Electropalatography (EPG) as a clinical and research tool: highlights from the first 40 years

Bill Hardcastle
Range of techniques for measuring tongue movements directly

- X-ray
- Magnetic Resonance Imaging (MRI)
- Ultrasonics
- Electromagnetic Articulography (EMA)
- Electropalatography (EPG)
A brief history of palatography

c.1800 Erasmus Darwin:
Tinfoil cylinders
London: Jones & Co.

1872 (James) Oakley Coles:
Direct wipe off, dry mixture of
flour and gum applied to palate
Coles O (1872) On the Production of Articulate

1877 Norman William Kingsley:
Indirect wipe off, rubber plate
coated with chalk
Kingsley NW (1877) The Mechanism of Articulate
speech
EPG palate

Computer display
EPG idealised
‘quasi-static’ patterns
“Fred can go” – careful speech

[fred kʰæn ˈɡou]

“Fred can go” – rapid colloquial speech

[fiːkʰæn ˈɡou]
EPG in phonetic research

- Coarticulatory phenomena in different languages (EUR-ACCOR project 1990-1996, Marchal et al; Farnetani and Recasens, 2010)
- /l/ vocalisations (Hardcastle and Barry, 1985; Scobbie, 2010)
- Correlates of rate variation (eg Byrd and Tan, 1996)
- Kinematics of /kl/ clusters (eg Hardcastle, 1985; Hardcastle et al, 1996; Bombien et al, 2006)
- ‘Instability’ of alveolars (Kohler, 1976; Ellis and Hardcastle, 2002)
- Covert contrasts (Hewlett, 1988; Gibbon, 1999)
- Palatalization in different languages (Recasens et al 1993)
- Laminal versus apical articulations (in Norwegian, Moen and Simonsen, 1998, 2007)
EPG as a clinical tool

Assessment, diagnosis and treatment of a range of speech disorders including:

- Articulation disorders of unknown origin
- Cleft palate
- Down Syndrome
- Dysfluency
- Glossectomy
- Hearing impairment
- Malocclusion and osteotomy
- Neurological (acquired)
- Neurological (developmental)
- Eating and swallowing disorders
EPG as a research and clinical tool: some highlights

- Instability of alveolars
- Misdirected articulatory gestures
- Undifferentiated gestures
- Covert contrast
- Labial-velar double articulations
- Treatment for speech disorders using visual feedback
Alveolar to velar assimilation
Nasal + Oral stop sequences

\[ /n \# k/ \text{ as in “I can’t believe the ban cuts no ice”} \]
\[ /n/ \rightleftharpoons /n/ \text{ or } /\eta/ \]

Controls
\[ /\eta/ \# /k/ \]
\[ /n/ \# /t/ \]
\[ /\eta/ \# /t/ \]

- 10 speakers x 10 reps x 2 speech rates
- EPG, acoustic and EMA analysis (selected items only)

Distribution of assimilations and nonassimilations for individual speakers A–J in fast speech productions of /n#k/.
EMA record of maximum tongue tip displacement for one speaker during nasal-oral stop sequence.
Normal speaker - target ‘deer’

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Apraxia of speech - target ‘deer’

Conduction aphasic - target ‘a key’

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tip (alveolar and velar contact on the /t/)
Cape (4th repetition) – MAG [kt]
with APD (D8, Gibbon et al., 1995). Note the similarity between these EPG patterns and those produced by the same child for a stop target in Figure 4.

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Child with cleft palate - target ‘pig’
Rebecca (female, 12;3 years, Dent et al. 1995)

- functional articulation disorder (lateral lisp)
- a saw

before therapy after therapy
David (male, 9, Gibbon and Wood, 2003)

- functional articulation disorder (velar fronting)
- a cap

before therapy

after therapy
Emma (female, 9 years, Gibbon et al. 1993)

- functional articulation disorder (alveolar backing)
- a.tar

before therapy
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after therapy
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Thanks to colleagues involved in EPG research and development

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