

Pilot Study of Remote Measurement and Fitting of Cochlear Implant Recipients

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Key words

cochlear implant, remote measurement, remote fitting

Introduction

It is envisioned that remote measurement and fitting of cochlear implant recipients can save time for audiological professionals who provide intra-operative support and post-operative service to a widespread recipient population, likewise for recipients who live far away from a CI fitting centre. A main study is intended to investigate the feasibility of remotely controlled intra-operative measurements as electrode impedances, and post-operative fittings of recipients provided with Nucleus cochlear implant systems.

Methods

A pilot study was first conducted to confirm if available technology used for video-conferencing and remote-control software is suitable for remote measurement and fitting. Additionally, an impression of the usability from all active participants, i.e. surgeons, audiologists and patients, was obtained. Intra-operative measurements were conducted where the audiologist controlling the measurement software was not in the operating theatre.

Post-operative fitting was conducted with two fitting sessions for each recipient. In one session the audiologist and recipient were in the same room; in the other session the audiologist and recipient were in different rooms. Audio and video signals were transmitted via internet-based video-conferencing technology. The fitting software and equipment was controlled remotely via the same internet link (Fig. 1).

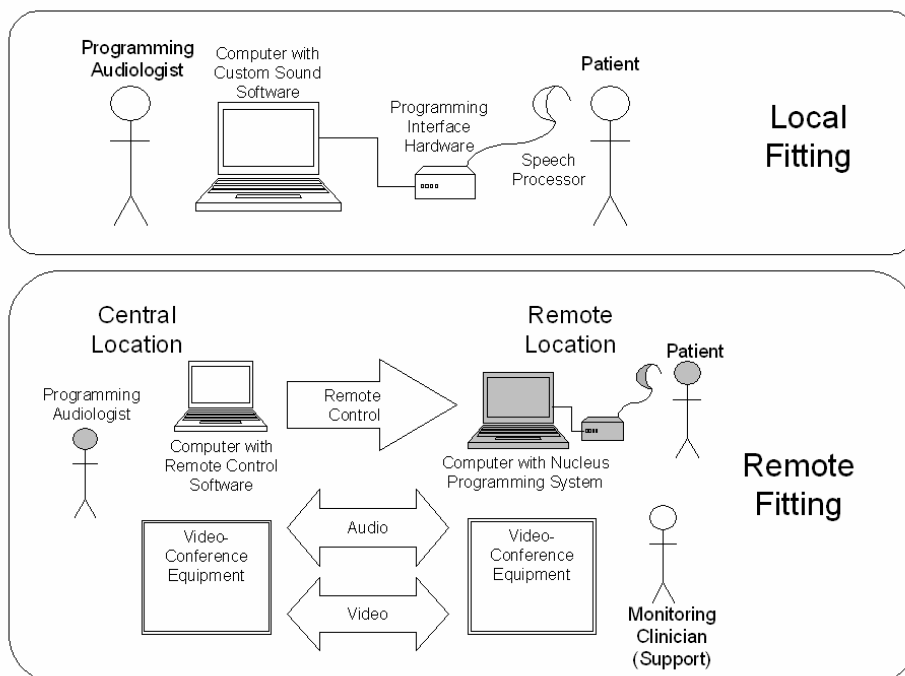


Fig. 1: Diagram of local and remote fitting scenarios.

Session	Audiologist	Surgeon	Monitoring Clinician	Patient
Surgery	1. intra-operative measurement CRF 2. satisfaction questionnaire	satisfaction questionnaire	satisfaction questionnaire	-
Local Fitting	1. measurement & fitting CRF	-	-	satisfaction questionnaire
Remote Fitting	1. measurement & fitting CRF 2. satisfaction questionnaire	-	satisfaction questionnaire	satisfaction questionnaire

Tab. 1: Questionnaires and CRFs for each participant per session.

All the active participants were surveyed at each session and had to fill in satisfaction questionnaires and case report forms (CRF) at each visit (Tab. 1).

Results

All remote sessions were completed. Intraoperative measurements and new maps could be obtained. There were no adverse events and the clinical software showed reliable performance.

Intraoperatively, remote measurement times were found to be acceptable, e.g.:

- impedances at 22 electrodes took at most 1 minute
- ESRT at 5 electrodes took 4 minutes
- AutoNRT at 250Hz at 5 electrodes took 3 minutes

Remote fitting seemed to be a viable way to create a map but the patient, parent and audiologist all preferred face-to-face contact. Remote sessions were longer than the corresponding local sessions by 10-15 minutes. An extra video screen was necessary at each location to deliver an acceptable image of the patient to the audiologist and vice versa, because patient image and clinical

software on only one screen was not acceptable. Video and audio were sufficient for the patient and audiologist to communicate, even for lip-reading.

Discussion

Remotely-controlled intraoperative measurements seemed to be as effective as locally-controlled, even with a difficult case. Remote technology for measurements seems to be more accepted than for fittings. A bandwidth of 512 kilobits per second seems to be the minimum for satisfactory remote fitting. Video is required for remote fitting but not required for remote intra-operative measurement.

Summary

All active participants were satisfied with remote measurement except for the sound quality. For remote fitting two video monitors were required on both sides, one monitor for the fitting software and one for the image of the audiologist or the recipient. Available technology can support remote measurement and fitting of Nucleus cochlear implant recipients. Training of all participants is important to prevent unnecessary delays during remote measurement and fitting sessions. Further study of remote measurement and fitting is feasible.