Preliminary results of Duet to Duet 2 upgrade.

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Introduction

The concept of combined Electric Acoustic Stimulation (EAS) in one ear, introduced by Prof. Christoph A. von Ilberg in the group of so called borderline cochlear implant (CI) adult candidates, has evolved during the past 10 years and embraced several new techniques including modifications of already existing surgical approaches, different cochlear implant devices including several new electrode designs as well as various groups of patients (von Ilberg et al, 1999; Skarzynski et al, 2003; 2006; 2007).

In order to facilitate appropriate combination of electric and acoustic stimulation, the DUET^{TM} audio processor was developed by MED-EL, Innsbruck, Austria. It combines a CI speech processor and an acoustic stimulation unit specifically designed to achieve amplification in low frequencies, between 125 and 2,000 Hz, in one single device. Recent studies have demonstrated that subjects perform significantly better when using the DUET^{TM} EAS system compared with the CI-only mode (Lorens et al, 2008).

Recently, the second generation of the DUET^{TM} audio processor has been introduced by the MED-EL company. The DUET 2^{TM} offers all the features of the DUET^{TM} plus the additional new ones. It has a new, ergonomically improved design with a reduced weight of only 14 g (including batteries) and is provided with the FineTuner, a remote control for switch-free adjustment of settings. An optimized frequency range, stronger acoustic amplification and improved, separate signal processing for CI and acoustic amplification, equip users with the newest hearing technology.

Objectives

To show sound quality and speech perception outcomes as well as subjective satisfaction with the new DUET 2^{TM} as compared to the DUET^{TM}.

Materials and Methods

Ten adults, ages at the time of upgrade from Duet processor to Duet 2 ranging from 29 years to 72 years, who had a minimum of 12 months of DUET^{TM} experience were fitted and tested with the DUET 2^{TM}. The average age at upgrade was 43 years (29 – 72 years). The patients were tested using the speech reception test in quiet and in noise. They also completed the visual analogue scales questioning satisfaction and device preference, when listening to speech and to a pop song. Tests were administered at upgrade (interval I) and 1 month after the upgrade (interval II).

Tests

Speech reception was tested using the Pruszewicz monosyllabic Polish word test (20 words per list, 20 lists), (Pruszewicz et al, 1994), with the lists of words being randomised between test conditions. The Pruszewicz monosyllable test is a consonant-vowel-consonant test in Polish, similar to the CNC monosyllabic word test in English. Recorded words were presented in the sound field at 60 dB SPL in quiet and in competition with speech-shaped noise at a speech-to-noise ratio (SNR) of +10 dB. The results shown are the mean values obtained using the three test lists.

Visual Analogue Scales (VASs) were completed by patients to evaluate satisfaction with the two devices as well as to compare both devices. These VASs were completed for both speech and music and were presented via a loudspeaker placed 1 m from the patient at 0° azimuth. The speech was a recording of a male voice reciting a popular Polish fairy tale. The musical segment was a popular song by Paris Red called “Promises” (CD: Re-Mix Mix Mix, Sony DJmixPRO, Sony Music Entertainment). It was played without any lyrics and repeated for each VAS. The VAS scale for evaluating the satisfaction required the child to mark on a 20 cm scale whether the perception was “bad”, “average” or “good”. For the comparison of VAS, patients were asked to listen to one device for a minimum of 30 seconds and then another device for a minimum of 30 seconds, and then mark on the 20 cm scale if the

second device was “worse”, “the same” or “better” than the first device. For the statistical evaluation, level of significance $p > 0.05$ was being used.

Results

Results for the speech reception test in quiet and in noise are shown in Figure 1. According to the Paired-samples T-tests, no significant differences could be found within the single device between Interval I and II, and between the devices within Interval I and II. Results for the VAS Satisfaction rating are found in Figure 2. According to the Paired-samples T-tests no significant differences could be found between the devices within Interval I and II. Results for the VAS devices comparison are shown in Figure 3. A positive score in “difference in mean value” means that the second device sounds better. Correspondingly, if the pair-wise comparison strategies are tested for significant differences from a mean value of 0 (One-samples T-test), a result smaller than 0 means that the first device sounds better. With a one-samples T-Test it was checked in interval I and II, if the mean value of each pair-wise coding strategy differs significantly from a mean test value of 0. All pair-wise comparisons in Interval I and II differ significantly from a mean test value of 0.

