**Introduction**

The electromylinx (EL) is a common voice prosthesis, however EL speech is often described as unnatural or robotic sounding, largely due to the lack of natural pitch variation. Prior studies have demonstrated that an electromyographic (EMG) interface can be effective for controlling EL onset/offset and dynamic fundamental frequency (F0) variation. In this study we tested a new EMG-controlled EL system (EMG-EL) with a wireless EMG sensor.

**Methods and Materials**

Speech capabilities of two Laryngectomee participants were tested using the EMG-EL in five different control modes, reflecting multiple combinations of manual (push-button) and EMG-based control of F0 and prosthetic voice onset/offset (Table 1). Listeners blind to EL control mode judged speech naturalness and intonation of questions versus statements.

**Participants**

Laryngectomee (Alaryngeal) Speakers

One male (age 84) and one female (age 59) who had undergone total laryngectomy 21 and 5 years prior to study enrollment (respectively) participated as EMG-EL users (speakers).

**Listeners**

1) Speech intelligibility was assessed by 4 SLP clinicians.
2) Assessment of intonation contrasts was performed by 6 SLP graduate students.
3) Assessment of EMG-EL speech naturalness was performed by 20 SLP graduate students (GS group), as well as 7 members of a Laryngectomee support group (LSG group).

**EMG-EL System Design**

Technical details of the wireless EMG-EL system are available elsewhere. Briefly, a battery-powered sensor acquires skin-surface EMG signals. The sensor filters and amplifies the EMG signal, generates an EMG envelope, and transmits it to a modified TriTone™ EL (Griffin Laboratories) for voice onset, offset, and F0 modulation proportional to suprathreshold changes in the envelope (Figure 1). EMG envelopes with fast (5 Hz) and slow (1 Hz) time constants are used to control device onset/offset and F0 variation, respectively. EMG-EL offset threshold is set at approximately 60-70% of the activation threshold to facilitate uninterrupted voice production.

**Results**

**Alaryngeal Voice Onset/Offset**

**Voice Initiation:** Times were similar for button and EMG-based control, which were both slightly faster than TEP (Figure 2).

**Voice Termination:** EMG-based voice termination was slower than button control for both speakers, slower than TEP voice termination for the female speaker, and similar to TEP voice termination for the male speaker.

**Serial Speech Production (Individual Words)**

Both speakers were 100% successful saying individual words while speaking with their primary means of alaryngeal speech (TEP for the female, monotone EL for the male), and on average 96% successful when speaking with the three EMG-based control options.

**EMG-EL Speech Naturalness**

Ranking of sentences based on paired comparisons placed the Monotone EL as least preferred (Red Ss in Table 2) and one of the three EMG-based control modes as the most natural-sounding (Green 1s in Table 2).

**Conclusions**

- Both Laryngectomee participants in this study effectively used submental EMG for EL voice control after only basic instruction.
- EMG-based vocal intonation can help distinguish questions versus statements.
- The new wireless EMG-EL may support more natural-sounding speech than typical EL devices.

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**References**