcastle, 1989; Gibbon et al., 2001; Gibbon, Smeaton-Ewins, & Crampin, 2005; Hardcastle et al., 1991; McAuliffe & Ward, 2006; Michi, Suzuki, Yamashita, & Imai, 1986; Michi, Yamashita, Imai, Suzuki, & Yoshida, 1993; Schmidt, 2007; Suzuki, 1989; Whitehill, Stokes, & Yonnie, 1996)

Hearing Impairment
(Bernhardt et al., 2005; Bernhardt, Gick, Bacsfalvi, & Ashdown, 2003; Crawford, 1995; Dagenais, 1992; Dagenais, Critz-Crosby, Fletcher, & McCutcheon, 1994; Dent, 2001; Dew, Glaister, & Roach, 1989; Martin, Hirson, Herman, Thomas, & Pring, 2007; Schmidt, 2007)

Cochlear Implant
(Bernhardt, Loyst, Pichora-Fuller, & Williams, 2000; Butcher, 1996; Pantelemidou, Herman, & Thomas, 2003)

Apraxia of Speech (Hardcastle et al., 1991; Howard & Varley, 1995; Lundeborg & McAllister, 2007; McAuliffe & Ward, 2006; Schmidt, 2007)

Dysarthria (Barry, 1995; Goldstein, Wolfram, Vogel, & Hoole, 1994; Hamilton, 1993; Hardcastle et al., 1987; Morgan, Liegeois, & Occomore, 2007)

Swallowing (Chi-Fishman & Stone, 1996)

Stuttering (Forster & Hardcastle, 1998)

TBI (Goldstein et al., 1994; Hartelius, 2005; Kuruvilla, Murdoch, & Goozee, 2008; Morgan et al., 2007)

Glossectomy (Suzuki, 1989)

Down Syndrome (Gibbon et al., 2003; Hamilton, 1993; Timmins, Cleland, Wood, Hardcastle, & Wishart, 2009; Wood, Wishart, Hardcastle, Cleland, & Timmins, 2009)

Cerebral Palsy (Gibbon & Wood, 2003)

Abe, M., Fukusako, Y., & Sawashima, M. (1977). Results of articulation training on 60 cleft palate patients. *The Japan Journal of Logopedics and Phoniatrics, 18*(2), 13-19.

Barry, R. (1989). EPG from square one: An overview of electropalatography as an aid to therapy. *Clinical Linguistics & Phonetics, 3*(1), 81-91.

Barry, R. (1995). EPG treatment of a child with the Worster-Drought syndrome. *European Journal of Disorders of Communication, 30*, 256-263.

Bernhardt, B., Bacsfalvi, P., Gick, B., Radanov, B., & Williams, R. (2005). Exploring the use of electropalatography and ultrasound in speech habilitation. *Canadian Journal of Speech Language Pathology and Audiology, 29*(4), 2005.

Bernhardt, B., Gick, B., Bacsfalvi, P., & Ashdown, J. (2003). Speech habilitation of hard of hearing adolescents using electropalatography and ultrasound as evaluated by trained listeners. *Clinical Linguistics & Phonetics, 17*(3), 199-216.

Bernhardt, B., Loyst, D., Pichora-Fuller, K., & Williams, R. (2000). Speech production outcomes before and after palatomtery for a child with a cochlear implant. *Journal of the academy of rehabilitative audiology, 33*, 11-37.

Bright, A. (1999). *The palatometer as an instrument for accent reduction therapy with three native ESL spanish speakers.* Brigham Young University, Provo.

Butcher, A. (Ed.). (1996). *Underlying Representations in the acquisition of phonology: Evidence from 'Before and After' Speech*. London: Whurr.

Carter, P., & Edwards, S. (2004). EPG therapy for children with long-standing speech disorders: predictions and outcomes. *Clinical Linguistics & Phonetics, 18*(6-8), 359-372.

Crawford, R. (1995). Teaching voiced velar stops to profoundly dear children, using EPG-two case studies. *Clinical Linguistics & Phonetics, 9*(3), 255-269.

Dagenais, P. (1992). Speech training with glossomtery and palatometry for profoundly hearing-impaired children. *Volta Review, 94*, 261-282.

Dagenais, P. (1995). Electropalatography in the treatment of articulation/phonological disorders. *Journal of Communication Disorders, 28*, 303-329.

Dagenais, P., Critz-Crosby, P., & Adams, J. (1994). Defining and remediating persistent lateral lisps in children using electropalatography: Preliminary findings. *American Journal of Speech-Language Pathology, 3*, 67-76.

Dagenais, P., Critz-Crosby, P., Fletcher, S., & McCutcheon, M. (1994). Comparing Abilities of Children With Profound Hearing Impairments to Learn Consonants Using Electropalatography or Traditional Aural.Oral Techniques. *Journal of Speech and Hearing Research, 37*(3), 687-699.

Dent, H. (Ed.). (2001). *Electropalatography: A tool for psycholinguistic therapy*. London: Whurr Publishers, Ltd.

