Hearing Loss : from animal models to rehabilitation strategies

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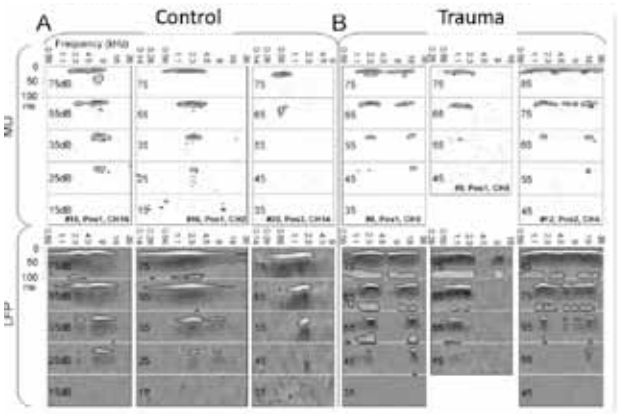
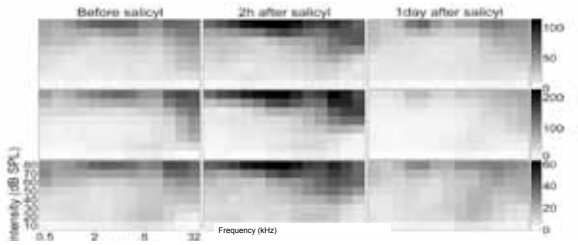
Aims and scope

Partial deafness is highly prevalent in any countries and it leads to dramatic deteriorations of life quality because it alters speech intelligibility. Our project aimed at describing the cortical reorganizations occurring after partial deafness to propose new rehabilitation strategies. In many cases, subjects with partial hearing loss suffer from tinnitus and hyperacusis, two phenomena which also impact on life quality. Thus, one goal of our project was also to propose strategies reducing tinnitus and hyperacusis.
Total deafness is a major handicap because it alters social communication in adult and prevents language acquisition in children. The only efficient treatment is the implantation of cochlear implants. Cortical reorganizations do also occur after installation of cochlear implants but the functional role of this plasticity remains unclear. Our project also aimed at proposing strategies to improve the recovery of speech intelligibility after implantation of cochlear implant.

Animal Studies

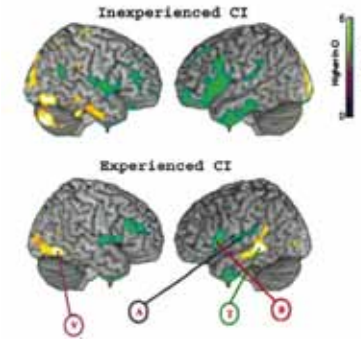


After an acoustic trauma inducing a 30-60dB hearing loss, the responses of auditory cortex neurons to conspecific vocalizations were not affected in terms of strength of evoked responses. In contrast, the response latency and the temporal organization of responses were clearly modified supporting the notion that a temporal code is involved in the representation of communication sounds.



Acoustic trauma and salicylate administration, both known to induce tinnitus in human subjects, were shown to increase the amplitude of stimulus-evoked responses (local field potentials) recorded in auditory cortex. Moreover, both treatments induced a decrease of the power spectrum over a relatively broad frequency band (10-30Hz) during spontaneous activity.

Human Studies and clinical applications



Differences in regional activity at rest between experienced cochlear implant (CI) recipients and normal-hearing subjects. Yellow reflects increased activity in CI users, it concerns the visual and temporal areas (V and T). Blue reflects decreased activity in CI users, compared with normal-hearing subjects, it encompass the auditory cortex and the frontal Broca's area (A and B respectively).

In cochlear implant subjects, spontaneous activity measured by cerebral blood flow was found to be higher than in normal subjects in visual and auditory areas. More importantly, these increases were correlated with the percentage of correct identification of words presented in audio-visual conditions.

In subjects experiencing hyperacusis and/or tinnitus, a new rehabilitation strategy was tested by compensating the attenuated acoustic stimulation due to hearing loss. This treatment was efficient in attenuating hyperacusis. The results were more variable for tinnitus (may be because of a too short period of treatment).

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