Conclusions

Subjects reported better satisfaction with the DUET 2^{TM} as compared to the DUET^{TM}. Speech perception outcomes with the DUET 2^{TM} were comparable to the DUET^{TM} . The DUET 2^{TM} can provide additional advantages over DUET^{TM} to the patients with partial deafness after cochlear implantation.

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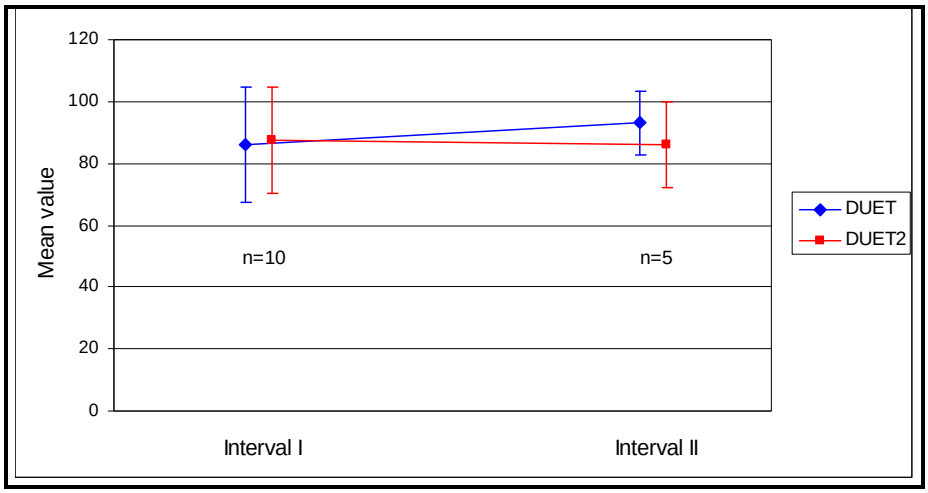
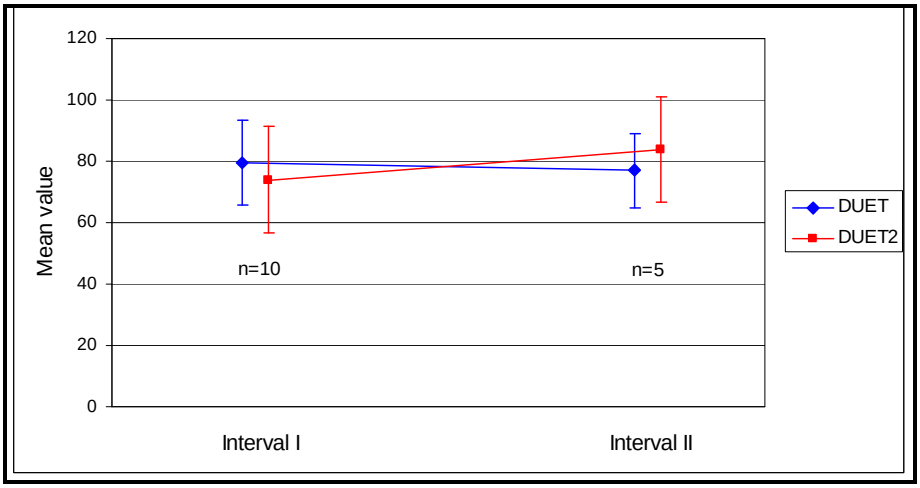
Figure 1: Results for the (a) speech reception test in quiet and (b) speech reception test in noise, as a function of interval.



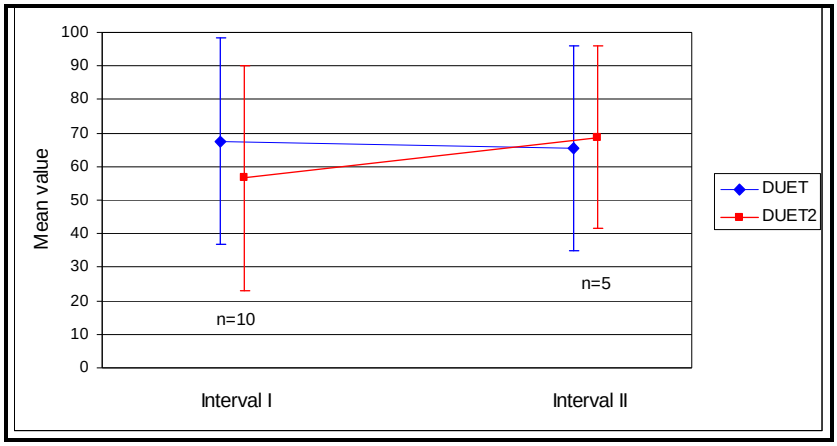
a)