Dent, H., Gibbon, F., & Hardcastle, W. (1995). The application of EPG to the remediation of speech disorders in school aged children and young adults. *European journal of disorders of communication: the journal of the College of Speech and Language Therapists, London, 30*, 264-277.

Dew, A., Glaister, N., & Roach, P. (1989). Combining displays of EPG and automatic segmentation of speech for clinical purposes. *Clinical Linguistics & Phonetics, 3*(1), 71-80.

Friel, S. (1998). When is a /k/ not a /k/? EPG as a diagnostic and therapeutic tool for abnormal velar stops. *International Journal of Language & Communication Disorders, 33*(supplement), 439-444.

Fujiwara, Y. (2007). Electropalatography home training using a portable training unit for Japanese children with cleft palate. *Advances in Speech-Language Pathology, 9*(1), 65-72.

Gibbon, F. (1999). Widening access to electropalatography for children with persistent sound system disorders. *American Journal of Speech-Language Pathology, 8*, 319-334.

Gibbon, F. (2004). Abnormal patterns of tongue-palate contact in the speech of individuals with cleft palate. *Clinical Linguistics & Phonetics, 18*(4-5), 285-311.

Gibbon, F., Crampin, L., Hardcastle, B., Nairn, M., Razzell, R., Harvey, L., et al. (1998). CLEFTNET (SCOTLAND): A NETWORK FOR THE TREATMENT OF CLEFT PALATE SPEECH USING EPG. *International Journal of Language & Communication Disorders, 33*, 44.

Gibbon, F., Dent, H., & Hardcastle, W. (1993). Diagnosis and therapy of abnormal alveolar stops in a speech-disordered child using electropalatography. *Clinical Linguistics & Phonetics, 7*(4), 247-267.

Gibbon, F., Ellis, L., & Crampin, L. (2004). Articulatory placement for /t/, /d/, /k/ and /g/ targets in school age children with speech disorders associated with cleft palate. *Clinical Linguistics & Phonetics, 18*(6-8), 391-404.

Gibbon, F., Hardcastle, B., & Suzuki, H. (1991). An electropalatographic study of the /r/, /l/ distinction for Japanese learners of English. *Computer Assisted Language Learning, 4*(3), 153-171.

Gibbon, F., & Hardcastle, W. (1987). Articulatory description and treatment of "lateral /s/" using electropalatography: a case study. *British Journal of Disorders of Communication, 22*, 203-217.

Gibbon, F., & Hardcastle, W. (1989). Deviant articulation in a cleft palate child following late repair of the hard palate: a description and remediation procedure using electropalatography (EPG). *Clinical Linguistics & Phonetics, 3*(1), 93-110.

Gibbon, F., Hardcastle, W., Crampin, L., Reynolds, B., Razzell, R., & Wilson, J. (2001). Visual feedback therapy using electropalatography (EPG) for articulation disorders associated with cleft palate. *Asia Pacific Journal of Speech, Language and Hearing, 6*, 53-58.

Gibbon, F., Hardcastle, W., Dent, H., & Nixon, F. (Eds.). (1996). *Description and treatment of abnormal sibilant production in a group of school-aged children using electropalatography*. Amsterdam: John Benjamins Company.

Gibbon, F., Hardcastle, W., & Moore, A. (1990). Modifying abnormal tongue patterns in an older child using electropalatography. *Child Language Teaching & Therapy, 6*, 227-245.

Gibbon, F., Lee, A., & Yuen, I. (2007). Understanding speech production using electropalatography. *Advances in Speech-Language Pathology, 9*(1), 1-2.

Gibbon, F., Mcneil, A., Wood, S., & Watson, J. (2003). Changes in linguapalatal contact patterns during therapy for velar fronting in a 10-year old with Down's Syndrome. *International Journal of Language & Communication Disorders, 38*(1), 47-64.

Gibbon, F., & Paterson, L. (2006). A survey of speech and language therapists' views on electropalatography therapy outcomes in Scotland. *Child Language Teaching & Therapy, 22*(3), 275-292.

Gibbon, F., Smeaton-Ewins, P., & Crampin, L. (2005). Tongue-palate Contact during selected vowels in children with cleft palate. *Folia Phoniatrica et Logopaedica, 57*, 181-192.

Gibbon, F., & Wood, S. (2003). Using electropalatography (EPG) to diagnose and treat articulation disorders associated with mild cerebral palsy: a case study. *Clinical Linguistics & Phonetics, 17*(4-5), 365-374.

Goldstein, P., Wolfram, Z., Vogel, M., & Hoole, P. (1994). Combined palatal-lift and EPG-feedback therapy in dysarthria: a case study. *Clinical Linguistics & Phonetics, 8*(3), 201-218.

Hamilton, C. (1993). Investigation of the articulatory patterns of young adults with Down's syndrome using electropalatography. *Down Syndrome Research and Practice, 1*(1), 15-28.

Hamlet, S. (1973). Speech adaptation to dental appliances: Theoretical consideration. *Journal of the Baltimore College of Dental Surgery, 28*(2), 51-63.

Hamlet, S., & Stone, M. (1978). Compensatory alveolar consonant production induced by wearing a dental prosthesis. *Journal of Phonetics, 6*, 227-248.

Hardcastle, W., Barry, R., & Clark, C. (1987). An instrumental phonetic study of lingual activity in articulation-disordered children. *Journal of Speech and Hearing Research, 30*, 171-184.

Hardcastle, W., Gibbon, F., & Jones, W. (1991). Visual display of tongue-palate contact: Electropalatography in the assessment and remediation of speech disorders. *British Journal of Disorders of Communication, 26*, 41-74.

Hardcastle, W., Jones, W., Knight, C., Trudgeon, A., & Calder, G. (1989). New developments in electropalatography: A state of the art report. *Clinical Linguistics & Phonetics, 3*(1), 1-38.

Hartelius, L. (2005). Use of electropalatography in the treatment of disordered articulation following traumatic brain injury: A case study. *Journal of medical speech-language pathology, 13*(3), 189-204.

Hazan, S., Iba, Faulkner. (2005). Effect of audiovisual perceptual training on the perception and production of consonants by Japanese learners of English. *Speech Communication, 47*, 360-378.

Howard, S., & Varley, R. (1995). III: EPG in Therapy Using electropalatography to treat severe acquired apraxia of speech. *European Journal of Disorders of Communication, 30*, 246-255.

Kuruvilla, M., Murdoch, B., & Goozee, J. (2008). Electropalatographic (EPG) assessment of tongue-to-palate contacts in dysarthric speakers following TBI. *Clinical Linguistics & Phonetics, 22*(9), 703-725.

Lundeborg, I., & McAllister, A. (2007). Treatment with a combination of intra-oral sensory stimulation and electropalatography in a child with severe developmental dyspraxia. *Logopedics Phoniatrics Vocology, 32*(2), 71-79. doi:10.1080/14015430600852035

Martin, K., Hirson, A., Herman, R., Thomas, J., & Pring, T. (2007). The efficacy of speech intervention using electropalatography with an 18-year-old deaf client: A single case study. *Advances in Speech-Language Pathology, 9*(1), 46-56.

McAuliffe, M., & Cornwell, P. (2008). Intervention for lateral /s/ using electropalatography (EPG) biofeedback and an intensive motor learning approach: a case report. *International Journal of Language & Communication Disorders, 43*(2), 219-229. doi:10.1080/13682820701344078

McAuliffe, M., & Ward, E. (2006). The use of electropalatography in the assessment and treatment of acquired motor speech disorders in adults: Current knowledge and future directions. *NeuroRehabilitation, 21*(3), 189-203.

Michi, K., Suzuki, N., Yamashita, Y., & Imai, S. (1986). Visual training and correction of articulation disorders by use of dynamic palatography: serial observation in a case of cleft palate. *Journal of Speech and Hearing Disorders, 51*, 226-238.

Michi, K., Yamashita, Y., Imai, S., Suzuki, N., & Yoshida, H. (1993). Role of visual feedback treatment for defective /s/ sounds in patients with cleft palate. *Journal of Speech and Hearing Research, 36*, 277-285.

Morgan, A., Liegeois, F., & Occomore, L. (2007). Electropalatography treatment for articulation impairment in children with dysarthria post-traumatic brain injury. *Brain Injury, 21*(11), 1183-1193.

Pantelemidou, V., Herman, R., & Thomas, J. (2003). Efficacy of speech intervention using electropalatography with a cochlear implant user. *Clinical Linguistics & Phonetics, 17*(4/5), 1.

Schmidt, A. (2007). Evaluating a new clinical palatometry system. *Advances in Speech-Language Pathology, 9*(1), 73-81.

Schmidt, A., & Beamer, J. (1998). Electropalatography treatment for training Thai speakers of English. *Clinical Linguistics & Phonetics, 12*(5), 389-403.

Suzuki, N. (1989). Clinical applications of EPG to Japanese cleft palate and glossectomy patients. *Clinical Linguistics & Phonetics, 3*(1), 127-136.

Syder, D. (Ed.). (1998). *James: Counseling an adult with articulation problems.* London: Whurr Publishers, Ltd.

Timmins, C., Cleland, J., Wood, S., Hardcastle, W., & Wishart, J. (2009). A perceptual and electropalatographic study of /ʃ/ in young people with Down's syndrome. *Clinical Linguistics & Phonetics, 23*(12), 911-925. doi:10.3109/02699200903141271

Whitehill, T., Stokes, S., & Yonnie, M. (1996). Electropalatography treatment in an adult with late repair of cleft palate. *Cleft Palate-Craniofacial Journal, 33*(2), 160-168.

Wood, S., Wishart, J., Hardcastle, W., Cleland, J., & Timmins, C. (2009). The use of electropalatography (EPG) in the assessment and treatment of motor speech disorders in children with Down's syndrome: Evidence from two case studies. *Developmental Neurorehabilitation, 12*(2), 66-75. doi:10.1080/17518420902738193

Wrench, A. (2007). Advances in EPG Palate Design. *Advances in Speech-Language Pathology, 9*(1), 3-12.