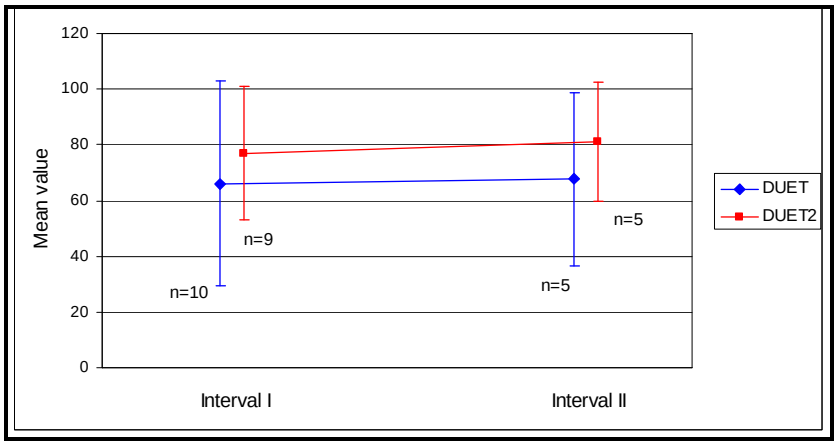
b)

Fig. 1

Figure 2: Results for the Satisfaction scaling (VAS) using (a) the speech stimuli, and (b) the music stimuli.



a)



b)

Fig. 2

Figure 3: Results for the device comparison (VAS)

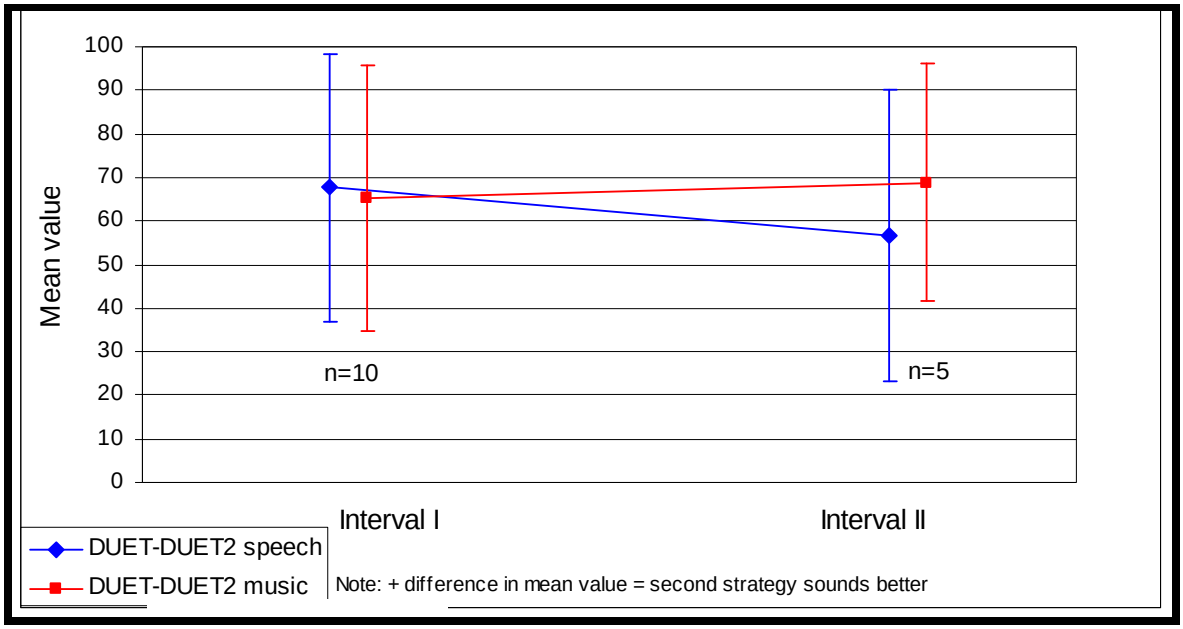


Fig. 3.